U.S. Army Corps of Engineers

Final
Supplemental Site Inspection Report
Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Prepared for
U.S. Army Corps of Engineers
Contract No. W912DQ-19-D-3005
Delivery Order No. W912DQ21F3015

April 2023

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Notice is hereby given that an Independent Technical Review (ITR) has been conducted that is appropriate to the level of risk and complexity inherent in the project for the Final Supplemental Site Inspection (SSI) Report for the former Staten Island Warehouse (SIW) Formerly Utilized Sites Remedial Action Program (FUSRAP) Site, Port Richmond, Staten Island, New York. During the ITR, compliance with established policy, principles, and procedures was verified. This included review of procedures to be used to create a product that meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers (USACE) policy.

John Wells, CIH, CSP, CHMM, Contractor ITR Team Member	4/10/23 Date
Natalie Magill, PhD, PE, PMP Contractor ITR Team Member	4/10/23 Date
Liyuan Liang, PhD Contractor Quality Reviewer	4/10/23 Date

Significant concerns and the explanation of the resolution are as follows:

None.

As noted above, all concerns resulting from the independent technical review of the document have been considered.

Margaret Dubbin, PE, PMP Contractor Project Manager	4/10/23 Date

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ACRONYMS AND ABBREVIATIONS

ADM	Archer-Daniels Midland
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
cpm	counts per minute
DTSI	Dolan Transportation Services Inc.
FUSRAP	Formerly Utilized Sites Remedial Action Program
GEO	GEO Consultants Corporation
GIS	Geographic Information System
GPS	Global Positioning System
IDW	investigation derived waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
MDC	Minimal Detectable Concentration
MED	Manhattan Engineering District
mg/kg	milligram per kilogram
MS	matrix spike
MSD	matrix spike duplicate
mya	million years ago
NaI(Tl)	thallium-activated sodium iodide
NAVD88	North American Vertical Datum of 1988
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NYSDEC	New York State Department of Environmental Conservation
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbon
pCi/g	picocuries per gram
pCi/L	picocuries per liter
%	percent
PPE	personal protective equipment
PRG	Preliminary Remediation Goal
psi	pounds per square inch
PVC	polyvinyl chloride
PWP	Project Work Plan
QC	Quality Control
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
SCA	Surface Characterization Area
SI	Site Inspection
SSI	Supplemental Site Inspection
SIW	former Staten Island Warehouse
SVOC	semi-volatile organic compound
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USDOE	U.S. Department of Energy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

EXECUTIVE SUMMARY

The former Staten Island Warehouse (SIW) Formerly Utilized Sites Remedial Action Program (FUSRAP) Site is located in Staten Island, New York (Figure 1-1). This Report documents a Supplemental Site Inspection (SSI) during which sediment, soil, and groundwater samples were collected to identify the extent and concentrations of previously identified radioactive substances. The SSI was performed by GEO Consultants Corporation (GEO) for the U.S. Army Corps of Engineers (USACE) under the FUSRAP, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In addition, the evaluation follows the guidance and policy outlined in the *Environmental Quality-Formerly Utilized Sites Remedial Action Program (FUSRAP) - Site Designation, Remediation Scope, and Recovering Costs (USACE Engineer Regulation, ER 200-1-4)* (USACE 2014) and *Guidance for Performing Site Inspections Under CERCLA* (USEPA 1992).

The SIW Site was used to store high-grade Belgian Congo uranium ore from 1939 to 1942. Previous investigations conducted at the SIW Site have determined the presence of residual radiological contamination in soil. The primary objectives of this project are to address data gaps related to the extent of potential radionuclide contamination in previous inspections, to compare the new and existing data against background values and risk-based screening criteria, and to characterize beach erosion at the SIW Site. The SSI activities are outlined in the Project Work Plan [PWP (USACE 2021a)] and the Uniform Federal Policy-Quality Assurance Project Plan [UFP-QAPP (USACE 2021b)].

Five previous investigations have been performed at the SIW Site. From 1980 to 2011, gamma walkover surveys and samples gathered from the SIW Site confirm elevated gamma levels in the northwest corner of the property. The USACE conducted a Preliminary Assessment and Site Inspection (SI) in 2011. Based on the information gathered, the USACE found insufficient evidence for federal responsibility for the contamination which led to a recommendation for no further action to be taken at the SIW Site under the FUSRAP. Additional data gathered and analysis in 2016 and 2017 led the USACE to reasonably determine potential soil contamination at the SIW Site meets the application eligibility criteria in Engineer Regulation (ER) 200-1-4 for eligibility in the FUSRAP. The SIW Site was officially added to the FUSRAP in May 2021.

The 2021 SSI fieldwork included a radiological survey (gamma walkover scan of surface and boreholes, radionuclide sampling of surface and subsurface soils, sediment, and groundwater), excavating test pits, chemical waste characterization sampling (for metals, semi-volatile organic compounds, and volatile organic compounds), a geotechnical study, and an erosion study. Due to the lithology of the Surface Characterization Area (SCA), soil boring recovery problems experienced in the 2011 SI (USACE 2017), were also encountered during the 2021 SSI fieldwork. Downhole gamma scans were not performed on soil borings less than 2-feet bgs or when groundwater filled the soil boring immediately after the soil boring was completed (e.g., beach area).

The surface gamma scans confirmed the presence of elevated (above background levels) radionuclide activity in an approximate 100-feet by 200-feet area in the northwest section of the SIW Site. The area of above background gamma levels is slightly shifted laterally to the southwest and northeast as related to previous investigations. With this minor difference, the area of radiological contamination is similar to that identified in previous investigations.

Borehole logging, test pits, surface soil sampling, sediment sampling, and subsurface soil sampling confirm that radiological contamination above screening levels within the SCA boundary exist in soil only and is contained within the upper 5-feet bgs and within the elevated gamma scan area. Sediment samples collected offshore during low tide were analyzed for the same radionuclides. Results indicate similar elevated radionuclides that are found in the vegetated area of the SCA.

Shallow groundwater samples are below the project screening levels (except for Ra-228 in one sample). The Ra-228 result of 5.83 picocuries per liter (pCi/L) from GW-10-1220 is slightly higher than the screening level of 5 pCi/L. The volume of water collected for gross alpha and beta analysis resulted in higher than typical values of sample Minimal Detectable Concentration (MDC), approximately 50 times higher than typical. Due to this high MDC for the gross alpha samples, more credibility should be placed on the isotopic results than the gross alpha values. The gross beta results for the samples exceed the MDC with magnitudes between approximately 100 and 800 pCi/L. This range of concentrations is greater than the 50 pCi/L project screening level for gross beta emitters. However, the 50 pCi/L screening level applies to drinking water. The sampled groundwater has no foreseeable use as drinking water and is likely significantly mixed with saline water from the Kill Van Kull. The radiological survey sample data, collected and analyzed during the 2021 SSI, was validated and determined to be useable.

A geotechnical analysis was performed to determine structural stability of the pier and its ability to support heavy construction equipment. As part of the geotechnical analysis, samples were collected to obtain Atterberg Limits, Unconfined Pressure Test Levels, and Sieve Analysis/Grain Size Distribution. The results of these tests indicate a moderately strong soil structure, despite the moisture and sand quantity located in the SCA. The equipment used during the geotechnical/environmental investigation (drill rig and mini excavator) did not cause observable failures to the soil at an estimated ground pressure of 5-pounds per square inch (psi). The soil pit excavations extended through the soil to a depth of approximately 6-feet. Given that no issues were encountered during the geotechnical/environmental investigation, and based on the results of the geotechnical testing of samples collected from soil borings, the use of a mini- or mid-sized excavator for any future remedial work at the SIW Site is unlikely to cause soil failure issues. A mid-sized excavator, such as a CAT 330L, is also unlikely to cause soil failure, even with a safety factor of 2.5 (ground pressure of 19 psi). Additional site preparation is recommended for removal of excavated material dependent upon the size of equipment being used.

Beach erosion has occurred along the northwestern and northern edge of the site, suggesting that some radionuclide-contaminated soil may be gradually transported from the SIW Site into the near-shore environment of the Kill Van Kull. A significant increase in shoreline erosion was observed due to major storms in the SIW Site area (e.g., Hurricane Irene and Hurricane Sandy). Erosional impacts have occurred at the SIW Site since the removal of building structures prior to 1980. Soil boring cores, test pit excavation, drilling refusal, and drilling equipment damage at approximately 3 to 4-feet along the SIW Site's northwestern shoreline indicate the presence of multiple foundation pillars. While the pillars may be slowing the effects of erosion, the evidence indicates that erosion will continue along the shoreline, further exposing higher levels of contamination to be transported by the Kill Van Kull tide.

1. INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

This Report documents a Supplemental Site Inspection (SSI) that was conducted at the former Staten Island Warehouse (SIW) Formerly Utilized Sites Remedial Action Program (FUSRAP) Site in Staten Island, New York (Figure 1-1). Previous investigations conducted at the SIW Site, including a 2011 Site Inspection (SI), have determined the presence of radiological contamination in some areas. The SSI was performed by GEO Consultants Corporation (GEO) for the U.S. Army Corps of Engineers (USACE) under the FUSRAP in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In addition, the evaluation follows the guidance and policy outlined in *Environmental Quality-Formerly Utilized Sites Remedial Action Program (FUSRAP) - Site Designation, Remediation Scope, and Recovering Costs (USACE Engineer Regulation, ER 200-1-4)* (USACE 2014) and the *Guidance for Performing Site Inspections Under CERCLA* (USEPA 1992).

The SIW Site was a commercial site owned by Archer-Daniels Midland (ADM) Company that was used to store high-grade Belgian Congo uranium ore from 1939 to 1942. The 1.25-acre area was identified as the SIW Site through the eligibility determination from U.S. Department of Energy (USDOE), stating that the northwest quadrant of the entire property was eligible for the FUSRAP. The 2021 SSI was confined to a 100-feet by 200-feet section of the northwest quadrant, identified in this Report as the Surface Characterization Area (SCA).

The primary objectives of this project are to address data gaps related to the extent of radionuclide contamination in previous inspections, to compare the new and existing data against background values and risk-based screening criteria, and to characterize beach erosion at the SIW Site. The SSI activities are outlined in the Project Work Plan [PWP (USACE 2021a)], and the Uniform Federal Policy-Quality Assurance Project Plan [UFP-QAPP (USACE 2021b)].

1.2 REPORT ORGANIZATION

The contents and organization of this Report are in accordance with U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Site Inspections Under CERCLA* (USEPA 1992) and the USEPA *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA 2005). The format of this Report is in general accordance with the USEPA guidance:

- Section 1 presents an introduction to the SSI, including project purpose, objectives, and the organization of this SSI Report.
- Section 2 describes the geographical location and features of the SIW Site as of September 2021. The operational and site history, including previous owners and property uses, are also discussed.
- Section 3 details the physical setting of the SIW Site based on relevant literature and information from the 2021 SSI and previous investigations. The topography, geology, hydrogeology, and the climate of the SIW Site are described.
- Section 4 provides an overview of previous investigations conducted at the property. A brief overview of each investigation, including work performed, results, conclusions, and recommendations are presented.
- Section 5 presents general information on the project field activities conducted during the 2021 SSI and the methods used in the inspection for data acquisition.

- Section 6 describes the results of the 2021 SSI. This section discusses soil and groundwater data resulting from the 2021 SSI and the data sets obtained from the SIW Site through previous inspections. These data identify the contaminants detected in the media at the SIW Site. A discussion of the distribution of these contaminants is also provided and a summary of the investigation and risk screening is presented.
- Section 7 details other aspects of the 2021 SSI, including the shoreline erosion of the SIW Site since the 2011 SI, changes in the radiological analysis from the 2011 SI to the 2021 SSI, excavation design analysis, and the conclusions and recommendations.
- Section 8 is a list of the references used in preparing the SSI Report.
- Figures and Tables are located immediately following the text.
- Appendix A contains quality forms completed in the field, including field logs, sampling forms, Daily Quality Control Reports, summary reports, and chain of custody forms.
- Appendix B contains the Quality Control Summary Report (QCSR) for Radiological and Waste Characterization Samples.
- Appendix C includes the laboratory data packages (electronic copy only).
- Appendix D is the Electronic Data Deliverables (electronic copy only).
- Appendix E is the Geographic Information System (GIS) data (electronic copy only, included on compact disk located at the front of the Final version).
- Appendix F contains boring logs recorded during 2021 subsurface soil sampling.
- Appendix G contains photograph logs of the SIW Site and fieldwork.
- Appendix H contains the downhole gamma logs.
- Appendix I contains the radiological scan data sheets.
- Appendix J contains the air monitoring data.
- Appendix K includes the previous inspection sampling results.
- Appendix L includes the civil and hydrographic surveys of the SIW Site.
- Appendix M contains the geotechnical analysis data.

2. SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION AND FEATURES

The SIW Site is located at 2351 Richmond Terrace, Staten Island, Richmond County, New York, 10302 (Figure 1-1). The entire SIW Site consists of approximately 4.5 to 5-acres, bounded by the Kill Van Kull tidal flat to the north and west. The SCA is in the northwest corner of the SIW Site and is approximately 100 by 200-feet (0.5-acres) (Figure 2-1). The SIW Site is located within the vicinity of coordinates at the point located at 40˚38'25" N and 74˚08'31" W.

The SIW Site protrudes into the Kill Van Kull and was originally described as a manmade, solid filled pier retained by timber crib bulkheads and built circa 1830 (USACE 2017). It was expanded circa 1890 with similar or timber sheet pile bulkheads. The SIW Site is entirely fenced, except along the Kill Van Kull shoreline, and is situated in a commercial and industrial area. The Bayonne Bridge crosses immediately overhead of the SIW Site to the west (Figure 2-2). The SIW Site is relatively flat and portions are paved.

A photographic analysis of the SIW Site area for USEPA Region 2 (USEPA 2009a) presents assessment of a series of aerial photographs taken from 1940 to 1988 (Figures 2-3 to 2-5). It is especially clear in photos taken prior to 1988 that the northern site boundary was sharp and well-defined, presumably by the back-filled area behind bulkheads. This is consistent with the apparent elimination of industrial activities at the SIW Site that began prior to 1970 as indicated by photographs (USEPA 2009a). Deterioration or removal of the bulkheads that established the docking facilities for the site may be associated with changes in the shoreline. The change could also be attributed to the demolition of buildings, piers, wharves, or other structures. However, over the period of several investigations, erosion has been observed to be a contributing factor in the changes to the shoreline. A more detailed explanation of the shoreline erosion at the SIW Site is included in Section 7.1.

2.2 SITE OPERATION AND HISTORY

The SIW Site in Port Richmond, Staten Island, New York, was used by African Metals Corporation to store high-grade Belgian Congo uranium ore from 1939 to 1942. In 1942, 2,007 drums of uranium ore were stored at the SIW Site containing 1,089 metric tons of ore. The ore contained approximately 600 metric tons of triuranium octoxide and 170 grams of radium [Oak Ridge National Laboratory (ORNL) 1980]. The uranium ore was later purchased by the Manhattan Engineering District (MED) in support of World War II activities (MED 1942). Ores were handled on the portion of the privately owned property north of Richmond Terrace. Portions of the former property south of the road are not part of the FUSRAP Site. The SIW Site underwent multiple non-governmental ownerships. Some former structures at the site, including the warehouse, were demolished.

Known site history dates back to 1836. The original property owned by ADM Company was divided into three parcels, which have changed ownership numerous times (ORNL 1980). One parcel is owned by the New York Port Authority, another is owned by Federal Express, and the last is owned by Dolan Transportation Services Inc. (DTSI), with the current tenant of Island Redi Mix Incorporated (as of September 2021). The parcel owned by DTSI comprises of a 20 by 40-meter area where radiological contamination was identified by ORNL in 1980 (USEPA 2008). At the time of the ORNL investigation, the parcel was owned by R.H.S. Realty Corporation (ORNL 1980). The USDOE conducted an eligibility review in 1986 and determined that the SIW Site was not eligible for FUSRAP based on contract language that indicated the government did not take possession of the ore until it was removed from the SIW Site.

In 1992, the New York State Department of Environmental Conservation (NYSDEC) performed surveys on the northwest portion of the SIW Site and confirmed the presence of radiological soil contamination (NYSDEC 1992). In February 2008, the USEPA conducted a radiological survey of the SIW Site. This survey confirmed results of previous surveys identifying an area of low-level surface radioactive contamination (USEPA 2008). USEPA requested that the USDOE review the 1986 eligibility finding. The contract language reviews indicated that the government took possession of the ore materials while on the dock. The findings of the USEPA survey and additional contract review, led the USDOE to declare the SIW Site eligible for FUSRAP inclusion in October 2009 (USEPA 2009b).

The 2011 SI included collection and analysis of surface and subsurface soil and groundwater samples to identify the level of radioactive substances and determine if hazardous radioactive substances impacted specific targets. The 2011 SI confirmed the results of previous surveys identifying an area of low-level surface radioactive contamination (USACE 2017). The sampling results from previous inspections can be found in Appendix K. The USACE found insufficient evidence for federal responsibility for the contamination which led to a recommendation for no further action to be taken at the Site under the FUSRAP. Additional data gathered and analysis in 2016 and 2017 led the USACE to determine that there was a reasonable potential that the soil contamination in SIW meets the application criteria in Engineer Regulation (ER) 200-1-4 for eligibility in the FUSRAP. The SIW site was officially added to the FUSRAP in May 2021.

2.3 CURRENT LAND USE

The SIW Site and adjacent properties on the east and south are zoned for commercial use. The property to the west is owned by the New York Port Authority as part of the Bayonne Bridge area. A rocky beach on the Kill Van Kull waterway bounds the northern portion of the property (Figure 2-6). As of September 2021, an active concrete batch plant was in full operation at the SIW Site. During the SSI fieldwork, an inquiry was made to the current tenant whether fly ash or coal ash is used or stored on the property. The SIW Site tenant stated that no fly ash or coal ash were used or stored on the property.

As of September 2021, the SCA is fenced off from access from the Richmond Terrace. The condition of this intrusion fence was in good shape. Pre-cast concrete barrier blocks have recently (approximately June of 2021) been added by the tenant to section off some of the SCA from the active concrete batch plant (Figure 2-7). The concrete blocks are on the concrete plant side of the area of contamination; however, there is an opening along the northern section of the concrete barrier wide enough for a person to walk through. The southern section of the SCA has been filled in and a 6-inch concrete pad has been constructed to support cement mixing equipment (Figure 2-7). The majority of the SCA is also overgrown and is littered with assorted forms of debris.

3. EXISTING SITE CONDITIONS

3.1 TOPOGRAPHY

The topography of Staten Island ranges from steep hills to flat terrain (Soren 1988). The elevation of the SIW Site ranges from 3 to 9-feet above mean sea level to sea level at the shore. The maximum land-surface altitude in the northeastern part of Staten Island is about 405-feet (Soren 1988). The surface water runoff flows toward the northeast of the Site into the Kill Van Kull. According to Federal Emergency Management Agency (FEMA 2007), most of the SIW Site is in Zone AE [(EL 8) floodway area] while the southern and eastern portions of the SIW Site are in Zone X (other flood areas, that have average flood depths of less than 1-foot or drainage areas less than 1 square mile). The sloping beach was noted to be underwater during high tide. The flat vegetated area is estimated to be 3 to 4-feet above the beach area and close to that of the original pier.

Two major hurricanes affected the Staten Island area since the July 2011 SI fieldwork, Hurricane Irene in August 2011 and Hurricane Sandy in October 2012. During Hurricane Sandy, the water level in Kill Van Kull rose up to a maximum of 14.35-feet above mean low tide (NOAA 2021a). The ground surface elevation of the SIW Site is at or below 10-feet North American Vertical Datum of 1988 (NAVD88), which is equivalent to 12.72-feet mean low tide (NOAA 2021b). Thus, it can be assumed that the entire SIW Site was impacted by floodwaters during Hurricane Irene and Hurricane Sandy.

3.2 REGIONAL GEOLOGY

Regional geology around the SIW Site consists of glacial drift (specifically ground moraine) and overlying Palisade Diabase Sill (Soren 1988). The ground moraine is described as a reddish-brown clayey till with local bodies of sand and gravel. The presence of boulders has been noted in glacial drift at Staten Island (Perlmutter and Arnow 1953). Estimated bedrock topography indicates that the bedrock surface in the vicinity of the SIW Site is at 0-feet above mean sea level (Soren 1988). Thus, bedrock underlying the SIW Site may be relatively shallow given that the ground surface elevation at the SIW Site is at or below 10-feet NAVD88.

Soil borings indicate the SIW Site was underlain throughout with fill material comprised of a clay, sand, silt, gravel mix with scattered debris. The fill appeared to extend vertically in most borings and often contained debris such as brick, asphalt, and creosote-treated wood chunks. Some of the soil cores did show evidence of native material consisting of sand and clay. At some locations, direct push drill refusal was encountered at depths of 4-feet. Drill refusal and poor core recovery is attributed to the presence of concrete and other construction debris that might have been used as fill material or foundations for structures that have been removed.

During the Paleozoic Era [approximately 540 to 250 million years ago (mya)], an altered remnant of oceanic crust broke from the North American plate; this remnant became the bedrock unit of Staten Island. This bedrock unit is made up of pale green, low-grade metamorphic serpentinite. This serpentinite unit is lens shaped and underlies an area of 22 square miles in the north central portion of Staten Island.

During the Mesozoic Era (approximately 250 to 65 mya), the Newark Basin formed as a result of divergent tectonic stresses. Three sedimentary units deposited within the basin: the Stockton Formation (sandstones and arkoses), the Lockatong Formation (siltstones and shales), and the Passaic Formation (shales, sandstones, conglomerates, and siltstones). During the Jurassic Period, the Palisades Sill, an igneous diabase of feldspar labradorite and pyroxene augite, intruded the layers of sedimentary rocks of the Newark Basin. The Raritan and Magothy Formations were deposited as coastal plain sediments from eroded highland material during the late Mesozoic Era.

During the Cenozoic Era (approximately 65 mya to present), the Wisconsin glacier retreated, leaving a layer of loose, unconsolidated, well-graded glacial till and outwash plain sediment consisting of very dark grayish brown coarse sandy loam, brown sandy loam, and dark grayish brown very gravelly sandy loam (Hernandez undated). A more detailed description of the geology at the SIW Site can be found in the UFP-QAPP (USACE 2021b).

3.3 HYDROGEOLOGY

Surficial materials at the SIW Site consist of a combination of artificial fill and native glacial till. This artificial fill was encountered to a depth of at least 5-feet in most soil borings. Although either type of material could be coarse enough to make an aquifer, the total thickness is expected to be on the order of 10 to 20-feet, and the near-shore location of the SIW Site indicates that groundwater extracted from the surficial materials would be non-potable. Flow-direction in these surficial materials is expected to be generally northward (Soren 1988); however, tidal influence is significant in this setting, and therefore, flow-direction varies somewhat with the tides.

These unconsolidated surficial materials are underlain by the Palisades Sill. The Jurassic Palisades Sill is a westerly dipping igneous body that intruded between Triassic-age sedimentary units, and is composed of diabase, a dark-colored, coarse-grained intrusive rock with negligible primary permeability. Secondary permeability created by joints and fractures may be present in the unit; however, a vertical hydraulic gradient in this near-shore setting would be expected to be upward in general, although tidal influence may periodically reverse the gradient.

3.4 CLIMATE

According to the Koppen Climate Classification, Staten Island, New York has a humid subtropical climate similar to other areas within the region (Weatherbase 2021). The climate is influenced greatly by its close proximity to the Atlantic Ocean. The average annual temperature for the site ranges from a low of 45.6 degrees Fahrenheit (ºF) to a high of 63.3 ºF. The lowest monthly average temperature occurs in January (24.5 ºF), and the highest monthly average temperature occurs in July (85.6 ºF). The average annual precipitation is 48.6-inches, with July and September being the highest months of precipitation (an average of 4.6-inches of rain). The annual snowfall for Staten Island is 29.0-inches which mostly occurs in the month of February (8.4-inches of snow) (Weatherbase 2021).

4. PREVIOUS INVESTIGATIONS

Prior radiological investigations at the property included surface gamma surveys, as well as a limited number of surface and subsurface soil samples that were analyzed for specific radionuclides. Results from these analyses are detailed in Appendix K. These previous investigations are briefly summarized below.

4.1 OAK RIDGE NATIONAL LABORATORY (1980)

In 1980, ORNL performed a surface gamma survey of the property (ORNL 1980). Most of this area yielded background gamma levels. However, a relatively small area in the northwest corner of the property had elevated levels of gamma radiation (Figure 4-1). This region has been described as the 20-meter by 40-meter area of contamination at the property. In addition, three soil samples were collected and analyzed for selected radionuclides. The sample collected from the northwest corner (ST-1, Appendix K) had elevated levels of U-238 and Ra-226. The results of these analyses are presented in Appendix K.

4.2 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (1992)

In 1992, NYSDEC conducted further radiologic investigations at the SIW Site (NYSDEC 1992). A surface gamma survey of a limited part of the property was performed. The survey identified the presence of areas of contamination that were at least three times higher than background, including an area that was over 167 times higher than background within the 20-meter by 40-meter region identified by ORNL (1980). A sketch map that identifies the background and elevated regions of the property is presented in Figure 4-2. In addition to the gamma survey, NYSDEC also collected six soil cores from within the 20-meter by 40-meter area covering a depth range from the surface to approximately 1.5-feet below ground surface (bgs). The cores were subsampled, and a variety of radionuclides were analyzed in each sample. The results of these analyses are presented in Appendix K.

Three samples from this investigation (072219, 072220, and 072221) showed poor precision. This was due to inadequate sample sizes for proper analysis. The material for these three samples was primarily organic (wood) material rather than soil. Therefore, the quantity of sample for analysis after drying was very small and was not sufficient to completely fill a standard gamma counting geometry.

4.3 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (2003)

In 2003, NYSDEC conducted a preliminary radiological survey on the parcel of land currently occupied by Federal Express, across Richmond Terrace from the SIW Site (as of September 2021). The purpose of the survey was to assess the potential for radiological contamination. In areas radiologically surveyed, one area was found to be above background. This area was described as a rock pile and had count rates approximately three times the background. Based on the radiation readings it was concluded this material was not considered to be high-grade uranium ore (NYSDEC 2003).

4.4 U.S. ENVIRONMENTAL PROTECTION AGENCY (2008)

In 2008, USEPA, in cooperation with the NYSDEC and New York City Department of Health, conducted a surface gamma survey of the vehicle-accessible area of the SIW Site in the paved and unpaved parking areas (USEPA 2008). Additional gamma surveying took place along part of a fence line in the area, but the details regarding the location of this survey area are unclear. In addition to the gamma survey, six surface soil samples (0 to 0.5-feet bgs) were collected from the 20-meter by 40-meter area. These were analyzed for selected radionuclides (Appendix K).

4.5 U.S. ARMY CORPS OF ENGINEERS (2017)

In 2011, USACE conducted a SI and confirmed the presence of elevated radioactivity in the 20-meter by 40-meter area identified in previous investigations (USACE 2017). Field activities included a gamma walkover survey, collection of soil and groundwater samples taken from 45 locations, and 4 test pits (Figures 4-3 and 4-4). Results from the 2011 SI showed that the majority of radiological soil contamination was defined laterally and is contained within the upper 5-feet bgs vertically. Beach erosion observed along the northern edge of the SIW Site suggested that some radionuclide contaminated soil may be gradually transported from the SIW Site into the near-shore environment of the Kill Van Kull. The 2011 SI recommended that sediment samples offshore of the most contaminated part of the SIW Site be collected and analyzed for the same radionuclides identified in the soils to determine if significant risk exists. Further vertical subsurface investigation was recommended as the SIW Site moves through the CERCLA process in order to verify vertical extent of contamination.

5. SUPPLEMENTAL SITE INSPECTION FIELD ACTIVITIES

5.1 INTRODUCTION

Field activities associated with the SSI work occurred in September 2021 at the SIW Site and included the following items:

- SIW Site preparation
- Surface gamma survey
- Topographic survey
- Hydrographic survey
- Surface soil sample collection
- Subsurface soil sample collection
- Downhole gamma logging
- Test pit excavation
- Groundwater sample collection
- Waste characterization sampling
- Collection of Quality Control (QC) samples [field duplicates and matrix spike (MS)/ matrix spike duplicate (MSD) pairs]
- Sediment sampling
- Air quality monitoring
- Investigation derived waste control and equipment scans

Prior to beginning fieldwork, the SIW Site was prepared by setting up an exclusion zone, two contamination reduction zones, a support zone, and mobile restrooms. The support zone was used for vehicle and equipment parking, temporary storage of debris, and waste storage. It was also used for initial QC checks on the equipment systems. The contamination reduction zones were sectioned off from general access and used for equipment decontamination, and radiological scanning of equipment and personnel. It was also where personal protective equipment (PPE) used in the exclusion zone was removed and placed in garbage bags.

5.2 SURFACE CHARACTERIZATION

The majority of the fieldwork at the SIW Site, except for the topographic and hydrographic surveys, was conducted within the boundaries of the SCA (Figure 2-1). Results from the gamma survey indicated an area with gamma count rates greater than 10,000 counts per minute (cpm) in the northwest corner, as shown on Figure 5-1. These results are relatively consistent with previous studies conducted by ORNL (1980), NYSDEC (1992), and USACE (2017).

5.2.1 Site Preparation

Upon arrival at the SIW Site a large portion of the SCA, excluding the beach and concreted areas, was covered with overgrown brush and shrubs. Additionally, the SCA was littered with trash and debris such as tree limbs, used tires, chairs, cans, bottles, and other debris washed up on shoreline. Prior to performing any project work related to radiological gamma surveys, drilling, or sample collection, the SIW Site was cleared of brush and shrubs with the use of trimmers modified with metal blades, hand clippers, and a chain saw. Brush and tree limbs removed were chipped and stockpiled outside of the sampling areas. Trash and debris located in direct areas of sampling were moved to not effect sampling results. Trash and debris too large to move or along shoreline were left in place.

5.2.2 Gamma Scan

Following the clearing of brush and shrubs, the gamma walkover survey was performed consistent with Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance (MARSSIM 2000). The survey was performed using a 2-inch by 2-inch thallium-activated sodium iodide [NaI(Tl)] gamma scintillation detector interconnected to a Trimble Global Positioning System (GPS). The survey was conducted using these controls: walking relatively straight parallel lines in approximately 1-meter spacings over an area, moving at a speed of approximately 0.5-meters per second, and passing the detector 2 to 4-inches above the ground surface in a serpentine motion. Count rate data from the ratemeter/scaler and position information from the GPS were collected once per second. Count rate and position information were downloaded periodically to a computer for evaluation, by plotting the data onto a project site map and statistical assessment. Color coding of count rate derived from statistical assessment facilitated identification of those portions of the SIW Site that were radiologically elevated relative to the SIW Site background count rates (Figure 5-1).

A background count rate of approximately 10,000 cpm was determined by using the gamma walkover scan data from the north of the known elevated radiological area and was used as the gamma walkover survey scan investigation level in this SSI. The mean count rate of this area (6,800 cpm) plus the recommended MARSSIM control limits of three standard deviations (2,400 cpm) was used and rounded up to the nearest 1,000 cpm, based on professional judgment. This approach provided a significantly reduced false positive rate which facilitated the selection of limited samples to be collected for radiological analysis. The color coding facilitated the investigation of areas with elevated count rates. Surface soil, subsurface soil, and test pit sample locations were subsequently selected, based in part on the results of the gamma walkover survey. The area of above background gamma levels is slightly shifted laterally to the southwest and northeast, relative to previous investigations. With this minor difference, the area of radiological contamination is similar to that identified in previous investigations (Figure 5-2).

5.2.3 Topographic Survey

A civil survey (Appendix L1) was conducted on the entire SIW Site (see full tax parcel included in Figure 1-1). The civil survey has confirmed past erosion impacts and property owner impacts on the SIW Site. Prior to 1988, the northwest corner of the SCA had begun to erode, causing a rounded corner of the elevated shoreline (Figure 2-5). Erosion of the shoreline has also occurred adjacent to the western edge of the SCA. In the southern portion of the SCA, the tenant has constructed a 6-inch concrete pad for placing cement mixing equipment. It appears that fill was brought in to level out the area under the concrete pad. Soil boring logs confirm the fill of 1 to 4-feet. The civil survey provides a baseline for design if future removal actions are required and a baseline to measure future erosion. The topographic survey provides details for record lines (right of ways), adopted lines and property lines based on New York City recorded section, final maps and/or filed maps (as of September 2021).

5.2.4 Hydrographic Survey

The hydrographic survey was completed with an unmanned survey vessel. The vessel was equipped with Single Frequency Singlebeam echo sounder used for data collection and real time water level recording. The upland topography and bathymetry were combined into one map (Appendix K). Along the western edge of the SCA, the bathometric lines indicate gradually increasing slope of elevation to the north, with a depth of 19-feet bgs. The steepest elevation change along the shoreline appears to be in the northwest corner of the SCA. Historical changes in topography and beach erosion over time at the SIW Site is covered in more detail in Section 7.1.

5.2.5 Geotechnical Analysis

Site soil consists of silty sand with gravel and sandy lean clay fill material overlying coarse riprap. Soil thickness was approximately 6 to 12-feet within the SCA (increasing in depth towards the south). Standard penetration tests yielded N60 of between 2 and 20, with an average N60 value of 10. Ten cohesive soil samples were collected from various soil borings and measured unconfined compressive strength. Results from those samples ranged from 8.6 to 39.9 pounds per square inch (psi), with an average of 22 psi. The samples analyzed for compressive strength were collected from direct push sampling using a nominal 2-inch diameter macro-core sampler and included a large proportion of sand. Therefore, the compressive strength results likely provide an underestimate of the bearing capacity of the site soils. Geotechnical data is included in Appendix M and the analysis is further discussed in Section 7.3.

Equipment used during the geotechnical/environmental investigation (e.g., GeoProbe 7822DT and Kubota U35-4 mini excavator) did not cause observable failures to the soil at an estimated ground pressure of 5 psi. The soil pit excavations extended through the soil to a depth of approximately 6-feet. These excavations remained open while the excavator equipment was placed adjacent within 4-feet of the pits. No observable failures presented within the excavation walls (except for slough from incoming groundwater near the bottom of the test pits).

5.3 SURFACE SOIL SAMPLING

Surface soil characterization samples were collected according to the methods presented in the PWP (USACE 2021a) and are discussed in the subsections below. Sampling consisted of the following tasks:

- Surface soil samples were obtained from within the top 0.5-feet of soils.
- Biased surface and subsurface soil samples were obtained from locations identified by the gamma survey and using previous SI data to delineate contaminants both horizontally and vertically.
- Biased samples were collected from the first 2-feet lift of each test pit, identified by elevated count rates observed during gamma logging of the soil pile.
- In addition to the biased samples, systematic samples from surface and subsurface locations were distributed throughout the sampling area (Figures 5-2 and 5-3).
- Soil samples were located using GPS referenced to North American Datum, Universal Transverse Mercator Zone 18N (meters), Geographic Coordinate System North American 1983.
- Samples were collected, labeled, logged, and shipped to Pace Laboratories, Mt. Juliet, Tennessee for analysis. Soil samples were analyzed for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40, as well as for uranium isotopes.
- Waste characterization samples were analyzed for the complete list of contaminants (e.g., volatile organics, semi volatile organics, and metals) reported in Table 1 of 40 the Code of Federal Regulations (CFR) 261.24.
- QC blind duplicate samples were collected at one sample for every ten primary samples collected or portion thereof and MS/MSD pair samples collected at one pair for every 20 primary samples collected or portion thereof.

- Samples were packaged and maintained under strict chain of custody (COC) until delivery to the laboratory.

5.3.1 Surface Soil Sample Collection

A total of 25 surface soil sampling locations were sampled for radiological analysis for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40 by gamma spectroscopy, as well as for U isotopes. In the 2021 PWP, 20 surface soil locations were proposed. However, some of the originally proposed subsurface soil sampling locations were either not accessible by drill rig based upon site conditions or drilling depth refusal limited the number of subsurface soil samples. Instead, 5 additional surface soil sampling locations were added (SS-21 through SS-25). Of the 25 surface soil sampling locations, 15 of the locations (SS-01 to SS-15) were based on a statistical grid, using guidance from MARSSIM (Figure 5-3). Some of the original surface soil sampling locations were moved based on assessment of on-site conditions (SS-09, SS-10, SS-14, and SS-15, respectively). The remaining 10 locations were selected using the biased sampling approach based on gamma survey results, gaps in data, and discussions among the project team to further bound contaminants horizontally and vertically (SS-16 to SS-20). The locations of surface samples SS-21 through SS-25 were chosen to better define the area with elevated gamma scan readings. Surface soil samples were collected from the top 0.5-feet of soil using stainless steel trowels. Results of the laboratory analyses for the surface soil samples are discussed in Section 6.1.2 and shown in Table 5-1.

For sampling locations on beach areas where a dense layer of cobbles and other stony debris existed, these materials were first removed from the sample location to expose the underlying soil/sediment. For surface soil sampling locations, visually identifiable non-soil components such as stones, twigs, and foreign objects were manually separated in the field and excluded from the laboratory samples to avoid biasing low results.

Radiological soil samples were not preserved in the field, as there are no preservation requirements for the radiological analyses. Stainless steel trowels used in sample collection were decontaminated between samples to avoid cross-contamination. Decontamination water was poured back in the holes from which the sample originated.

5.4 SUBSURFACE SOIL SAMPLING

Borings for subsurface soil characterization were collected by a direct push method using a Geoprobe® 7822DT series track-mounted drilling rig (owned and operated by AARCO Environmental Services Corporation, a subcontractor to GEO), by hand auger, or post-hole digger. The drilling rig was also equipped with hollow stem auger attachment. Of the 34 subsurface soil samples collected, 28 were collected from 14 unbiased soil boring locations (SB-01 through SB-15, excluding SB-13), as shown in Figure 5-4. Of the 14 unbiased soil borehole locations, 5 were inaccessible due to on-site conditions and were relocated after a project group discussion. Sample location SB-10 shifted west approximately 15-feet from original location due to a brick wall recently placed along the eastern edge of the SCA by the tenant. Sample location SB-09 shifted west approximately 10-feet to split difference of SB-08 and new location of SB-10. Sample locations SB-14 and SB-15 shifted west from original location due to recently placed structures by tenant. The other 6 subsurface samples, also shown in Figure 5-4, were collected from biased sample locations that were chosen based on gamma survey results, gaps in data, and discussions among the project team.

5.4.1 Subsurface Soil Sample Collection

Subsurface soil samples were collected by using a direct push drilling rig with hollow stem auger attachment. Drilling activities began by advancing a 2-inch steel macro-core sampler core barrel to a depth of 12-feet, refusal, or interface with groundwater. Subsurface soil samples were collected with a target depth up to 12-feet. In the case of inaccessibility with the drilling rig, samples were collected using an auger or post-hole digger. Eleven of the 20 soil boring locations were completed using the drill rig (SB-04, SB-05, SB-06, SB-07, SB-09, SB-10, SB-11, SB-12, SB-14, SB-15, and SB-16). Nine soil boring locations were completed using a hand auger or post-hole digger (SB-01, SB-02, SB-03, SB-08, SB-17, SB-18, SB-19, SB-23, and SB-24).

Initial direct push drilling efforts resulted in refusal at approximately 6 to 7-feet. Refusal was attributed to the various material encountered (e.g., brick structures, rip rap, fill material). Refusal contributed to broken core barrels and replacing multiple casing shoes. The drill rig was moved a few feet in multiple directions with similar results. The hollow stem auger attachment was then used on the drill rig with refusal at the same depth as the direct push method. Both methods resulted in similarly poor percentage recovery. Groundwater was also encountered at approximately 6-feet bgs. While using the direct push method, the macro-core sampler was advanced with intermediate soil samples contained inside 4-foot clear acetate liners that had been inserted into the core barrel prior drilling. The liners were removed from the core barrel at the sampling locations. The acetate sleeves were sliced open with a core cutter to expose the soils for classification and radiological screening. The sample cores were then scanned and described. Significant conditions, including the presence of groundwater, were noted. Boring logs associated with each of the 20 subsurface boring locations are included in Appendix F.

When using the hollow stem auger; once the core barrel was removed from the ground, the barrel was split open and sample were scanned, logged, and samples were collected from the cores. Excess soil was returned to the hole from which it was extracted. Any remaining excess soil was spread evenly around the borehole location. The empty core barrel was scanned and decontaminated (if necessary) with water prior to moving to next soil boring location. Decontamination water was poured back in the holes from which the samples were collected. Samples were then shipped to the off-site laboratory to be analyzed for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40 by gamma spectroscopy, as well as for U isotopes.

Subsurface soil samples were collected from each soil core at depth intervals based on the results of the scan of the core at elevated logged points. In the case of poor recoveries, the majority of the core was collected for sampling. Samples collected from the 0 to 4-feet intervals of a poorly recovered core were taken from the bottom of the core, working up, so as not to duplicate the material collected for a surface soil sample at that same location, when possible. This was also the method used for the collection of samples from cores with poor recovery in the remaining intervals since slough from the upper interval was contained in the top portion of the lower interval cores. Results of these analyses are discussed in Section 6.1.2 and shown in Table 5-2.

As is typical of fill that may contain construction debris, recovery was poor for some boring intervals, which made precise determination of sample depths difficult. Soil boring locations SB-11, SB-12, SB-14, and SB-15 were located on a 6-inch concrete pad installed by the tenant (approximately 6 months prior to 2021 fieldwork). After permission from tenant, the drill rig was used to drill through the concrete pad to collect surface and subsurface samples. The highest percentages of recovery were in the drilling cores removed from SB-11, SB-12, SB-14, and SB-15. This is most likely due to compaction of material in preparation for construction of the concrete pad.

In the event that groundwater was encountered, and the borehole appeared to produce water sufficient for sample collection, a groundwater sample was collected. A more detailed discussion of groundwater sampling is discussed in Section 5.4.4.

A strong diesel fuel odor was encountered in some soil cores collected from the parking lot area and the northwestern tip of the beach. Specifically, the odors were strong in samples SB-10 and SB-12 (Figure 5-4). A faint diesel fuel odor was also noted in SB-11.

5.4.2 Downhole Gamma Logging

Downhole gamma logging was performed in each borehole to 12-feet bgs, point of refusal, or prior to encountering groundwater. As specified in the PWP (USACE 2021a) to reduce the potential for borehole collapse, a section of 2-inch diameter polyvinyl chloride (PVC) casing, capped at one end, was inserted into the borehole to allow for downhole scanning. Downhole gamma scans were not performed on soil borings less than 2-feet bgs or when groundwater filled the soil boring immediately after the soil boring was completed (e.g., beach area).

Gamma rate meter counts were logged from each borehole with a NaI(Tl) scintillation detector. The scintillation detector was suspended from a tripod, which was used to obtain these measurements by advancing the rate meter at approximately 0.5 inches per second. In addition, static counts were collected at fixed points within the borehole (approximately 5 readings per foot). Gamma count rates were logged for each borehole and are further discussed in Section 6.1.2 and shown in Table 5-3. Downhole gamma scan results were not taken into consideration when determining the location for sample collection for each core. This was due to poor recovery of the sample cores as well as uncertainty of the actual depths of elevated downhole gamma scan results on the cores. The comparison between downhole gamma scans and a scan of the associated soil core is included in Section 6.1.2.

5.4.3 Test Pits

Four test pits were excavated during this SSI, using a Kubota U35-4 mini excavator. The locations are presented in Figure 5-4. The locations of the test pits were chosen to further delineate the eastern and southern extent of contaminants in the elevated radiological boundary. Each test pit was excavated to a maximum depth of 8-feet bgs or refusal and up to 6-feet in length, with a nominal width of 2-feet (approximately the width of the excavator bucket). Soils were removed from each test pit in 2-feet lifts. Each lift of excavated soil was spread uniformly and was then scanned and inspected for the presence of contamination (ore). The first two floors of test pits were also scanned for contamination using the same methods as the gamma survey walkover, discussed in Section 5.3, except for the use of GPS with the survey instrument. The floors of the test pits were not scanned below 4-feet, per the Accident Prevention Plan (USACE 2021c). For the gamma survey of the floor and walls of the test pits, survey count rates were recorded manually in field logbooks. A photograph log of subsurface conditions was maintained and is included in Appendix G. Upon completion of the test pit characterization, the excavation spoils were placed back in the test trench and compacted using the bucket of the excavator.

A total of eight soil samples from the test pits (two from each test pit) were collected in areas of elevated radioactivity identified during gamma scans of the excavated material and analyzed for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40 by gamma spectroscopy, and U isotopes (U-234, U-235, U-238) by alpha spectrometry. Gamma scan readings of the spoil piles indicated higher readings in the first levels removed (0 to 2-feet bgs and 2 to 4-feet bgs, respectively). One sample was collected from the first lift and one sample was collected from the second lift of each of the four test pits. Results of these analyses are discussed in Section 6 and are also shown in Table 5-4.

Groundwater was encountered at each of the four test pit locations at approximately 5 to 7-feet bgs. A sump pump was placed at the bottom of Test Pit 2 (TS-02) and Test Pit 3 (TS-03) for dewatering purposes. The sump pump was used to remove water at the rate of approximately 40-gallons per minute for at least 15 minutes and the water level did not subside. This level appeared to match the elevation of the tide in the Kill Van Kull waterway. The area of the groundwater in the bottom of the test pit was approximately 6-feet in length, 2-feet wide, and 6-inches in depth. It was decided to terminate the dewatering and stop the attempt to excavate the test pit further. At test pit locations including Test Pit 1 (TS-01), TS-02, and TS-03, groundwater was encountered at approximately 5 to 6-feet and the digging became extremely difficult at approximately 6-feet bgs. Groundwater was encountered at approximately 6-feet bgs in Test Pit 4 (TS-04), and the excavation was terminated at approximately 7-feet bgs. Larger riprap was encountered in TS-01, TS-02, and TS-03 at approximately 6-feet bgs, but not encountered in TS-04.

5.4.4 Groundwater Sample Collection

Groundwater samples were collected from four borehole locations in accordance with GEO's groundwater sampling procedure contained in the PWP (USACE 2021a) (Figure 5-5). Four borehole locations produced enough groundwater to sample with bailers.

Once borings were advanced to their final depth (maximum 12-feet bgs), 2-inch outside diameter PVC casings with an open bottom end were temporarily installed to prevent borehole collapse and to facilitate sampling. A dedicated bailer was used to collect groundwater in SB-06, SB-07, SB-09, and SB-10. Groundwater quality parameters (pH, dissolved oxygen, conductivity, turbidity, and temperature) were collected and are provided in Table 5-5. The samples were analyzed by the off-site laboratory for gross alpha, gross beta, Ra-226, and Ra-228 using drinking water standards. Alpha spectroscopy analysis was used to determine the isotopic concentrations of the three uranium isotopes. Results of these analyses are presented in Table 5-6.

5.4.5 Waste Characterization

Two composite soil samples for waste characterization were collected from the test pit spoils and analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), and metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) using toxicity characteristic leaching procedure. One composite sample was collected from the first lift (0 to 2-feet bgs) of TS-01 and TS-02 and the second composite sample was collected from the first lift (0 to 2-feet bgs) of TS-03 and TS-04. These locations are detailed in Figure 5-6.

Specific analytes include the chemicals listed in Table 1 of 40 CFR 261.24. Soil samples were also evaluated to determine ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), reactivity (40 CFR 261.23), and toxicity (40 CFR 261.24). Results of these analyses are discussed in Section 6.1.3. and are included in Tables 5-7 through 5-9, respectively.

Additional waste generated included scanned PPE, used acetate sleeves, and used PVC pipes. Soils and liquids removed from the ground were returned to the location where they were excavated, and thus did not generate waste. Protective clothing, acetate sleeves, and waste PVC pipes used during sample collection were contained in garbage bags, scanned to ensure they were not contaminated, and then disposed of in trash receptacles.

Since the contamination known at the SIW Site is suspected of being uranium ore, the chemicals found in that ore may also be present on-site. The uranium ore purchased by the MED had the following average non-radiological composition (percentages are rounded) (MED 1942).

20.4% SiO_2	6.3% PbO
0.7% FeO	0.2% CuO
2.1% Al_2O_3	0.2% P_2O_5
1.7% CaO	0.1% Co+Ni
2.9% MgO	1.1% Na_2O_3 [printed as "*No_2O_3 (?)*" in MED 1942]*

*%: percent *Note: The reference is likely a typographical error, further emphasized by the "(?)" contained in the original document. %: percent*

Lead is the only potential metal found in the ore that is regulated by the Resource Conservation and Recovery Act (RCRA). It should be noted that although some ore dissolution may occur due to local environmental factors, it is expected that metals in waste samples (especially lead) may be co-located with the radioactive contamination. From the analysis further discussed in Section 6.1.2, it was observed that highest concentrations of lead were found in the area of elevated radiological activity, as determined by the gamma walkover survey. Chemicals other than lead, if found on-site, are not related to the uranium ore, and therefore, are not considered FUSRAP waste.

5.5 SEDIMENT SAMPLING

To determine the contaminants (if any) in near-shore sediment, samples were collected from near-shore areas at mean low tide. A tidal chart for the 2021 SSI fieldwork is included in Table 5-10. Since there is evidence that fishermen use the shore area at the SIW Site, it was recommended that sediment samples offshore of the most contaminated part of the SIW Site be collected and analyzed to evaluate potential risks from exposure to this sediment.

5.5.1 Sediment Sample Collection

Sediment samples were collected from 10 locations at the shoreline along the northern and western boundary of the SCA (Figure 5-7). Samples were collected from 0 to 0.5-feet bgs and were collected with a stainless-steel trowel. The stainless-steel trowels were decontaminated between sediment sampling locations. After the sediment samples were collected, the excess sediment was returned to the hole from which it was extracted. Excess sediment was spread evenly around the sample location.

Sediment samples were analyzed for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40 by gamma spectroscopy, and U isotopes (U-234, U-235, U-238) by alpha spectrometry. Results of these analyses are discussed in Section 6.1.2. and are included in Table 5-11.

5.6 QUALITY CONTROL SAMPLING

Blind field duplicate samples were collected for surface soil, subsurface soil, sediment, and groundwater matrices. The duplicates were collected simultaneously or in immediate succession with the primary samples collected at that location. The duplicates were recovered from the same sample and in the same manner as the original to ensure homogenization of the sample. Duplicates were then split between the appropriate containers, and treated in the same manner during storage, transportation, and analysis. QC blind duplicate samples were collected at one sample for every 10 primary samples collected or portion thereof. MS/MSD pair samples collected at one pair for every 20 primary samples collected or portion thereof. Duplicate samples were numbered, logged, and transferred under GEO COC procedures to the off-site laboratory for analyses. Comparability of the QC samples with the original primary samples is discussed in detail in the Quality Control Summary Report (Appendix B).

5.7 AIR QUALITY MONITORING

Air monitoring was performed during field activities that had the potential to generate respirable, contaminated, airborne particulates. These activities included brush clearing, direct push drilling, surface and sediment sample collection, and test pit excavation. Air monitoring surveys were performed which measured gross alpha activity at or near the SCA to evaluate potential off-site emissions. The predominant wind direction was checked each morning and afternoon to ensure that the monitoring stations were placed at downwind and upwind locations. Air samples were collected downwind and upwind of the site boundaries during work activities to monitor potential offsite exposure during SSI work activities.

5.8 INVESTIGATION DERIVED WASTE AND EQUIPMENT SCANS

Minimal investigation derived waste (IDW) was generated during this investigation and mainly comprised of spent PPE including Tyvek suits, boot covers, and nitrile gloves. Soil or liquid IDW was not generated, since excavated test pit soil, as well as discarded soil boring cores, and surface and sediment sample spoils were placed back into their place of origin as backfill. Spent PPE was bagged and a release survey was conducted on each bag prior to release. The release survey for the bagged PPE was conducted in a similar manner as the release survey for equipment used on-site by collecting readings from the sides, top and bottom of the bags. The bags were properly disposed in waste receptacles.

PPE and equipment were scanned following work within the designated radiation zones to ensure no contamination was carried outside of the zone. Equipment used within the radiation zones underwent release surveys with a NaI(Tl) gamma scintillation detector, Ludlum Model 2929 Alpha/Beta Scaler, and a Ludlum Model 2360 Ratemeter. The results of the surveys, included in Appendix I, confirmed no contamination was present on the equipment.

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6. SITE CONTAMINATION, EXPOSURE PATHWAYS, AND TARGETS

The objective of this section is to assess the impact of residual radioactivity in the SCA at the SIW Site.

6.1 SOIL EXPOSURE PATHWAY

6.1.1 Targets

As noted above, the area of the SIW Site known to contain radiological contamination above applicable screening levels, the SCA, is overgrown with thick vegetation and the southern portion of the SCA is being used by the property tenant as part of a concrete batch plant. Because the SIW Site is being used as an active concrete batch plant, access to the contaminated area is limited, the most plausible exposure targets include outside SIW Site workers and SIW Site intruders. Furthermore, there is no complete barrier to prevent local fisherman and intruders from entering the contaminated area by water from the Kill Van Kull waterway. The most likely soil exposure routes include external gamma radiation, inhalation of respirable, contaminated, airborne particulates, and inadvertent ingestion of contaminated soil.

Bank erosion adjacent to the contaminated region of the SIW Site due to tidal activity, wave action associated with passing ocean-going vessels, storm surges such as Hurricane Irene, Hurricane Sandy (August 2011 and October 2012, respectively), and periodic heavy rainfall events has the potential for transporting contaminated soil into the near-shore area of the Kill Van Kull. Potential uptake of contaminated sediment by bottom-feeding fish and/or shellfish may occur and represent another exposure pathway. The area of impacted sediment appears to be limited, and unlikely to have a significant impact on fish and shellfish populations.

6.1.2 Radiological Contamination Results

For this SSI, sediment, surface, and subsurface soil samples were collected and analyzed as described in Section 5.

Soil and sediment samples were analyzed by gamma spectroscopy for Ra-226 (Pb-214, Bi-214), Ac-228, K-40, Th-234, and by alpha spectrometry for the uranium isotopes (U-234, U-235, and U-238). Radionuclide activity data for soil samples collected at the SIW Site are presented in Tables 5-1 through 5-11 (excluding Table 5-5 Water Quality Parameters and Table 5-10 Tidal Chart).

6.1.2.1 Gamma Survey

The gamma walkover survey was performed as described in Section 5.2.2 and covered the majority of the SCA. There were rocky areas near the shoreline that were very slippery with difficult terrain, which limited surveyor access. The gamma walkover survey provided the gamma count rates in cpm and corresponding location data. The data collected was evaluated including color coding to reflect specific ranges of count rates (Figure 5-1).

In Figure 5-1, the blue data points represent background levels of gamma radiation (≤ 10,000 cpm, see Section 5.2.2). The area with elevated count rates (green to red data points) are generally consistent with the results from the previous gamma walkover survey collected during the 2011 SI fieldwork (USACE 2017). The elevated radiological boundary was developed based on the gamma walkover survey count rates and is included on Figure 5-1. Two areas of note in which higher count rates were identified in the 2021 SSI compared to the 2011 SI are the following areas:

- A small, localized area in the northern portion of the elevated radiological boundary as shown on Figure 5-1 with counts rates up to 44,000 cpm

- An area ranging from 12,000 to 16,000 cpm on the very southern portion of the SCA along the shoreline

A total of 10 biased samples was collected and adjustments were made to some systematic sample locations to either investigate or further bound the elevated areas identified during the gamma walkover survey. The biased locations include the following soil borings:

- Locations SB-16, SB-17, SB-19, and SS-25 were collected to investigate and bound areas identified in the northern portion of the SCA.

- Locations SB-18 and SB-24 were added to bound the SCA to the west.

- Locations SS-21 and SS-22 were added to bound the SCA to the east.

- Location SB-23 was included to bound the SCA to the south.

- Location SS-20 was added to investigate the elevated counts in the southern portion of the SCA along the shoreline.

Systematic location SB-10 was moved a small distance to investigate the elevated count rates in the southeastern portion of the SCA. Figures 5-2, 5-3, and 5-6 show the location of SCA, the surface, subsurface and sediment sampling locations, respectively.

6.1.2.2 Soil Screening Levels

To evaluate the presence of elevated concentrations of specific radionuclides in sediment and soils, project screening levels were set to either the higher of a background threshold value derived from background data from previous inspections (USEPA 2009a and USACE 2017) or receptor-specific (Residential) risk-based screening levels for soil using USEPA's online calculator Preliminary Remediation Goals for Radionuclides (PRG) set to a target risk of 10^{-6} (USEPA 2021). Table 6-1 provides the background data threshold values, the calculated risk-based screening levels, and project screening levels for the appropriate radionuclides. This screening approach evaluated risks under residential land use as a conservative approach given that the SIW Site is zoned as commercial/industrial.

6.1.2.3 Soils in the Surface Characterization Area

The project screening levels in Table 6-1 were used as threshold values to identify those soil samples at the SIW Site where the radionuclide concentrations are elevated. The results are illustrated in multiple figures, where radionuclides in the surface, subsurface soil, and sediment samples that exceed the screening levels are presented in a sequence representing sample depths of 0 to 0.5-feet bgs, 0.5 to 4.0-feet bgs, and greater than 4-feet bgs (Figures 6-1 through 6-10). When cover material was present, the depths for this evaluation were determined excluding the cover material.

Two soil samples were collected from each test pit based on the gamma scans. Sample results from the 0 to 2-feet and 2 to 4-feet interval of the test pits are included in the 0.5 to 4.0-feet interval for this evaluation.

Figures 6-1 through 6-9 present the results for Ra-226, U-234, U-235, and U-238, respectively. Th-234 is in secular equilibrium with U-238. Since the U-238 screening level is more conservative, the U-238 results were used to evaluate the soil results. Figures were included for the depth intervals in which a screening level was exceeded for radionuclides of interest. In these Figures, white colored dots indicate a sample that did not exceed the screening level, yellow ones indicate a sample that exceeded the screening level by less than 5 times, and red dots indicate a result that was greater than 5 times the screening level. If two samples were collected at the same location within the designated interval, the higher result was used in the figures. For subsurface soils greater than 4-feet in depth, only Ra-226 exceeded screening level, and no other radionuclides of interest exceeded the screening level at this depth. The majority of elevated gamma counts identified during the downhole boring gamma surveys were within the top 2.5-feet of soil. The test pit gamma count rates and concentrations of radionuclides of interest generally decreased with increasing depth in test pits. One test pit sample collected below 4-feet (i.e., from TS-04 within the 4 to 6-feet depth interval) exceeded the Ra-226 screening level with a value of 2.74 picocuries per gram (pCi/g).

There were exceedances of Ra-226 above the screening level within the SCA at all the depth intervals (Figures 6-1 to 6-3). The eight test pit samples exceeded the Ra-226 screening level. The samples at locations outside the elevated radiological boundary to the south, below the concrete (SB-11, SB-12, SB-14, and SB-15) that had Ra-226 concentrations above the screening level, also showed elevated count rates during the downhole borehole logging ranging in depth from approximately 1.5 to 5-feet below the concrete and gravel cover material. The deepest elevated downhole gamma counts occurred at SB-14 which had a Ra-226 concentration of 2.44 pCi/g at the 4.5-6.5-feet depth interval. Based on the decreasing downhole count rates beyond 5-feet in the southern part of the SCA, it is not likely there would be Ra-226 exceedances at deeper depths.

Screening level exceedances for uranium isotopes occurred at boring location SB-17 for the surface and the 1 to 2-feet depth intervals (Figures 6-6 and 6-7, respectfully). TS-02 and TS-04 also had uranium data above the screening levels. The deepest interval (3 to 4-feet depth) with the three uranium isotopes exceeding the associated screening levels was in TS-02. There were also 6 additional locations within the top 2-feet of soil in which U-235 exceeded the screening level (Figure 6-6 and Figure 6-7). Two of the 6 locations were from outside the elevated radiological boundary determined by the gamma walkover survey. The highest Ra-226, U-234, U-235, and U-238 values were 347, 73.6, 3.8, and 73.3 pCi/g, respectively and were within TS-02 in the 0 to 2-feet interval (Figures 6-1 through 6-9).

6.1.2.4 Comparison of Results from the Current and Previous Inspections

Section 4 presented a review of the previous inspections conducted at SIW Site by USDOE (ORNL 1980), NYSDEC (1992), Region 2 of USEPA [in cooperation with NYSDEC and the New York City Department of Health (USEPA 2008)], and USACE (2017). During the first two investigations, soil samples ranged in depth from the surface to a maximum depth of 18-inches bgs. During the 2011 SI fieldwork activities, surface samples were collected from the 0 to 2-feet bgs interval and subsurface samples were collected to a maximum depth of 10-feet bgs (USACE 2017). The samples collected from the SIW Site were analyzed for a suite of radionuclides including Ra-226, U-235, and U-238. In the 2011 SI field investigation, soil samples were also analyzed for U-234. These radionuclides are the focus of this comparison. During the first two site investigations most of the samples were collected from the region of the SIW Site where gamma walkover survey results indicated elevated count rates (Figures 4-2 and 4-3). During the 2011 SI fieldwork activities, samples were collected both within and outside the designated SCA for 2021 SSI. The relevant data from previous investigations are presented in Appendix K. Surface soil, subsurface soil, sediment, and groundwater data for the 2021 SSI are shown in Tables 5-1 through 5-11 (excluding Table 5-5 Water Quality Parameters and Table 5-10 Tidal Chart).

The previous investigations at the SIW Site have consistently identified radioactivity in the upper 2-feet of soil that exceeds the 2021 screening levels. The concentrations in the surface soils for Ra-226, U-235, and U-238 are generally somewhat lower in the 2011 SI and the 2021 SSI than the two previous site investigations. Three samples (from Locations 072219, 072220, and 072221) from the NYSDEC (1992) data had unusually high concentrations for the Ra-226, U-235, and U-238. However, it was noted that these samples had poor analysis precision due to the material consisting of organic wood material rather than soil resulting in insufficient sample quantities. Therefore, the reliability of these specific results is uncertain. With the exception of those three samples, the higher results from the NYSDEC (1992) data are of a similar magnitude to the results from TS-02 in the 0 to 2-foot layer (TS-02-002) which are 347, 73.8, 3.8, and 73.3 pCi/g for Ra-226, U-234, U-235, and U-238, respectively (Table 5-4).

The elevated results in the surface soil above the screening levels has mostly been within the elevated radiological boundary (Figure 5-1) identified during the 2011 SI and the 2021 SSI with the following exceptions:

- The 2011 SI identified three sample locations to the south and one to the east of the elevated radiological boundary with Ra-226 exceeding the 2021 SSI screening level. The 2021 SSI identified one sample location to the northwest of the elevated radiological boundary (SB-01) slightly over the Ra-226 screening level.
- One uranium sample result exceeded the screening level outside the elevated radiological boundary during the 2021 SSI was U-235, which was at SB-01. During the 2011 SI, there were no uranium samples results from outside the elevated radiological boundary that exceeded the current screening level.

The elevated uranium concentrations in subsurface soils above the screening levels were located within the identified elevated rad boundaries in both the 2011 SI and 2021 SSI. In the current SSI there were five locations to the south of the elevated radiological boundary with Ra-226 values slightly above the screening level compared to samples in the 2011 SI:

- In the 2011 SI, subsurface samples were collected and analyzed from the 0 to 5-foot layer and the 5 to 8-foot layer and results for Ra-226 in the area south of the elevated radiological areas ranged from approximately 1 to 1.8 pCi/g (USACE 2017).
- The 2021 SSI results exceeded the screening level for Ra-226 to the south of the elevated radiological boundary ranged from approximately 2.3 to 3.8 pCi/g indicating a slight increase in Ra-226 subsurface concentrations to the southern portion of the investigation area.

6.1.3 Non-Radiological Contamination Results

In addition to the sampling program that focuses on defining the distribution of radiological contamination at the SIW Site, two composite waste characterization samples were collected from the four test pits (Figure 5-4) and were analyzed for RCRA metals, SVOCs, and VOCs. The samples, WC-01 (composite samples from TS-01 and TS-02) and WC-02 (composite samples from TS-03 and TS-04) are in the elevated radiological boundary. An additional sample, SB-16-0000, was selected based on an elevated reading (>65,000 cpm). SB-16-0000 was inspected and scanned after the gamma scan walkover survey. This sample was collected near the shoreline and was found amongst many similar type rocks, which can be generally described as a black slag. In general, other than lead, which could be attributed to near-by facilities that would suggest higher than normal concentration of lead (e.g., leaded gasoline, leaded paint, etc.), there is no reason to expect association between non-radiological contamination at the SIW Site and the uranium ore that was stored there during the early 1940s (USEPA 2009c). The presence of these constituents is consistent with fuel spills that may have occurred at the industrial site, or a nearby lead manufacturing facility which was fully operational from 1839 to 1943.

The purpose of the non-radiological analyses is to provide preliminary information that might be needed to determine the final disposition of soil if remedial actions will be performed in the future. Most of these chemicals (e.g., organic constituents), if detected, could not have been from use of the SIW Site for uranium ore storage but may be present due to decades of industrial use of the area.

The waste characterization data obtained from surface and subsurface soils at the three locations are presented in Tables 5-9 through 5-11. The majority of results for organic constituents (SVOCs and VOCs) were non-detects and either U or UJ qualified. Among the VOCs (Table 5-9), benzene, toluene, ethylbenzene, and total xylenes were commonly detected at one or more of the three sampling locations, but at low concentrations, as J qualified analytes. The presence of these constituents is consistent with fuel spills that may have occurred at the industrial site, although a definitive explanation for the presence of such contamination at the SIW Site is unknown and beyond the scope of this effort. Some other VOC analytes detected in some soil samples (e.g., acetone, methylene chloride, toluene, and 2-butanone) are not characteristic of SIW Site contamination. Most of the remaining VOC analytes were not detected in the samples (UJ qualified).

For the SVOCs, most analytes were not detected in samples from the three locations (Table 5-8). However, the polycyclic aromatic hydrocarbons (PAHs) that were included in the soil sample analyses are the most common contaminants that were detected. Detection levels were moderately less than those in the 2011 SI (USACE 2017). The PAHs are common compounds found in coal and petroleum-based fuels and are frequently deposited from asphalt pavement from the atmosphere as products of combustion. Their presence is not unexpected in soils in a heavily industrialized area, in a highly populated region where diesel and gasoline fuels are burned by vehicles, and with coal-fired electrical power plants surrounding the New York City region. The presence of the concrete slab on the SIW Site, which is approximately 6-inches thick, may have contributed to their presence. Also, asphalt debris was observed in several of the soil cores located near the asphalt area of the SIW Site. As discussed in Section 5.4.1, fuel odor was observed in several subsurface borings. Several SVOC analytes were detected in soil samples and are considered to be common laboratory contaminants rather than characteristic of SIW Site contamination.

Although there may be many potential sources of metal contamination at the SIW Site, including industrial and other regional activities, the possibility that the uranium ore may have associated non-radiogenic metal constituents cannot be ignored. The uranium ore in the Belgian Congo was hydrothermal in origin and is known to have a variety of associated metals that were deposited along with the uranium-bearing minerals. An assay of the non-radiogenic constituents in the original ore stored at the property in the early 1940s is provided in Section 5.4.5. It shows that a significant concentration of lead [6.27 percent (%) lead(II) oxide (PbO) – approximately 58,200 milligrams per kilogram (mg/kg) of lead (Pb)] and lesser amounts of a variety of other metals (e.g., copper, cobalt, and nickel) were present.

A majority of the metal compounds analyzed (Table 5-7) included in the 2021 SSI, arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury were detected in soil samples from at least two of the three locations, except for silver. Concentration results for WC-01 were deemed valid detections at the sample location. The sample from WC-02 yielded J qualified concentrations for the analytes arsenic, barium, lead, and mercury. Most of the observed metal concentrations were low, but lead and arsenic were detected. The high estimated concentrations of lead (as high as nearly 1000 mg/kg) may possibly be related to the ore stored at the property, but also may be attributed to the extensive former use of leaded gasoline in the surrounding region (substantial marine traffic observed during 2021 fieldwork) and deposition at the SIW Site from the atmosphere.

6.2 GROUNDWATER EXPOSURE PATHWAY

Conclusions from the 2011 SI stated that groundwater sampled from the SIW Site were not a concern to human health and the environment. During the 2021 SSI, groundwater samples were collected from four locations (Figure 5-5). The 2021 SSI considers the possibility that infiltration of precipitation at the SIW

Site may result in leaching of radionuclides from contaminated soils and transport to surface water where mixing occurs.

6.2.1 Targets

As a manmade structure, materials at the SIW Site consist of a combination of native glacial till and artificial fill. This artificial fill was encountered to a depth of at least 3-feet bgs in most boreholes (Appendix F). Although either type of material could be coarse enough to make an aquifer, the total thickness is expected to be on the order of 10 to 20-feet. The SIW Site extends into the Kill Van Kull which indicates that groundwater extracted from the construction materials would likely be highly influenced if not representative of adjacent surface water. Groundwater flow is expected to be to the north and influenced by the tides (approximately 4 to 5.5-feet daily fluctuation).

Groundwater underlying Staten Island is recharged primarily by precipitation with an annual average total of 46.3-inches. The groundwater originates in the central portions of the island and radiates outward. This groundwater flow in the vicinity of the SIW Site is expected to be to the north. Island fresh water is surrounded on all sides by saltwater interfaces (Soren 1988). As mentioned in Section 3.2, the SIW Site is underlain by diabase, which has low permeability and is not considered a viable source of groundwater. Staten Island groundwater has not been used for drinking water since 1970 (Soren 1988). Instead, New York City receives drinking water from upstate resources via aqueducts and piping.

There is no expectation that shallow groundwater at the SIW Site will result in exposure to outside workers or intruders. Furthermore, groundwater discharging to the near-shore environment of the Kill Van Kull on the north and west sides of the SIW Site will undergo rapid dilution by mixing with the surface water. Once groundwater underlying the SIW Site discharges into the Kill Van Kull, it transitions from a groundwater to a surface water exposure pathway with associated targets. The surface water component of potential exposure is discussed in Section 6.3.

6.2.2 Results

The analytical results for the four groundwater samples are presented in Table 5-6. The screening levels for the radionuclides are included in Table 6-2. These screening levels are appropriate for drinking water rather than for shallow groundwater at the SIW Site. Although there is no intention of, or likelihood for, human consumption or exposure in the future. Drinking water screening levels were selected as conservative values. The groundwater eventually is discharged into the Kill Van Kull. With the exception of Ra-228 in GW-10-1220, the isotope-specific activity data in Table 5-6 are below the appropriate screening levels. The Ra-228 result of 5.83 picocuries per liter (pCi/L) from GW-10-1220 was slightly higher than the screening level of 5 pCi/L.

The water quality parameters collected during groundwater sampling are presented in Table 5-5. In order to perform analyses for gross alpha and gross beta on the SIW Site groundwater samples, a very small volume of water could be used for evaporation in preparation for alpha and beta counting. The effect of this factor results in very high values of sample specific detection limits [reported as Minimal Detectable Concentrations (MDCs) in Table 5-6], approximately 50 times higher than typical. Gross alpha was not detected at this high MDC in GW-06-1205 but likely would have been detected at typical MDCs. Due to the high MDCs reported for the gross alpha samples, more credibility should be placed on the isotopic results than the gross alpha values.

The gross beta results for the samples exceed the respective uncertainties and MDCs with magnitudes between approximately 100 and 800 pCi/L. This range of concentrations is greater than the 50 pCi/L threshold level for gross beta results that USEPA uses as a trigger for analyzing samples for specific beta emitters. However, the 50 pCi/L threshold applies to drinking water. The sampled groundwater has no foreseeable use as drinking water and is likely significantly mixed with saline water from the Kill Van Kull. Also, due to the amount of solids present in the dried samples, it is reasonable to conclude that a significant portion of gross beta activity is the result of K-40 (a naturally occurring radionuclide). While the specific activity affected by K-40 cannot be quantified, it is potentially significant in regard to beta counts. It is reasonable to assume that both the gross alpha and beta results presented in Table 5-6 do not warrant concern for potential risk to human health and the environment.

6.3 SURFACE WATER EXPOSURE PATHWAY

Surface water does not exist on the SIW Site; however, it is bordered along its northern and western boundaries by the Kill Van Kull waterway. It is noted in USACE (2021b) that significant erosion occurs along the northwest portion of the SIW Site. This is evident in aerial photographs and was confirmed during the 2021 SSI fieldwork. Photographs from previous investigations show the known area of contamination to extend to the areas impacted by erosion and/or tidal influences. Wind, river inflow, and tidal influences commonly cause the water current and sediment flows in the Kill Van Kull to switch directions (Chant 2001).

6.3.1 Targets

The Kill Van Kull is an interstate water body and is classified by the NYSDEC as Class SD (NYCDEP 2021). The usage of Class SD saline surface waters is fishing, so SD waters should be suitable for fish survival. It is also classified by the state of New Jersey as impaired (contamination exceeds New Jersey water quality standards for dioxin, pesticides, PAH, and polychlorinated biphenyls) and SE3 [Surface Water Quality Standards – New Jersey Administrative Code 7:9B (New Jersey 2016)]. The designated uses of SE3 saline waters of estuaries are: secondary contact recreation, maintenance and migration of fish populations, migration of diadromous fish, maintenance of wildlife, and other reasonable uses. Previous reports of the Kill Van Kull area indicate petroleum spills and other chemical contamination (New Jersey Department of Environmental Protection 2006). The Kill Van Kull is not a source of public drinking water.

6.3.2 Results

In Section 6.2.2, the analytical results of four groundwater samples obtained during the 2021 SSI are described. Available compositional evidence indicates that groundwater at these locations has been impacted by leaching and transport of radionuclides associated with soil contamination at the SIW Site. This observation also supports the conclusion that possible discharge of potentially radionuclide contaminated groundwater to the Kill Van Kull waterway may occur.

Based on the data presented in Section 6.1.2, there is evidence of radiological contamination in surface soils that poses a potential threat of release (via erosion and/or transport) into the surface water. However, it cannot be determined at this time, based on available evidence, if the slightly elevated concentrations of several radionuclides in surface soils on the beach exposed at low tide are indicative of a broader release issue.

6.4 DATA ASSESSMENT

The analytical data collected during the SSI (located in Appendix D) were evaluated for quality, accuracy, precision, comparability, sensitivity, representativeness, and completeness. Field QC samples analyzed include field duplicates and MS/MSD sample pairs. Laboratory QC samples include laboratory control samples, laboratory control sample duplicates, and method blanks. Results of the field and laboratory QC sample analysis are provided in the project QCSR (Appendix B).

A summary of the QC results for the soil and groundwater samples that were collected as part of the 2021 SSI fieldwork activities can be found in the project QCSR (Appendix B). The results of the laboratory and field QC sample analyses presented in the QCSR indicate that, overall, the laboratory conducted the field analyses with acceptable accuracy, precision, comparability, sensitivity, representativeness, and completeness for the radionuclides and chemicals of interest.

Validation of the analytical data was performed by subject matter experts and the data validation report can be found in Appendix B. The gamma U-238 result based on the Th-234 gamma result for three samples (SS-DUP-17, TS-02-0002, and TS-02-0304) were rejected due to incomparable alpha and beta U-238 results, however, the U-238 results using alpha spectroscopy were accepted as usable data and were used for evaluation against soil screening levels. There were no other major issues identified by the validation.

7. SUPPLEMENTAL INFORMATION

7.1 EROSION EVALUATION

As part of the 2021 SSI, an evaluation of shoreline erosion of the SIW Site (specifically the SCA) was completed and shows a significant rate of erosion along the Kill Van Kull waterway. The shoreline discussed in this SSI Report is elevated and heavily vegetated (Figure 7-1). As indicated in previous inspections, the shoreline is eroding to the southeast and undercutting a majority of the elevated area along the northern edge of the SCA during tidal change (Figure 7-2). A sample from SB-17, located in the undercut section of the shoreline, yielded one of the higher elevated readings for U-235 surface soil exceedances (Figure 6-6).

The retreating shoreline could lead to the contaminants from the SCA to be displaced into the Kill Van Kull waterway. A comparison of a civil survey performed in 1999 (Appendix L2) to the civil and hydrographic survey conducted in 2021 (Appendix L1), confirmed the shoreline erosion. This erosion may be from continuous wave action exacerbated by storm surges during the two hurricanes discussed in Section 3.1. Using historical shoreline data, the shoreline is retreating further south and east within the elevated radiological boundary (Figure 7-3). Historical evidence combined with the current rate of erosion indicate that the elevated shoreline will likely erode a majority of the vegetated area of the SCA.

As previously referenced, the SIW Site was a manmade pier built circa 1830 (USACE 2017) and is shown in an 1844 National Oceanic and Atmospheric Administration (NOAA) navigational chart as a singular, rectangle pier (Figure 7-4). The physical shape of the SIW Site has changed over time and appears to be correlated with the building structures added to, and removed, from the property. The width of the pier seemed to increase by 1887, likely due to fill brought in to form a structural foundational for site buildings. The first evidence of buildings at the SIW Site are shown in an 1887 NOAA navigational chart (Figure 7-5). The width of the pier seemed to increase as buildings are erected on the SIW Site and the adjacent property to the east. These buildings are further detailed in the 1898 Sanborn Fire Insurance Map (Figure 7-6). By 1900, the SIW Site had a rigid, well-defined shape strengthened by the timber sheet pile bulkheads.

By 1917, a small shed was added to the western area of the SIW Site on fill material and a thin, elongated pier was built to the east of the SIW Site (Figure 7-7). For this SSI, it was not determined if the shed was built on artificial fill or natural fill brought in by longshore drift. In an aerial photograph taken in 1924, it appears as if the area between the SIW Site and the pier to the east of the SIW Site was filled in. The small shed to the west of the SIW Site is no longer there, and silos/tanks are shown (Figure 7-8). In a 1938 Sanborn Fire Insurance Map (Figure 7-9), a storage building is shown on the western section of the SIW Site fill area where the shed was observed in Figure 7-7.

An aerial photograph from 1944, clearly showed the silos/tanks, storage building on the western side of the SIW Site, and the well-defined shape of the SIW Site which protrudes into the Kill Van Kull waterway (Figure 7-10). Prior to 1951, two of the silos/tanks were removed; however, industrial activity conducted at the SIW Site appears to continue as in previous years (Figure 7-11). The aerial photographs published from 1940 (Figure 2-3), 1944 (Figure 7-10), and 1951 (Figure 7-11), illustrate that barges and other types of vessels were docking immediately adjacent to the shore on the northern and western sides of the peninsula. By 1970, all but two of the buildings have been removed and there appeared to be substantial fill to the east of the SIW Site (Figure 7-12). The timbers used to strengthen the SIW Site still appear intact in 1970 (Figure 7-12).

Prior to 1980, all of the buildings on the SIW Site were removed (Figure 7-13). Comparing Figure 7-13 to Figure 2-5, there is a noticeable change in the defining shape of the SIW Site's northwest and southwest corners, most likely due to deterioration of some of the timber crib bulkheads, leading to erosion. Later photographs (first clearly observed in Figure 2-5, from 1988) indicate that the northern shoreline of the constructed peninsula, extending into the Kill Van Kull waterway, is no longer as sharply defined as earlier photographs.

From 2001 to 2010, and from 2010 to 2018, there was a significant impact due to erosion on the SIW Site, particularly along the northern and northwestern shoreline (Figures 7-13 and 7-14, respectfully). Reference markers and line segments were used to demonstrate the erosional effect on the Kill Van Kull and SIW Site shoreline for Figures 7-13 and 7-14. With respect to the northern edge of the SIW Site (Figure 7-14), from 2001 to 2018, there was approximately 150% increase in beach area between the reference markers and the northwest shoreline and a 200% increase in the northeastern edge of the shoreline. Between 2001 and 2010 in the northwestern section of the SIW Site , there was approximately 50% increase in beach area between the reference markers and the shoreline (Figure 7-15). Between 2010 to 2018, there was approximately 100% increase in beach area between the reference markers and the shoreline (Figure 7-15).

While there appears to be significant increase in shoreline erosion due to major storms in the SIW Site area (i.e., Hurricane Irene and Hurricane Sandy), it is also clear that since 1980 and the removal of building structures, there has been significant erosional impact at the SIW Site. During the 2011 SI and the 2021 SSI fieldwork, foundation pillars (brick and concrete) for buildings that had been on the SIW Site, were partially uncovered along the northwestern section of the SIW Site. The semi-exposed structures along the undercut shoreline (Figure 7-2), likely are slowing the effects of shoreline erosion. Soil boring cores, test pit excavation, drilling refusal, and drilling equipment damage at approximately 3 to 4-feet along the SIW Site's northwestern shoreline, indicate the presence of multiple foundation pillars. While the pillars may be slowing the effects of erosion, the evidence shown indicate that erosion will continue along the shoreline. Boring logs and geotechnical sampled data from the 2021 SSI fieldwork confirm previous lithological descriptions of a mostly clayey sand, which has the potential for increased rates of erosion.

Historical evidence indicates erosion has contributed to the depletion of the vegetated area of the SCA beginning in the early 1980s. The shoreline in Figure 5-1 shows that during high tides, a portion of the elevated radiological boundary is underwater. There is reasonable risk that contamination known to be in the SCA of the SIW Site is exposed to the Kill Van Kull. Erosion is expected to continue removing soils from the SCA, exposing higher levels of contamination to be transported by the Kill Van Kull tide.

7.2 RADIOLOGICAL ANALYSIS

7.2.1 Evaluation of Uranium Present within the Staten Island Warehouse Site

In terms of radioactivity contribution, natural uranium is composed of 48.6, 2.2 and 49.2% U-238, U-235, and U-234, respectively (Minteer et al 2007). As such, the U-238 to U-234 radioactivity ratio for natural uranium of 0.98 (i.e., 48.6 divided by 49.6) is expected.

Although depleted uranium concentrations are subject to some variability, activity concentrations of U-234, U-235, and U-238 are typically on the order of 8.4, 1.45, and 90.14%, respectively. Given that both U-235 and U-234 are extracted from natural uranium during the enrichment process, the residual concentrations of these isotopes present in depleted uranium result in activity ratios of U-238 to U-234 and U-238 to U-235 of 10.7 and 62.2, respectively. Comparing these activity ratios from natural uranium and depleted uranium, the ratio of U-238 to U-234 would change by a factor of about 10.9 (from 0.98 to 10.7) while the ratio of U-238 to U-235 would change by a factor of about 2.9 (from 21.7 to 62.2).

As noted above, concentrations of U-234 and U-238 in natural uranium are similar and are present at over 20 times the U-235 concentration. As such, U-234 and U-238 concentrations are commonly used when evaluating isotopic ratios based on activity concentrations from radiological analysis (e.g., alpha spectrometry) to determine whether individual samples contain natural, depleted, or enriched uranium. Activity concentrations of U-235 are commonly present at levels below applicable lower limits of detection such that the data does not lend itself to detailed statistical analysis.

Calculation of U-238 to U-234 ratios for SIW Site surface soil samples collected in September 2021, reflect ratios ranging from 0.78 ± 0.22 to 1.35 ± 0.23 with a mean of 1.08 and a mean value for total propagated uncertainty of 0.26. (Table 7-1). Similarly, for subsurface soils U-238 to U-234 ratios ranged from 0.87 ± 0.16 to 1.46 ± 0.36 with a mean of 1.06 and a mean value of the total propagated uncertainty of 0.22. (Table 7-2). Although the U-238 to U-234 ratios are slightly higher than the 2011 SI samples, the average ratios with the total propagated uncertainty are within the expected range for natural uranium and it is reasonable to conclude that uranium present at the SIW Site is natural uranium.

7.2.2 Evaluation of Radium Present within the Staten Island Warehouse Site

Given the absence of significant contaminant migration as a result of differences in solubility, Ra-226 (being a member of the naturally occurring U-238 decay series) decays with the same apparent activity concentration as the uranium parent. Comparison of U-238 and Ra-226 activity concentrations in surface soils reflects U-238 to Ra-226 ratios ranging from 0.51 ± 0.49 to 6.7 ± 0.48 with a mean value of 1.17 and a mean value of uncertainty of 0.25 (Table 7-1). The upper bound ratio of 6.7 may be representative of an outlier, as the next highest ratio for surface soils is 1.78 ± 0.16. Similarly, the U-238 to Ra-226 activity ratios in subsurface soils ranged from 0.21 ± 0.09 to 2.21 ± 0.30 with a mean value of 1.02 and a mean value of uncertainty of 0.22 (Table 7-2). Ra-226 activity concentrations are commonly more variable than those of U-238 due to a lack of homogeneity resulting from specific activity differences and differences in solubility. The mean ratios of U-238 to Ra-226 are 1.17 and 1.02 in surface and subsurface soils, respectively. The overall ratio is within the range that would be expected for uranium ore. The results are consistent with results obtained in the 2011 SI samples.

7.3 EXCAVATION DESIGN ANALYSIS

Typical ground pressure estimates for various excavators are given in Table 7-3. Given that no issues were encountered during the geotechnical/environmental investigation, the use of a mini excavator for site remedial work is unlikely to cause soil failure issues. A mid-sized excavator, such as a CAT 330L, is also unlikely to cause soil failure, even with a safety factor of 2.5 (ground pressure of 19 psi). The larger excavators may prove to be too heavy; however, they may also require too large of an area to make them useful for the restricted size of the site.

As part of the geotechnical analysis, samples were collected to obtain Atterberg Limits (Table 7-4), Unconfined Pressure Test Levels (Table 7-5), and Sieve Analysis/Grain Size Distribution (Table 7-6). The results of these tests indicate a moderately strong soil structure, despite the moisture and sand quantity located in the SCA.

Additional site preparation is recommended if material is excavated and removed using tandem-axle dump trucks. A fully loaded tandem-axle dump truck would have a ground pressure over 100 psi, depending upon the weight of the load. This would likely cause severe rutting that may cause the truck to get stuck.

The above analysis and options are based on geotechnical conditions in the area and data obtained from site exploration. Variations could occur between exploration locations or be caused by the modifying effects of construction or weather. At the time of the 2021 SSI fieldwork, the current tenant had made physical changes to the SIW Site, including material fill and a 6-inch concrete slab on the southern portion of the SCA, concrete block walls along the southern and eastern portion of the SCA, and staging of a large concrete batch plant, and erected other building structures on the property. Future removal actions will need to account for these obstructions.

8. CONCLUSION

The 2021 SSI fieldwork included performing a radiological survey (gamma walkover scan of surface and boreholes, radionuclide sampling of surface and subsurface soils, sediment, and groundwater), excavating test pits, chemical waste characterization sampling (including metals, SVOCs, and VOCs), a geotechnical study, and an erosion study. Conclusions for these SSI elements are discussed below.

8.1 RADIOLOGICAL SURVEY

The surface gamma scans confirmed the presence of elevated (above background levels) radionuclide activity in an approximate 100-feet by 200-feet area in the northwest section of the SIW Site, described earlier as the SCA. As noted in the report the area of above background gamma levels is slightly shifted laterally to the southwest and northeast as related to previous investigations. With this minor difference, the area of radiological contamination is similar to that identified in previous investigations.

Borehole logging, test pits, surface soil sampling, sediment sampling, and subsurface soil sampling confirm that the above screening levels of radiological contamination exists in soil only and is contained within the upper 5-feet bgs and within the elevated gamma scan area.

Shallow groundwater samples (except for Ra-228 in one sample) are below the project screening levels. The Ra-228 result of 5.83 picocuries per liter (pCi/L) from GW-10-1220 was slightly higher than the screening level of 5 pCi/L. The volume of water collected for gross alpha and beta analysis resulted in higher than typical values of sample MDC, approximately 50 times higher than typical. Due to this high MDC for the gross alpha samples, more credibility should be placed on the isotopic results than the gross alpha values. The gross beta results for the samples exceed the MDC with magnitudes between approximately 100 and 800 pCi/L. This range of concentrations is greater than the 50 pCi/L project screening level for gross beta emitters. However, the 50 pCi/L screening level applies to drinking water. The sampled groundwater has no foreseeable use as drinking water and is likely significantly mixed with saline water from the Kill Van Kull. The radiological survey sample data, collected and analyzed during the 2021 SSI, was validated and determined to be useable.

8.2 CHEMICAL WASTE CHARACTERIZATION

Waste characterization samples were collected from the four test pits and were analyzed for RCRA metals, SVOCs, and VOCs. The majority of results for organic constituents (SVOCs and VOCs) were non-detects. In general, other than lead, which could be attributed to nearby facilities that would suggest higher than normal concentration of lead, (e.g., leaded gasoline, leaded paint, etc.), there is no reason to expect association between non-radiological contamination at the SIW Site and the uranium ore that was stored there during the early 1940s. The presence of these constituents is consistent with fuel spills that may have occurred at the industrial site, or a nearby lead manufacturing facility which was fully operational from 1839 to 1943. Several SVOC analytes were detected in soil samples and are considered to be common laboratory contaminants rather than characteristic of SIW Site contamination.

8.3 GEOTECHNICAL STUDY

A geotechnical analysis was performed to determine structural stability of the pier and its ability to support heavy construction equipment. As part of the geotechnical analysis, samples were collected to obtain Atterberg Limits, Unconfined Pressure Test Levels, and Sieve Analysis/Grain Size Distribution. The results of these tests indicate a moderately strong soil structure, despite the moisture and sand quantity located in the SCA. The equipment used during the geotechnical/environmental investigation (drill rig and mini excavator) did not cause observable failures to the soil at an estimated ground pressure of 5 psi. The soil pit excavations extended through the soil to a depth of approximately 6-feet bgs. Given that no issues were encountered during the geotechnical/environmental investigation and results of the geotechnical testing of samples collected from soil borings, the use of a mini- or mid-sized excavator for any future remedial work at the SIW Site is unlikely to cause soil failure issues. A mid-sized excavator, such as a CAT 330L, is also unlikely to cause soil failure, even with a safety factor of 2.5 (ground pressure of 19 psi). Additional site preparation is recommended for removal of excavated material dependent upon the size of equipment being used.

8.4 EROSION STUDY

Beach erosion has occurred along the northwestern and northern edge of the site, suggesting that some radionuclide-contaminated soil may be gradually transported from the SIW Site into the near-shore environment of the Kill Van Kull. A significant increase in shoreline erosion was observed due to major storms in the SIW Site area (i.e., Hurricane Irene and Hurricane Sandy), and erosional impacts have occurred at the SIW Site since the removal of building structures prior to 1980. Soil boring cores, test pit excavation, drilling refusal, and drilling equipment damage at approximately 3 to 4-feet along the SIW Site's northwestern shoreline, indicate the presence of multiple foundation pillars. While the pillars may be slowing the effects of erosion, the evidence shown indicate that erosion will continue along the shoreline, further exposing higher levels of contamination to be transported by the Kill Van Kull tide.

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TABLES

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Table 5-1. Results of Surface Soil Samples (by Gamma Spectroscopy)																		
		Analyte	**Actinium-228 (Radium-228)**				**Bismuth-212**				**Radium-226 (Bismuth-214)**				**Lead-212**			
		CAS#									**13982-63-3**							
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**NA**				**2.294**				**NA**			
		Project Screening Level	**735**				**NA**				**2.294**				**NA**			
		Source of Screening Level	**USEPA 2021 Residential**				**NA**				**USEPA 2008 Background**				**NA**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SS-01-0825	0-0.5	9/24/2021	2.37	J	0.415	0.52	3.18	J	1.29	1.92	**2.76**	J	0.352	0.253	2.66	J	0.305	0.252
SS-02-0835	0-0.5	9/24/2021	1.12	J	0.285	0.455	1.2	J	0.859	1.51	1.09	J	0.209	0.24	1.13	J	0.215	0.253
SS-03-0810	0-0.5	9/24/2021	2.51	J	0.394	0.511	2.58	J	1.1	1.79	2.23	J	0.298	0.268	2.8	J	0.304	0.216
SS-DUP-03	0-0.5	9/24/2021	0.632	J	0.339	0.624	1.15	UJ	1.28	2.43	0.543	J	0.256	0.45	1.47	J	0.231	0.221
SS-04-0926	0-0.5	9/22/2021	0.585	J	0.33	0.745	0.826	UJ	1.31	2.66	**4.6**	J	0.535	0.388	0.142	UJ	0.227	0.411
SS-05-0915	0-0.5	9/22/2021	1.37	J	0.366	0.598	1.44	J	1.37	2.55	**4.05**	J	0.532	0.35	1.61	J	0.266	0.28
SS-06-0936	0-0.5	9/22/2021	1.01	J	0.324	0.558	1.62	J	1.05	1.78	1.31	J	0.255	0.242	1.22	J	0.182	0.173
SS-DUP-06	0-0.5	9/22/2021	0.986	J	0.323	0.519	1.33	J	1.14	2.04	2.08	J	0.321	0.305	1.21	J	0.225	0.28
SS-07-1220	0-0.5	9/22/2021	0.439	J	0.192	0.372	0.83	J	0.665	1.15	0.429	J	0.137	0.198	0.481	J	0.112	0.159
SS-08-1400	0-0.5	9/23/2021	1.84	J	0.361	0.514	1.77	J	1.05	1.78	1.46	J	0.245	0.258	1.75	J	0.234	0.229
SS-09-0840	0-0.5	9/23/2021	1.15	J	0.336	0.594	0.917	UJ	1.1	2.17	1.61	J	0.27	0.313	1.42	J	0.265	0.352
SS-10-0750	0-0.5	9/23/2021	1.75	J	0.421	0.632	0.869	UJ	1.38	2.82	**2.58**	J	0.387	0.377	2.05	J	0.325	0.323
SS-11-1100	3-4.0	9/23/2021	0.812	J	0.273	0.511	1.18	J	0.893	1.54	0.599	J	0.188	0.279	0.805	J	0.177	0.241
SS-12-1115	2-3.0	9/23/2021	0.985	J	0.288	0.402	1.55	J	1.15	2.08	1.24	J	0.255	0.304	1.44	J	0.195	0.167
SS-13-1015	0-0.5	9/27/2021	0.991	J	0.172	0.229	1.26	J	0.556	0.861	1.43	J	0.163	0.139	1.17	J	0.133	0.123
SS-14-1205	1.5-2.5	9/23/2021	0.462	J	0.219	0.465	0.551	UJ	0.795	1.52	0.502	J	0.157	0.228	0.682	J	0.14	0.177
SS-15-1135	1.5-2.0	9/23/2021	0.526	J	0.229	0.467	0.968	J	0.837	1.58	0.978	J	0.193	0.222	0.835	J	0.163	0.196
SS-16-1300	0-0.5	9/23/2021	1.43	J	0.425	0.663	1.39	J	1.59	2.9	**3.34**	J	0.467	0.416	1.26	J	0.272	0.358
SS-17-1230	0-0.5	9/24/2021	1.61	J	0.333	0.546	2.76	J	1.25	2.11	**15.5**	J	1.28	0.308	1.64	J	0.235	0.304
SS-18-1250	0-0.5	9/24/2021	1.02	J	0.257	0.385	1.51	J	0.893	1.49	1	J	0.209	0.22	1.15	J	0.197	0.215
SS-19-1310	0-0.5	9/24/2021	0.893	J	0.151	0.202	1.37	J	0.537	0.819	1.23	J	0.139	0.114	1.3	J	0.133	0.107
SS-20-1020	0-0.5	9/27/2021	0.72	J	0.205	0.328	0.57	UJ	0.705	1.33	0.697	J	0.15	0.187	0.918	J	0.145	0.168
SS-21-1000	0-0.5	9/27/2021	0.486	J	0.134	0.222	0.519	J	0.425	0.716	0.901	J	0.124	0.128	0.669	J	0.095	0.105
SS-22-0935	0-0.5	9/27/2021	0.737	J	0.299	0.566	0.509	UJ	0.956	1.84	1.23	J	0.239	0.25	0.814	J	0.175	0.226
SS-23-1014	0-0.5	9/27/2021	0.592		0.173	0.257	0.771	J	0.555	0.982	0.983		0.156	0.148	0.663		0.119	0.134
SS-24-0941	0-0.5	9/27/2021	0.895	J	0.348	0.585	2.08	J	1.36	2.32	**3.91**	J	0.487	0.347	1.02	J	0.191	0.223
SS-25-0940	0-0.5	9/27/2021	0.671	J	0.209	0.352	0.597	UJ	0.76	1.45	1.99	J	0.263	0.201	0.543	J	0.14	0.179

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021c)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; SS: surface sample; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 5-1. Results of Surface Soil Samples (by Gamma Spectroscopy)																		
		Analyte	**Lead-214**				**Potassium-40**				**Thallium-208**				**Uranium-235**			
		CAS#					**13966-00-2**											
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**18.81**				**NA**				**Below MDA**			
		Project Screening Level	**NA**				**NA**				**NA**				**NA**			
		Source of Screening Level	**NA**				**NA**				**NA**				**NA**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SS-01-0825	0-0.5	9/24/2021	2.88	J	0.331	0.279	6.76	J	1.59	1.74	0.789	J	0.138	0.152	0.35	J	0.106	0.173
SS-02-0835	0-0.5	9/24/2021	1.12	J	0.197	0.217	13.2	J	2.06	1.01	0.271	J	0.095	0.134	0.0995	U	0.086	0.723
SS-03-0810	0-0.5	9/24/2021	2.62	J	0.3	0.25	11	J	1.84	1.79	0.819	J	0.131	0.131	0.37	J	0.104	0.172
SS-DUP-03	0-0.5	9/24/2021	0.795	J	0.223	0.39	1.94	J	1.76	3.1	0.228	J	0.106	0.163	0.0184	U	0.102	0.196
SS-04-0926	0-0.5	9/22/2021	5.57	J	0.581	0.399	9.77	J	2.39	2.65	0.37	J	0.12	0.162	0.466	UJ	0.117	0.715
SS-05-0915	0-0.5	9/22/2021	4.44	J	0.578	0.472	10.3	J	2.07	2.02	0.426	J	0.125	0.176	0.379	J	0.129	0.215
SS-06-0936	0-0.5	9/22/2021	1.3	J	0.211	0.266	14.3	J	2.45	1.52	0.396	J	0.114	0.146	0.15	J	0.072	0.12
SS-DUP-06	0-0.5	9/22/2021	2.41	J	0.312	0.296	7.9	J	1.86	2.02	0.294	J	0.115	0.176	0.263	J	0.117	0.198
SS-07-1220	0-0.5	9/22/2021	0.449	J	0.112	0.162	7.48	J	1.41	1.22	0.176	J	0.064	0.098	0.0267	U	0.049	0.094
SS-08-1400	0-0.5	9/23/2021	1.58	J	0.227	0.247	11.1	J	1.96	1.85	0.402	J	0.1	0.127	0.192	J	0.099	0.171
SS-09-0840	0-0.5	9/23/2021	1.94	J	0.323	0.324	11.9	J	2.23	2.08	0.389	J	0.109	0.139	0.221	U	0.116	0.95
SS-10-0750	0-0.5	9/23/2021	2.49	J	0.386	0.401	10.7	J	2.23	2.14	0.553	J	0.145	0.192	0.33	U	0.122	1.09
SS-11-1100	3-4.0	9/23/2021	0.651	J	0.156	0.239	10.8	J	1.95	1.52	0.228	J	0.09	0.143	0.115	J	0.078	0.139
SS-12-1115	2-3.0	9/23/2021	1.28	J	0.2	0.256	10.5	J	2.07	1.69	0.46	J	0.106	0.11	0.223	J	0.067	0.097
SS-13-1015	0-0.5	9/27/2021	1.51	J	0.156	0.135	12.1	J	1.3	0.8	0.317	J	0.056	0.065	0.164	J	0.063	0.102
SS-14-1205	1.5-2.5	9/23/2021	0.556	J	0.132	0.197	11.1	J	1.82	1.45	0.145	J	0.072	0.123	0.0667	J	0.062	0.115
SS-15-1135	1.5-2.0	9/23/2021	0.697	J	0.165	0.266	13.1	J	2.03	1.1	0.379	J	0.101	0.132	0.126	U	0.071	0.692
SS-16-1300	0-0.5	9/23/2021	4.08	J	0.467	0.384	10.7	J	2.33	2.28	0.306	J	0.126	0.189	0.385	J	0.154	0.26
SS-17-1230	0-0.5	9/24/2021	17.2	J	1.48	0.335	11.1	J	1.77	1.92	0.337	J	0.107	0.174	2.17	J	0.23	0.23
SS-18-1250	0-0.5	9/24/2021	1.3	J	0.203	0.182	9.59	J	1.69	1.04	0.391	J	0.095	0.102	0.228	J	0.086	0.134
SS-19-1310	0-0.5	9/24/2021	1.25	J	0.132	0.122	12.2	J	1.23	0.751	0.283	J	0.05	0.057	0.13	J	0.052	0.086
SS-20-1020	0-0.5	9/27/2021	0.828	J	0.138	0.171	10.6	J	1.57	1.12	0.271	J	0.067	0.084	0.0753	J	0.067	0.123
SS-21-1000	0-0.5	9/27/2021	0.971	J	0.115	0.118	7.6	J	0.99	0.73	0.199	J	0.043	0.053	0.0561	J	0.047	0.081
SS-22-0935	0-0.5	9/27/2021	1.36	J	0.219	0.264	7.55	J	1.77	1.91	0.287	J	0.091	0.128	0.108	J	0.084	0.153
SS-23-1014	0-0.5	9/27/2021	1.19		0.157	0.167	8.28		1.4	1.21	0.279		0.06	0.064	0.202	J	0.221	0.391
SS-24-0941	0-0.5	9/27/2021	4.16	J	0.456	0.332	6.76	J	1.87	1.97	0.329	J	0.117	0.166	0.377	J	0.103	0.154
SS-25-0940	0-0.5	9/27/2021	2.12	J	0.25	0.231	7.58	J	1.54	1.45	0.26	J	0.067	0.079	-0.351	U	0.311	0.603

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021c)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; SS: surface sample; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 5-1. Results of Surface Soil Samples (by Gamma Spectroscopy)																		
		Analyte	**Thorium-234 (U-238)**				**Uranium-234**				**Uranium-235**				**Uranium-238**			
		CAS#					**13966-29-5**				**15117-96-1**				**7440-61-1**			
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**2.524**				**Below MDA**				**2.462**			
		Project Screening Level	**1220**				**5.83**				**0.203**				**6.48**			
		Source of Screening Level	**USEPA 2021 Residential**				**USEPA 2021 Residential**				**USEPA 2021 Residential**				**USEPA 2021 Residential**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SS-01-0825	0-0.5	9/24/2021	2.62	UJ	1.69	3.04	3.45		0.358	0.128	**0.254**		0.103	0.075	3.52		0.356	0.075
SS-02-0835	0-0.5	9/24/2021	0.808	U	1.22	2.37	0.622	J	0.185	0.163	0.0054	U	0.0433	0.08	0.819		0.183	0.091
SS-03-0810	0-0.5	9/24/2021	3.45	U	1.95	2.91	3.43	J	0.365	0.133	0.14	J	0.0863	0.089	3.96		0.383	0.064
SS-DUP-03	0-0.5	9/24/2021	3.17	J	1.39	2.12	3.86		0.411	0.15	0.169		0.095	0.088	3.63		0.396	0.128
SS-04-0926	0-0.5	9/22/2021	2.02	J	1.14	2.09	2.53		0.363	0.238	**0.248**	J	0.112	0.089	2.65		0.345	0.145
SS-05-0915	0-0.5	9/22/2021	-6.81	U	3.18	5.34	2.78	J	0.366	0.161	**0.206**		0.102	0.077	2.8	J	0.356	0.077
SS-06-0936	0-0.5	9/22/2021	1.4	J	0.797	1.63	1.45		0.256	0.164	0.0943		0.0727	0.08	1.2	J	0.219	0.092
SS-DUP-06	0-0.5	9/22/2021	-2.35	U	2.07	4.62	2.77		0.367	0.173	0.0417	J	0.0786	0.118	3.02	J	0.376	0.145
SS-07-1220	0-0.5	9/22/2021	-0.101	U	0.679	1.58	0.719		0.213	0.164	0.0213	U	0.081	0.133	0.81	J	0.205	0.086
SS-08-1400	0-0.5	9/23/2021	-2.27	U	1.72	3.83	1.46		0.232	0.093	0.0317	J	0.0436	0.06	1.59	J	0.238	0.074
SS-09-0840	0-0.5	9/23/2021	1.34	U	1.68	3.48	1.72		0.283	0.139	0.0733	J	0.0723	0.09	1.99		0.298	0.114
SS-10-0750	0-0.5	9/23/2021	1.51	U	1.98	4.26	2.17		0.335	0.204	**0.212**		0.107	0.092	2.35		0.335	0.158
SS-11-1100	3-4.0	9/23/2021	0.694	UJ	1.08	2.28	0.784	J	0.241	0.177	0.0912	J	0.0887	0.106	0.8		0.235	0.148
SS-12-1115	2-3.0	9/23/2021	1.04	UJ	0.7	1.58	0.939	J	0.21	0.151	0.0049	U	0.0575	0.1	0.988		0.198	0.09
SS-13-1015	0-0.5	9/27/2021	0.364	U	0.745	1.7	0.813		0.199	0.169	0.0394	J	0.0458	0.058	0.866	J	0.19	0.132
SS-14-1205	1.5-2.5	9/23/2021	-0.23	U	0.823	1.97	0.324	J	0.119	0.121	0.0019	UJ	0.0224	0.044	0.258	J	0.096	0.087
SS-15-1135	1.5-2.0	9/23/2021	1.7	J	1.34	2.55	0.628		0.229	0.228	0.0345	J	0.0574	0.087	0.838		0.221	0.145
SS-16-1300	0-0.5	9/23/2021	-5.03	U	2.96	6.01	1.82		0.324	0.23	0.101	J	0.0767	0.078	2.09		0.326	0.176
SS-17-1230	0-0.5	9/24/2021	12.3	J	4.51	4.29	**24.9**		1.02	0.111	**1.19**	J	0.226	0.072	**24.9**	J	1.02	0.088
SS-18-1250	0-0.5	9/24/2021	-0.109	U	1.12	2.55	1.03		0.218	0.171	0.0309	J	0.0429	0.059	1.18		0.217	0.133
SS-19-1310	0-0.5	9/24/2021	1.45	UJ	0.912	1.46	0.962		0.193	0.158	0.0521	J	0.0679	0.093	0.955		0.182	0.132
SS-20-1020	0-0.5	9/27/2021	-0.599	U	0.983	2.37	1.04		0.222	0.145	0.037	J	0.0581	0.085	0.995	J	0.204	0.085
SS-21-1000	0-0.5	9/27/2021	0.477	U	0.625	1.34	0.669		0.185	0.16	0.033	J	0.0522	0.076	0.678	J	0.179	0.141
SS-22-0935	0-0.5	9/27/2021	-0.062	U	1.04	2.48	0.869		0.241	0.22	0.0179	U	0.0442	0.075	0.925		0.226	0.169
SS-23-1014	0-0.5	9/27/2021	0.877	UJ	0.604	1.21	0.61		0.209	0.209	0.0702	J	0.063	0.071	0.771	J	0.203	0.16
SS-24-0941	0-0.5	9/27/2021	1.47	UJ	0.934	1.94	2.11		0.316	0.188	0.0692	J	0.062	0.07	2.14	J	0.3	0.108
SS-25-0940	0-0.5	9/27/2021	1.7	U	0.908	1.51	0.932		0.209	0.141	0.0669	J	0.0665	0.083	1.14		0.223	0.121

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021c)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; SS: surface sample; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 5-2. Results of Subsurface Soil Samples (Alpha and Gamma Spectroscopy)																		
		Analyte	**Actinium-228 (Ra-228)[1]**				**Bismuth-212[1]**				**Raduim-226 (Bismuth-214)[1]**				**Lead-212[1]**			
		CAS#									**13982-63-3**							
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**NA**				**2.294**				**NA**			
		Project Screening Level	**735**				**NA**				**2.294**				**NA**			
		Source of Screening Level	**USEPA 2021 Residential**				**NA**				**USEPA 2008 Background**				**NA**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SB-01-0102	1-2	9/24/2021	0.929	J	0.289	0.388	1.6	J	1.08	1.78	0.788	J	0.206	0.241	0.94	J	0.207	0.258
SB-01-0501	0.5-1	9/24/2021	1.45	J	0.383	0.584	2.69	J	1.29	1.94	1.14	J	0.275	0.369	1.66	J	0.268	0.263
SB-DUP-01	0.5-1	9/24/2021	1.51	J	0.43	0.651	2.39	J	1.39	2.26	1.13	J	0.298	0.389	1.56	J	0.269	0.272
SB-02-0102	1-2	9/24/2021	1.08	J	0.204	0.301	1.35	J	0.62	1.02	1.03	J	0.158	0.172	0.873	J	0.137	0.178
SB-02-0501	0.5-1	9/24/2021	1.27	J	0.225	0.278	1.84	J	0.75	1.28	1.1	J	0.155	0.164	1.3	J	0.174	0.202
SB-DUP-02	0.5-1	9/24/2021	1.13	J	0.285	0.427	2.18	J	1.03	1.73	1.13	J	0.212	0.224	1.09	J	0.216	0.266
SB-03-0102	1-2	9/24/2021	1.91	J	0.354	0.466	1.82	J	1.09	1.9	1.46	J	0.258	0.302	1.9	J	0.246	0.214
SB-03-0815	0.8-1.5	9/24/2021	1.72	J	0.391	0.609	0.0268	UJ	1.15	2.28	1.47	J	0.271	0.316	1.67	J	0.239	0.251
SB-04-0102	1-2	9/22/2021	1.86	J	0.449	0.732	1.88	J	1.34	2.45	**3.59**	J	0.44	0.379	1.18	J	0.317	0.495
SB-04-0406	4-6	9/22/2021	1.04	J	0.367	0.678	1.56	J	1.43	2.73	1.07	J	0.275	0.396	1.03	J	0.283	0.425
SB-05-0505	0.5-5	9/22/2021	1.19	J	0.299	0.409	2.3	J	1.02	1.52	1.47	J	0.254	0.26	1.2	J	0.174	0.164
SB-05-0510	5-10	9/22/2021	1.12	J	0.228	0.358	0.767	J	0.78	1.42	1.2	J	0.184	0.198	1.19	J	0.162	0.18
SB-06-0203	2-3	9/22/2021	1.08	J	0.292	0.476	1.42	J	0.976	1.65	**3.06**	J	0.407	0.247	1.41	J	0.237	0.246
SB-06-0501	0.5-1	9/22/2021	1.23	J	0.322	0.491	2.11	J	1.05	1.65	**5.69**	J	0.539	0.264	1.47	J	0.19	0.179
SB-07-0102	1-2	9/22/2021	1.27	J	0.196	0.261	1.85	J	0.618	0.905	**2.86**	J	0.254	0.144	1.64	J	0.165	0.139
SB-07-0203	2-3	9/22/2021	0.837	J	0.27	0.457	1.53	J	0.92	1.51	1.33	J	0.229	0.195	0.89	J	0.155	0.17
SB-08-0102	1-2	9/23/2021	1.32	J	0.283	0.376	1.55	J	0.966	1.59	1.19	J	0.22	0.201	1.63	J	0.238	0.185
SB-09-0117	1-1.7	9/23/2021	1.52	J	0.406	0.649	2.81	J	1.45	2.46	1.35	J	0.293	0.408	1.75	J	0.29	0.287
SB-09-0506	5-6	9/23/2021	1.48	J	0.35	0.445	2.04	J	1.28	2.25	1.79	J	0.285	0.255	1.51	J	0.239	0.274
SB-10-0465	4-6.5	9/23/2021	0.935	J	0.285	0.483	0.281	UJ	0.933	1.9	1.09	J	0.22	0.262	1.07	J	0.182	0.217
SB-10-0517	0.5-1.7	9/23/2021	2.31	J	0.484	0.711	3.43	J	1.49	2.55	**2.64**	J	0.383	0.366	3.04	J	0.413	0.3
SB-11-0405	4-5	9/23/2021	2.02	J	0.265	0.325	2.15	J	0.794	1.23	1.9	J	0.211	0.18	1.92	J	0.197	0.179
SB-11-0506	5-6	9/23/2021	1.38	J	0.346	0.515	1.16	J	1.08	1.93	1.08	J	0.246	0.303	1.4	J	0.225	0.258
SB-DUP-11	4-5	9/23/2021	5.04	J	0.773	0.722	4.96	J	2.31	3.85	**3.8**	J	0.549	0.451	4.71	J	0.534	0.331
SB-12-0304	3-4	9/23/2021	0.854	J	0.307	0.512	1.35	J	1.04	1.77	**3.39**	J	0.462	0.26	0.942	J	0.216	0.283
SB-12-0506	5-6	9/23/2021	1.56	J	0.362	0.515	1.13	UJ	1.2	2.33	1.76	J	0.285	0.31	1.82	J	0.277	0.258
SB-14-0608	6-8	9/23/2021	2.73	J	0.317	0.333	3.73	J	0.937	1.21	**2.44**	J	0.255	0.206	3.05	J	0.275	0.201
SB-14-2540	2.5-4	9/23/2021	1.34	J	0.299	0.397	0.354	UJ	0.948	1.92	**2.35**	J	0.315	0.23	1.29	J	0.182	0.164
SB-15-0406	4-6	9/23/2021	2.12	J	0.415	0.453	1.96	J	1.26	2.24	**2.35**	J	0.334	0.316	2.06	J	0.285	0.308
SB-15-0608	6-8	9/23/2021	1.36	J	0.232	0.277	1.1	J	0.737	1.36	0.942	J	0.15	0.189	1.13	J	0.164	0.199
SB-16-0235	2-3.5	9/23/2021	1.43	J	0.346	0.502	2.21	J	1.14	1.81	1.34	J	0.267	0.298	1.33	J	0.199	0.197
SB-DUP-16	2-3.5	9/23/2021	1.25	J	0.311	0.465	0.478	UJ	0.984	1.89	1.07	J	0.231	0.258	1.53	J	0.241	0.229
SB-17-0102	1-2	9/24/2021	2.21	J	0.577	0.99	1.14	UJ	2.17	3.95	**19.8**	J	1.64	0.526	1.59	J	0.353	0.501
SB-DUP-17	1-2	9/24/2021	1.72	J	0.407	0.665	2.39	J	1.4	2.39	**9.7**	J	0.846	0.329	2.25	J	0.297	0.335
SB-18-0102	1-2	9/24/2021	1.11		0.219	0.289	1.29		0.64	1.08	1.22		0.173	0.142	1.05		0.147	0.136
SB-19-0102	1-2	9/24/2021	0.83	J	0.272	0.452	1.21	J	0.865	1.47	1.14	J	0.219	0.214	1.19	J	0.172	0.161
SB-19-0203	2-3	9/24/2021	1.08	J	0.289	0.413	1.4	J	1.07	1.89	0.991	J	0.235	0.282	1.18	J	0.179	0.18
SB-23-0102	1-2	9/27/2021	1.07	J	0.496	0.971	0.924	UJ	1.73	3.39	**3.85**	J	0.56	0.502	0.963	J	0.292	0.445
SB-DUP-23	1-2	9/27/2021	0.864	J	0.339	0.597	0.613	UJ	1.28	2.52	**2.76**	J	0.405	0.367	0.734	J	0.228	0.343
SB-24-0102	1-2	9/27/2021	2.97	J	0.385	0.382	3.18	J	1.03	1.54	**2.64**	J	0.309	0.236	3.11	J	0.311	0.186

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

[1]: by gamma spectrometry; [2]: by alpha spectrometry; 2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; R: rejected; SB: soil boring; U: not detected at the assocated level; USEPA: U.S. Environmental Protection Agency; *The DUP is a field duplicate of the preceding sample

Table 5-2. Results of Subsurface Soil Samples (Alpha and Gamma Spectroscopy)																		
		Analyte	Lead-214[1]				Potassium-40[1]				Thallium-208[1]				Uranium-235[1]			
		CAS#					13966-00-2											
		Units	pCi/g				pCi/g				pCi/g				pCi/g			
		Background Soil	NA				18.81				NA				Below MDA			
		Project Screening Level	NA				NA				NA				0.203			
		Source of Screening Level	NA				NA				NA				USEPA 2021 Residential			
Sample ID	Depth (ft bgs)	Sample Date	Result	Qual	2σ	MDA	Result	Qual	2σ	MDA	Result	Qual	2σ	MDA	Result	Qual	2σ	MDA
SB-01-0102	1-2	9/24/2021	0.939	J	0.188	0.216	7.54	J	1.78	1.41	0.287	J	0.098	0.122	0.144	J	0.101	0.175
SB-01-0501	0.5-1	9/24/2021	1.07	J	0.255	0.508	6.56	J	1.7	1.67	0.48	J	0.134	0.177	0.131	J	0.102	0.187
SB-DUP-01	0.5-1	9/24/2021	1.02	J	0.271	0.551	8.19	J	2.05	1.83	0.46	J	0.15	0.213	0.181	J	0.111	0.198
SB-02-0102	1-2	9/24/2021	1.12	J	0.148	0.164	7.5	J	1.37	1.79	0.367	J	0.07	0.086	0.0332	U	0.051	0.442
SB-02-0501	0.5-1	9/24/2021	1.22	J	0.185	0.195	15.1	J	1.7	0.865	0.487	J	0.082	0.084	0.174	U	0.071	0.615
SB-DUP-02	0.5-1	9/24/2021	1.36	J	0.219	0.2	13.9	J	2.11	0.994	0.484	J	0.105	0.102	0.1	U	0.093	0.739
SB-03-0102	1-2	9/24/2021	1.78	J	0.247	0.271	8.77	J	1.78	1.87	0.58	J	0.117	0.128	0.183	J	0.096	0.174
SB-03-0815	0.8-1.5	9/24/2021	1.65	J	0.237	0.26	4.68	J	1.43	1.77	0.496	J	0.116	0.144	**0.205**	J	0.091	0.156
SB-04-0102	1-2	9/22/2021	4.58	J	0.553	0.376	11.1	J	2.33	2.53	0.455	J	0.138	0.197	**0.507**	U	0.152	1.15
SB-04-0406	4-6	9/22/2021	1.31	J	0.316	0.405	14	J	2.83	2.78	0.338	J	0.13	0.192	**0.236**	U	0.137	1.2
SB-05-0505	0.5-5	9/22/2021	1.7	J	0.228	0.25	10.6	J	1.99	1.56	0.432	J	0.106	0.128	**0.211**	J	0.073	0.114
SB-05-0510	5-10	9/22/2021	1.49	J	0.183	0.195	11.4	J	1.59	1.3	0.332	J	0.078	0.101	0.124	J	0.074	0.129
SB-06-0203	2-3	9/22/2021	3.05	J	0.391	0.247	8.6	J	1.7	1.4	0.418	J	0.099	0.105	**0.358**	J	0.115	0.176
SB-06-0501	0.5-1	9/22/2021	6.02	J	0.55	0.24	10.5	J	1.76	1.6	0.548	J	0.112	0.142	**0.62**	J	0.106	0.135
SB-07-0102	1-2	9/22/2021	2.96	J	0.257	0.152	10.8	J	1.2	0.802	0.412	J	0.065	0.074	**0.296**	J	0.075	0.115
SB-07-0203	2-3	9/22/2021	1.15	J	0.188	0.25	9.3	J	2	2.06	0.226	J	0.087	0.13	0.0878	U	0.29	0.53
SB-08-0102	1-2	9/23/2021	1.34	J	0.213	0.214	11.5	J	1.87	1.18	0.37	J	0.096	0.113	**0.204**	J	0.088	0.144
SB-09-0117	1-1.7	9/23/2021	1.5	J	0.287	0.384	11.1	J	2.2	1.44	0.454	J	0.144	0.208	**0.238**	U	0.112	1.05
SB-09-0506	5-6	9/23/2021	1.87	J	0.269	0.312	8.93	J	2.06	1.92	0.597	J	0.138	0.161	0.15	U	0.078	0.615
SB-10-0465	4-6.5	9/23/2021	1.16	J	0.191	0.251	16.2	J	2.5	1.29	0.409	J	0.109	0.136	0.0877	U	0.066	0.507
SB-10-0517	0.5-1.7	9/23/2021	2.35	J	0.367	0.415	9.04	J	1.95	1.75	0.833	J	0.177	0.221	**0.222**	U	0.123	1.13
SB-11-0405	4-5	9/23/2021	1.91	J	0.2	0.191	10.6	J	1.37	1.08	0.699	J	0.093	0.089	0.187	J	0.076	0.129
SB-11-0506	5-6	9/23/2021	1.2	J	0.204	0.239	13	J	2.26	1.86	0.352	J	0.11	0.163	**0.241**	J	0.089	0.144
SB-DUP-11	4-5	9/23/2021	4.31	J	0.528	0.397	19.7	J	3.45	2.35	1.62	J	0.263	0.229	**0.608**	J	0.157	0.226
SB-12-0304	3-4	9/23/2021	3.34	J	0.437	0.303	8.8	J	1.92	1.68	0.163	J	0.098	0.155	**0.278**	J	0.129	0.214
SB-12-0506	5-6	9/23/2021	1.64	J	0.269	0.299	11.3	J	2.05	1.83	0.605	J	0.134	0.166	0.196	U	0.098	0.913
SB-14-0608	6-8	9/23/2021	2.83	J	0.267	0.216	10.0	J	1.42	1.33	0.933	J	0.116	0.11	**0.322**	J	0.093	0.151
SB-14-2540	2.5-4	9/23/2021	2.44	J	0.288	0.251	9.61	J	1.83	1.33	0.419	J	0.104	0.132	**0.266**	J	0.077	0.115
SB-15-0406	4-6	9/23/2021	2.44	J	0.307	0.294	9.56	J	2	1.67	0.893	J	0.16	0.168	**0.344**	UJ	0.092	0.622
SB-15-0608	6-8	9/23/2021	1.2	J	0.186	0.198	14.2	J	1.68	1.03	0.337	J	0.074	0.094	0.176	U	0.072	0.612
SB-16-0235	2-3.5	9/23/2021	1.3	J	0.21	0.277	13.4	J	2.41	1.71	0.473	J	0.112	0.124	0.103	J	0.073	0.128
SB-DUP-16	2-3.5	9/23/2021	1.14	J	0.2	0.217	15.8	J	2.34	1.17	0.441	J	0.106	0.113	0.131	J	0.091	0.156
SB-17-0102	1-2	9/24/2021	21.8	J	1.8	0.535	9.98	J	2.48	3.21	0.569	J	0.174	0.275	**1.28**	J	0.899	0.346
SS-DUP-17	1-2	9/24/2021	11.8	J	0.998	0.381	8.94	J	1.96	2.43	0.561	J	0.131	0.175	0.0293	J	0.683	0.257
SB-18-0102	1-2	9/24/2021	1.44		0.172	0.163	12.1		1.68	1.23	0.376		0.071	0.076	0.203	J	0.232	0.413
SB-19-0102	1-2	9/24/2021	1.29	J	0.193	0.225	9.48	J	1.85	1.32	0.303	J	0.09	0.118	0.152	J	0.063	0.101
SB-19-0203	2-3	9/24/2021	1.02	J	0.185	0.263	13.9	J	2.4	1.5	0.34	J	0.103	0.132	0.065	J	0.063	0.114
SB-23-0102	1-2	9/27/2021	4.97	J	0.569	0.418	8.34	J	2.16	1.99	0.351	J	0.158	0.265	**0.54**	J	0.175	0.27
SB-DUP-23	1-2	9/27/2021	3.54	J	0.419	0.385	7.54	J	1.97	2.21	0.251	J	0.124	0.199	**0.391**	J	0.143	0.237
SB-24-0102	1-2	9/27/2021	2.8	J	0.302	0.216	13.8	J	1.88	1.54	0.773	J	0.118	0.117	**0.319**	J	0.088	0.143

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

[1]: by gamma spectrometry; [2]: by alpha spectrometry; 2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; R: rejected; SB: soil boring; U: not detected at the assocated level; USEPA: U.S. Environmental Protection Agency; *The DUP is a field duplicate of the preceding sample

Table 5-2. Results of Subsurface Soil Samples (Alpha and Gamma Spectroscopy)																		
Analyte			Thorium-234 (U-238)[1]				Uranium-234[2]				Uranium-235[2]				Uranium- 238[2]			
CAS#							13966-29-5				15117-96-1				7440-61-1			
Units			pCi/g				pCi/g				pCi/g				pCi/g			
Background Soil			NA				2.524				Below MDA				2.462			
Project Screening Level			1220				5.83				0.203				6.48			
Source of Screening Level			USEPA 2021 Residential				USEPA 2021 Residential				USEPA 2021 Residential				USEPA 2021 Residential			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SB-01-0102	1-2	9/24/2021	0.856	U	1.27	2.72	1.66		0.253	0.127	0.124		0.0803	0.085	1.74		0.249	0.061
SB-01-0501	0.5-1	9/24/2021	-3.88	U	2.22	4.71	0.597		0.179	0.164	0.041	J	0.0476	0.061	0.634	J	0.158	0.094
SB-DUP-01	0.5-1	9/24/2021	-2.31	U	2.14	5.17	1.25		0.229	0.123	0.0837		0.0694	0.08	1.35	J	0.23	0.091
SB-02-0102	1-2	9/24/2021	0.369	U	0.839	1.76	0.634	J	0.169	0.145	0.0521	J	0.0528	0.066	0.918		0.182	0.112
SB-02-0501	0.5-1	9/24/2021	1.02	UJ	1.19	2.37	0.809	J	0.181	0.158	0.0094	U	0.0585	0.093	0.752		0.166	0.132
SB-DUP-02	0.5-1	9/24/2021	0.463	U	1.18	2.42	0.787	J	0.166	0.1	-0.005	U	0.0441	0.081	0.795		0.157	0.053
SB-03-0102	1-2	9/24/2021	2.06	UJ	1.51	2.87	3.21		0.341	0.148	0.178		0.0854	0.071	3.19		0.336	0.13
SB-03-0815	0.8-1.5	9/24/2021	0.79	U	1.28	2.82	3.52		0.382	0.136	0.182		0.103	0.106	3.07	J	0.352	0.084
SB-04-0102	1-2	9/22/2021	4.85	J	2.65	4.12	4.81	J	0.442	0.173	**0.293**		0.113	0.08	4.78		0.43	0.101
SB-04-0406	4-6	9/22/2021	2.07	J	2.05	4.06	1.84	J	0.277	0.163	0.0512	J	0.0518	0.062	2.04		0.277	0.103
SB-05-0505	0.5-5	9/22/2021	0.96	UJ	0.703	1.6	1.74	J	0.297	0.157	0.0665	J	0.0873	0.121	1.56		0.271	0.096
SB-05-0510	5-10	9/22/2021	-1.29	U	1.41	3.12	1.35	J	0.274	0.201	0.0181	U	0.0442	0.074	1.43	J	0.257	0.115
SB-06-0203	2-3	9/22/2021	1.07	U	1.38	2.96	2.54		0.376	0.177	0.0087	U	0.0946	0.158	2.6	J	0.367	0.088
SB-06-0501	0.5-1	9/22/2021	3.91	J	1.56	1.95	5.01		0.468	0.19	0.197	J	0.0998	0.086	5.05	J	0.462	0.147
SB-07-0102	1-2	9/22/2021	1.88	J	1.09	1.95	2.73		0.458	0.207	0.145	J	0.116	0.124	2.73	J	0.452	0.173
SB-07-0203	2-3	9/22/2021	1.52	J	0.839	1.55	1.4		0.259	0.141	0.04	J	0.0622	0.091	1.48	J	0.26	0.114
SB-08-0102	1-2	9/23/2021	0.653	U	1.1	2.37	0.966		0.195	0.14	0.0518	J	0.0524	0.065	1.12	J	0.191	0.082
SB-09-0117	1-1.7	9/23/2021	1.13	U	1.81	4.02	1.59		0.288	0.175	0.0304	U	0.0761	0.12	1.48		0.272	0.147
SB-09-0506	5-6	9/23/2021	2.14	J	1.03	1.69	1.94		0.279	0.146	0.0611	J	0.0714	0.096	1.92		0.267	0.087
SB-10-0465	4-6.5	9/23/2021	0.74	J	0.672	1.41	0.909		0.2	0.114	0.0986		0.0701	0.068	1.16		0.22	0.095
SB-10-0517	0.5-1.7	9/23/2021	1.13	U	2.06	4.55	2.55		0.316	0.122	0.0727	J	0.076	0.099	2.73		0.32	0.064
SB-11-0405	4-5	9/23/2021	-1.46	U	1.47	3.28	1.46	J	0.25	0.127	0.0359	UJ	0.0562	0.082	1.8	J	0.27	0.104
SB-11-0506	5-6	9/23/2021	1.12	U	1.27	2.64	1.02	J	0.236	0.171	0.0294	U	0.0742	0.117	1.06		0.232	0.143
SB-DUP-11	4-5	9/23/2021	2.29	UJ	1.6	3.31	2.01	J	0.293	0.141	0.128	J	0.0824	0.083	2.09		0.29	0.094
SB-12-0304	3-4	9/23/2021	-0.236	U	1.43	3.17	1.35	J	0.309	0.268	0.0941	J	0.0839	0.1	1.43		0.278	0.163
SB-12-0506	5-6	9/23/2021	1.04	U	1.63	3.45	1.2	J	0.239	0.198	0.0383	U	0.0842	0.124	1.69		0.249	0.129
SB-14-0608	6-8	9/23/2021	-3.93	U	2.24	3.99	2.08	J	0.311	0.204	0.114	J	0.0986	0.124	2.27	J	0.303	0.13
SB-14-2540	2.5-4	9/23/2021	1.57	UJ	0.812	1.59	2.99	J	0.43	0.248	0.176	J	0.105	0.092	3.1	J	0.414	0.142
SB-15-0406	4-6	9/23/2021	2.31	J	1.14	1.76	2.3		0.323	0.172	0.0477	J	0.0615	0.085	2.4		0.314	0.097
SB-15-0608	6-8	9/23/2021	1.43	J	1.17	2.25	0.834		0.186	0.161	0.0168	U	0.0614	0.095	0.807		0.154	0.072
SB-16-0235	2-3.5	9/23/2021	1.18	UJ	0.767	1.61	1.04		0.223	0.176	0.0321	J	0.0441	0.061	1.16		0.219	0.137
SB-DUP-16	2-3.5	9/23/2021	0.408	U	1.2	2.62	0.928		0.194	0.124	0.0315	UJ	0.0558	0.083	0.874		0.176	0.06
SB-17-0102	1-2	9/24/2021	18.5	J	6.89	6.04	**22**		0.841	0.144	**0.97**		0.179	0.067	**22.1**		0.839	0.084
SS-DUP-17	1-2	9/24/2021	-5.2	R	3.39	6.43	**14.3**		0.776	0.136	**0.526**		0.155	0.088	**14.6**		0.781	0.1
SB-18-0102	1-2	9/24/2021	1.27	UJ	0.787	1.36	0.838		0.195	0.15	0.0043	U	0.0399	0.074	0.756		0.168	0.084
SB-19-0102	1-2	9/24/2021	0.818	UJ	0.624	1.43	0.694		0.204	0.187	0.0974		0.0693	0.067	1.01		0.214	0.135
SB-19-0203	2-3	9/24/2021	0.855	UJ	0.666	1.48	0.79		0.207	0.176	0.0346	J	0.0474	0.065	0.998		0.202	0.101
SB-23-0102	1-2	9/27/2021	1.49	U	2.12	4.7	2.9		0.401	0.182	**0.272**		0.129	0.107	2.9	J	0.394	0.156
SB-DUP-23	1-2	9/27/2021	-2.13	U	2.19	5.17	2.05		0.325	0.155	0.0447	J	0.0684	0.1	2.54	J	0.352	0.114
SB-24-0102	1-2	9/27/2021	2.2	UJ	1.41	2.7	1.98		0.288	0.138	0.105	J	0.0807	0.092	2.21	J	0.292	0.066

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

[1]: by gamma spectrometry; [2]: by alpha spectrometry; 2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; DUP: duplicate; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; R: rejected; SB: soil boring; U: not detected at the assocated level; USEPA: U.S. Environmental Protection Agency; *The DUP is a field duplicate of the preceding sample

Table 5-3. Downhole Gamma Scan Results																					
	SB-01	SB-02	SB-03	SB 04 Test 1				SB-04 Test 2				SB-05 Test 1				SB-05 Test 2					
Depth (ft bgs)	GR	GR Total[1]	GR Total[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]		
-0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
0.0	2207	2228	2133	1378	26.7	8.8	0.1	1378	26.7	8.8	0.1	1925	45.6	18.3	2.8	1530	33.1	12.2	1.4		
0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
0.2	-	-	-	1678	26.7	8.9	0.2	1678	26.7	8.9	0.2	1858	40.4	19.8	2.2	1601	33.5	11.9	1.4		
0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
0.4	-	-	-	1867	26.8	8.9	0.3	1867	26.8	8.9	0.3	2058	42.6	25.4	1.9	1902	34.8	11.9	1.5		
0.5	3186	2727	2465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
0.6	-	-	-	2195	26.7	8.9	0.3	2195	26.7	8.9	0.3	1959	42.6	21.8	1.6	1761	35.1	11.6	1.7		
0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
0.8	-	-	-	2333	26.9	9.0	0.3	2333	26.9	9.0	0.3	1727	42.8	20.9	1.4	1794	35.5	12.0	1.9		
0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.0	2535	2936	2113	2126	27.0	9.1	0.2	2126	27.0	9.1	0.2	1636	43.1	18.6	1.2	1680	35.0	12.7	2.2		
1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.2	-	-	-	2124	27.0	9.3	0.3	2124	27.0	9.3	0.3	1666	38.8	18.3	1.1	1555	36.0	12.3	2.1		
1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.4	-	-	-	1696	27.1	9.4	0.4	1696	27.1	9.4	0.4	1258	40.9	16.6	2.4	1408	35.1	13.0	2.3		
1.5	1786	3003	1307	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.6	-	-	-	1783	27.4	9.5	0.4	1783	27.4	9.5	0.4	1447	43.7	16.5	2.2	1479	35.5	13.1	2.5		
1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.8	-	-	-	1623	27.7	9.6	0.4	1623	27.7	9.6	0.4	1101	40.3	15.2	2.1	1128	35.2	13.3	2.4		
1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.0	1503	2920	822	1545	28.0	9.7	0.4	1545	28.0	9.7	0.4	834	40.7	14.1	1.9	799	35.5	13.3	2.7		
2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.2	-	-	-	1432	28.0	9.7	0.4	1432	28.0	9.7	0.4	992	39.1	13.2	1.8	902	34.8	13.6	2.6		
2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.4	-	-	-	1627	28.3	9.8	0.4	1627	28.3	9.8	0.4	731	36.6	14.2	1.7	825	34.4	13.2	2.7		
2.5	1261	2923	657	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.6	-	-	-	1601	28.4	10.0	0.4	1601	28.4	10.0	0.4	831	35.3	13.4	1.6	849	34.5	13.0	2.6		
2.8	-	-	-	1336	28.5	10.0	0.4	1336	28.5	10.0	0.4	904	34.6	13.1	1.5	604	34.0	12.7	2.7		
3.0	1209	-	-	1623	28.7	10.2	0.4	1623	28.7	10.2	0.4	858	33.4	12.4	1.4	931	34.0	12.6	2.7		
3.2	-	-	-	1491	28.5	9.7	0.4	1491	28.5	9.7	0.4	1117	32.4	12.5	1.3	1146	33.7	12.6	2.9		
3.4	-	-	-	1530	28.8	9.8	0.4	1530	28.8	9.8	0.4	1511	32.3	12.6	1.3	1295	33.9	12.6	2.8		
3.6	-	-	-	1208	28.5	9.8	0.5	1208	28.5	9.8	0.5	-	-	-	-	-	-	-	-		
3.8	-	-	-	874	28.8	9.5	0.5	874	28.8	9.5	0.5	-	-	-	-	-	-	-	-		
4.0	-	-	-	752	28.0	9.5	0.5	752	28.0	9.5	0.5	-	-	-	-	-	-	-	-		
4.2	-	-	-	667	28.2	9.5	0.5	667	28.2	9.5	0.5	-	-	-	-	-	-	-	-		
4.4	-	-	-	667	27.5	9.6	0.5	667	27.5	9.6	0.5	-	-	-	-	-	-	-	-		
4.6	-	-	-	732	27.6	9.6	0.5	732	27.6	9.6	0.5	-	-	-	-	-	-	-	-		
4.8	-	-	-	589	27.7	9.6	0.5	589	27.7	9.6	0.5	-	-	-	-	-	-	-	-		
5.0	-	-	-	619	27.7	9.6	0.5	619	27.7	9.6	0.5	-	-	-	-	-	-	-	-		
5.2	-	-	-	770	27.8	9.6	0.5	770	27.8	9.6	0.5	-	-	-	-	-	-	-	-		
5.4	-	-	-	784	27.6	9.7	0.5	784	27.6	9.7	0.5	-	-	-	-	-	-	-	-		
5.6	-	-	-	728	27.6	9.7	0.6	728	27.6	9.7	0.6	-	-	-	-	-	-	-	-		
5.8	-	-	-	751	27.6	9.3	0.6	751	27.6	9.3	0.6	-	-	-	-	-	-	-	-		
6.0	-	-	-	885	27.5	9.5	0.6	885	27.5	9.5	0.6	-	-	-	-	-	-	-	-		
6.2	-	-	-	855	27.7	9.6	0.8	855	27.7	9.6	0.8	-	-	-	-	-	-	-	-		
6.4	-	-	-	775	28.0	9.6	0.8	775	28.0	9.6	0.8	-	-	-	-	-	-	-	-		
6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Note: The downhole gamma logging tool was equipped with a Thallium doped Sodium Iodide crystal (NaI(Tl)), which, when struck by gamma rays, emits pulses of light. These pulses are amplified by a photomultiplier tube and are converted into electrical pulses. The # of pulses are counted, digitized and transmitted to the surface acquisition system. In addition to the “total natural gamma counts” a real time process on the energy spectrum is applied and computes the concentration of the three main radioisotopes K, Th and U. 1: counts per minute; *Hole collapsed; **Encountered groundwater; -: no data; bgs: below ground surface; cpm: counts per minute; ft: feet; GR: gamma rate; K: Potassium; Th: Thorium; U: Uranium

Table 5-3. Downhole Gamma Scan Results																								
	SB-06 Test 1				SB- 06 Test 2				SB-07 Test 1				SB-07 Test 2				SB-09 Test 1				SB-09 Test 2			
Depth (ft bgs)	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]
-0.1	3040	34.4	21.6	2.6	-	-	-	-	1231	17.5	7.4	2.0	1289	31.1	14.2	6.1	-	-	-	-	-	-	-	-
0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1284	24.8	15.2	1.9	1377	11.4	10.6	1.1
0.1	-	-	-	-	2339	42.9	23.5	2.6	1439	19.7	13.0	1.3	1227	32.3	14.0	5.9	-	-	-	-	-	-	-	-
0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1694	30.5	10.1	1.3	1557	11.6	10.6	1.1
0.3	3550	28.6	31.2	1.7	3012	43.0	23.6	2.4	1601	14.8	13.5	4.8	1395	32.5	14.7	5.7	-	-	-	-	-	-	-	-
0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1623	26.1	20.6	1.0	1942	12.2	10.7	1.1
0.5	-	-	-	-	3232	42.2	21.8	3.0	2248	15.6	10.8	3.8	1794	33.3	15.0	5.3	-	-	-	-	-	-	-	-
0.6	2549	42.1	29.9	2.6	-	-	-	-	-	-	-	-	-	-	-	-	2472	26.1	18.2	0.8	2311	12.7	10.9	1.0
0.7	-	-	-	-	2460	43.7	22.1	2.8	2332	23.4	9.0	3.2	2167	33.8	14.2	5.0	-	-	-	-	-	-	-	-
0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2618	28.4	18.5	0.6	2679	13.0	11.1	1.0
0.9	2477	44.1	28.6	2.1	2276	43.1	23.5	2.6	2439	29.5	14.8	2.7	2230	33.2	14.6	5.4	-	-	-	-	-	-	-	-
1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2897	33.7	20.5	0.5	2899	13.4	11.3	1.1
1.1	-	-	-	-	2533	42.9	23.2	2.7	2180	29.3	14.7	2.4	2364	33.2	15.5	5.1	-	-	-	-	-	-	-	-
1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2704	34.5	20.5	0.5	2828	13.6	11.6	1.1
1.3	2215	45.9	29.0	1.7	2527	43.2	22.9	3.1	2090	26.0	13.0	4.1	2309	33.6	15.3	5.4	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2997	32.1	18.2	0.4	2829	14.3	11.9	1.1
1.5	-	-	-	-	2073	43.2	22.8	3.0	2823	25.3	13.6	5.5	2548	35.1	16.5	5.1	-	-	-	-	-	-	-	-
1.6	1957	45.8	26.6	2.1	-	-	-	-	-	-	-	-	-	-	-	-	2696	34.3	20.5	1.7	2635	14.5	11.8	1.1
1.7	-	-	-	-	2069	42.3	23.0	2.8	2457	29.6	12.3	5.0	2596	34.3	17.1	4.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3230	34.5	21.9	4.9	2752	14.9	11.9	1.1
1.9	1819	42.5	24.9	2.6	2032	42.2	22.6	2.9	2300	30.5	12.5	6.9	2676	35.4	17.0	4.7	-	-	-	-	-	-	-	-
2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2986	36.0	22.2	5.2	2657	15.1	11.9	1.1
2.1	-	-	-	-	1890	42.0	22.2	3.1	-	-	-	-	2663	36.6	17.7	4.6	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2952	38.4	20.5	4.8	3131	15.5	12.1	1.1
2.3	-	-	-	-	1718	40.9	22.7	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2689	39.6	19.8	5.2	2495	15.7	12.4	1.1
2.5	-	-	-	-	1815	41.1	22.7	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2231	40.2	18.5	5.5	2258	15.9	12.3	1.2
2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1751	38.6	17.4	5.6	1594	16.2	12.4	1.2
3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1251	37.6	17.6	5.7	1339	16.4	12.3	1.1
3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1179	36.7	17.0	5.4	1266	17.0	12.1	1.1
3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	885	35.7	16.1	5.1	990	16.9	12.0	1.1
3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	827	35.1	15.3	4.9	822	16.8	12.0	1.1
3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	642	34.6	14.6	4.6	707	16.8	12.2	1.1
4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	664	33.8	14.7	4.4	837	17.0	12.2	1.2
4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	738	32.7	14.7	4.2	800	17.2	12.2	1.2
4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	758	32.7	14.1	4.1	742	17.1	12.1	1.1
4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	969	32.0	13.5	3.9	936	17.1	12.2	1.1
4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	754	31.4	13.7	3.7	861	17.3	12.1	1.1
5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	734	31.2	13.6	3.6	715	17.4	12.0	1.1
5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	535	30.5	13.1	3.5	672	17.3	11.9	1.1
5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	574	30.2	12.7	3.4	683	17.6	11.8	1.1
5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	490	29.6	12.3	3.2	596	17.6	11.8	1.1
5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	623	29.2	12.4	3.1	698	17.6	11.7	1.1
6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	504	28.8	12.0	3.0	498	17.6	11.6	1.1
6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: The downhole gamma logging tool was equipped with a Thallium doped Sodium Iodide crystal (NaI(Tl)), which, when struck by gamma rays, emits pulses of light. These pulses are amplified by a photomultiplier tube and are converted into electrical pulses. The # of pulses are counted, digitized and transmitted to the surface acquisition system. In addition to the "total natural gamma counts" a real time process on the energy spectrum is applied and computes the concentration of the three main radioisotopes K, Th and U. 1: counts per minute; *Hole collapsed; **Encountered groundwater; -: no data; bgs: below ground surface; cpm: counts per minute; ft: feet; GR: gamma rate; K: Potassium; Th: Thorium; U: Uranium

Table 5-3. Downhole Gamma Scan Results																
	SB-10 Test 1				SB-10 Test 2				SB-11 Test 1				SB-11 Test 2			
Depth (ft bgs)	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]
-0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.0	2116	24.3	11.8	4.1	1472	33.0	15.8	3.0	730	23.3	7.9	0.9	689	34.9	10.2	3.7
0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.2	2608	28.9	13.0	2.7	2130	33.0	15.9	3.4	852	26.6	8.9	4.3	665	34.5	10.3	3.7
0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.4	2886	29.7	11.7	2.0	2502	33.8	16.3	3.3	598	26.2	9.8	3.2	478	34.4	10.1	3.6
0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.6	2660	33.7	17.6	1.6	2653	35.9	16.3	3.2	831	27.7	7.9	4.8	835	34.0	10.1	3.5
0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.8	2819	33.7	18.9	2.8	2500	35.8	16.1	3.4	772	28.8	8.4	4.0	781	34.2	9.9	3.5
0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0	3070	40.0	20.0	2.4	2735	36.9	16.8	3.7	835	30.7	7.2	3.5	627	34.1	9.8	3.4
1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	2886	41.4	21.7	2.1	2855	36.9	17.7	3.6	807	29.7	6.3	3.0	518	33.9	9.8	3.4
1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	3252	39.6	21.2	2.8	2888	37.4	18.6	4.0	870	27.7	6.9	2.7	725	33.9	10.0	3.3
1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.6	2977	39.1	21.6	2.5	2879	37.4	18.7	4.3	1118	29.0	7.6	2.4	877	34.0	9.8	3.3
1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2826	39.4	22.8	2.3	2926	37.9	18.7	4.2	1410	28.4	7.9	2.2	961	33.9	9.7	3.3
1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	2249	36.9	25.5	2.9	2772	38.2	18.9	4.5	1173	29.2	8.0	2.8	839	33.5	9.6	3.2
2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.2	2073	38.0	26.8	2.6	2421	37.6	18.6	4.4	1269	30.7	7.4	2.6	1056	34.0	9.6	3.2
2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.4	1687	38.1	25.4	3.0	2136	37.7	18.8	4.7	1328	31.6	7.7	2.4	1183	33.8	9.7	3.1
2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.6	1375	36.6	23.8	2.8	1429	36.8	18.5	4.6	1455	31.9	7.1	2.3	1200	33.5	9.6	3.2
2.8	1260	37.0	22.8	2.6	1261	37.3	18.3	4.5	1092	31.7	6.7	2.1	1198	33.2	9.5	3.1
3.0	1246	35.9	22.0	2.5	1080	36.7	18.1	4.4	1014	30.6	6.3	2.0	1155	33.0	9.6	3.2
3.2	945	34.3	21.2	2.3	1023	36.7	17.9	4.3	1325	31.9	6.5	1.9	1133	32.8	9.7	3.2
3.4	1125	34.7	20.6	2.2	1078	37.1	17.7	4.2	1663	32.3	6.2	2.5	1141	32.6	9.8	3.4
3.6	1104	33.0	20.3	2.5	992	37.3	17.5	4.1	1949	34.2	6.6	2.4	1546	32.8	9.8	3.5
3.8	1351	33.0	19.4	2.4	1110	37.9	17.7	4.0	2232	33.8	6.3	2.9	1445	32.9	9.8	3.4
4.0	1522	33.0	18.9	2.3	1141	37.7	17.4	4.0	2372	35.7	7.0	3.2	1427	32.8	9.8	3.4
4.2	1590	33.0	18.0	2.2	1154	37.3	17.0	3.9	2260	35.4	7.5	3.1	2165	33.4	9.7	3.4
4.4	1469	33.3	17.3	2.4	1445	37.6	16.7	3.8	2696	36.4	8.0	4.2	2463	34.4	9.6	3.3
4.6	1703	34.7	17.8	2.6	1452	37.4	16.4	4.0	2528	35.8	9.5	4.5	2257	34.4	9.7	3.4
4.8	1447	34.8	17.1	2.5	1439	37.6	16.6	3.9	2798	36.5	9.6	4.3	2456	34.3	9.9	3.5
5.0	1415	34.2	17.4	2.4	1437	37.2	16.5	3.9	2462	37.2	10.3	4.7	2612	34.0	10.2	3.5
5.2	1452	34.4	17.3	2.3	1600	37.4	16.6	3.8	2841	38.3	11.9	5.0	2287	33.6	10.5	3.5
5.4	1240	33.8	17.0	2.3	1371	37.1	16.5	3.7	2650	38.8	12.9	4.8	2979	34.0	10.7	3.4
5.6	1247	33.5	16.5	2.5	1070	36.9	16.2	3.7	2704	39.8	13.9	4.7	2619	34.3	10.9	3.4
5.8	1235	33.4	16.4	2.9	1289	36.6	16.0	3.6	2250	39.6	14.5	4.5	2848	34.6	11.3	3.3
6.0	-	-	-	-	-	-	-	-	2159	39.3	14.0	4.4	2559	34.9	11.1	3.5
6.2	-	-	-	-	-	-	-	-	1738	39.2	14.0	4.6	2330	35.6	11.0	3.5
6.4	-	-	-	-	-	-	-	-	1545	38.4	14.1	4.5	1681	35.8	11.3	3.4
6.6	-	-	-	-	-	-	-	-	1443	37.8	14.0	4.3	1697	35.6	11.2	3.6
6.8	-	-	-	-	-	-	-	-	1507	38.1	14.6	4.2	1575	36.0	11.2	3.5
7.0	-	-	-	-	-	-	-	-	1629	37.9	14.3	4.5	1364	35.7	11.1	3.5
7.2	-	-	-	-	-	-	-	-	1617	37.9	13.9	4.4	1693	36.0	11.2	3.5
7.4	-	-	-	-	-	-	-	-	1691	37.3	13.5	4.3	1756	35.8	11.2	3.4
7.6	-	-	-	-	-	-	-	-	1496	38.2	13.2	4.2	1881	35.6	11.2	3.4
7.8	-	-	-	-	-	-	-	-	1367	38.3	13.2	4.1	1586	36.0	11.1	3.4
8.0	-	-	-	-	-	-	-	-	1444	38.7	12.9	4.0	1721	36.0	11.0	3.3
8.2	-	-	-	-	-	-	-	-	1241	38.4	12.6	3.9	1383	36.0	10.9	3.3
8.4	-	-	-	-	-	-	-	-	1370	39.0	12.9	3.8	1390	35.9	10.8	3.3
8.6	-	-	-	-	-	-	-	-	1116	38.8	12.8	3.9	1397	36.2	10.7	3.2
8.8	-	-	-	-	-	-	-	-	1365	39.0	12.5	4.0	1542	36.1	10.9	3.2
9.0	-	-	-	-	-	-	-	-	1247	39.1	12.3	4.0	1232	36.2	11.0	3.3
9.2	-	-	-	-	-	-	-	-	1653	38.6	12.3	3.9	1310	36.0	10.9	3.3
9.4	-	-	-	-	-	-	-	-	1205	38.8	12.1	3.8	1437	36.1	10.9	3.4
9.6	-	-	-	-	-	-	-	-	1502	38.6	11.8	3.7	1293	36.0	10.8	3.5
9.8	-	-	-	-	-	-	-	-	1526	38.2	11.6	3.9	1304	35.8	10.7	3.5
10.0	-	-	-	-	-	-	-	-	1185	37.8	11.4	3.8	1553	36.2	11.0	3.6
10.2	-	-	-	-	-	-	-	-	1217	37.7	11.4	3.7	1682	36.3	11.0	3.6
10.4	-	-	-	-	-	-	-	-	1062	37.5	11.2	3.6	1318	36.2	10.9	3.6
10.6	-	-	-	-	-	-	-	-	1085	37.6	11.0	3.8	1312	36.0	11.0	3.5
10.8	-	-	-	-	-	-	-	-	1015	37.4	10.8	3.9	1583	36.0	11.0	3.5
11.0	-	-	-	-	-	-	-	-	930	37.0	10.6	3.9	1075	35.9	11.1	3.5
11.2	-	-	-	-	-	-	-	-	729	36.7	10.5	3.8	1228	35.9	11.1	3.5
11.4	-	-	-	-	-	-	-	-	851	36.3	10.8	3.7	937	35.8	11.0	3.5
11.6	-	-	-	-	-	-	-	-	668	35.7	10.6	3.7	749	35.7	11.0	3.5
11.8	-	-	-	-	-	-	-	-	681	35.7	10.5	3.9	776	35.4	10.9	3.5
12.0	-	-	-	-	-	-	-	-	721	35.3	10.5	3.8	942	35.1	10.8	3.4
12.2	-	-	-	-	-	-	-	-	-	-	-	-	720	35.3	10.7	3.4
12.4	-	-	-	-	-	-	-	-	-	-	-	-	588	35.3	10.6	3.4
12.6	-	-	-	-	-	-	-	-	-	-	-	-	945	35.0	10.5	3.4

Note: The downhole gamma logging tool was equipped with a Thallium doped Sodium Iodide crystal (NaI(Tl)), which, when struck by gamma rays, emits pulses of light. These pulses are amplified by a photomultiplier tube and are converted into electrical pulses. The # of pulses are counted, digitized and transmitted to the surface acquisition system. In addition to the “total natural gamma counts” a real time process on the energy spectrum is applied and computes the concentration of the three main radioisotopes K, Th and U. 1: counts per minute; *Hole collapsed; **Encountered groundwater; -: no data; bgs: below ground surface; cpm: counts per minute; ft: feet; GR: gamma rate; K: Potassium; Th: Thorium; U: Uranium

Table 5-3. Downhole Gamma Scan Results												
	SB- 12 Test 1				SB-12 Test 2				SB-14 Test 1			
Depth (ft bgs)	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]
-0.1	-	-	-	-	-	-	-	-	-	-	-	-
0.0	727	17.4	1.3	0.0	744	33.9	12.1	2.7	573	12.00162	3.52	0.77
0.1	-	-	-	-	-	-	-	-	-	-	-	-
0.2	1052	11.6	6.1	0.0	808	33.6	11.9	2.6	602	11.97744	3.52	0.77
0.3	-	-	-	-	-	-	-	-	-	-	-	-
0.4	831	24.4	4.5	0.0	998	33.8	12.0	2.6	834	12.01746	3.58	0.77
0.5	-	-	-	-	-	-	-	-	-	-	-	-
0.6	1190	19.5	7.3	0.0	972	33.5	12.1	2.6	977	12.2028	3.67	0.77
0.7	-	-	-	-	-	-	-	-	-	-	-	-
0.8	1205	29.5	8.3	0.0	1074	33.4	11.9	2.5	1109	12.44928	3.71	0.77
0.9	-	-	-	-	-	-	-	-	-	-	-	-
1.0	1302	25.3	7.1	0.0	1167	33.1	11.7	2.6	1200	12.5358	3.82	0.77
1.1	-	-	-	-	-	-	-	-	-	-	-	-
1.2	1429	26.5	6.2	0.0	1254	33.3	11.7	2.7	1446	12.87816	3.73	0.77
1.3	-	-	-	-	-	-	-	-	-	-	-	-
1.4	1287	25.1	7.1	0.0	1259	33.1	11.7	3.1	1130	13.01028	3.73	0.91
1.5	-	-	-	-	-	-	-	-	-	-	-	-
1.6	1697	27.1	6.4	0.0	1468	33.9	11.8	3.0	1254	13.46628	3.73	0.91
1.7	-	-	-	-	-	-	-	-	-	-	-	-
1.8	1711	30.1	8.6	1.4	1397	34.3	12.0	3.0	1123	13.41708	3.85	0.91
1.9	-	-	-	-	-	-	-	-	-	-	-	-
2.0	1865	31.1	7.9	2.1	1488	34.1	12.0	2.9	1059	13.33212	3.85	0.91
2.1	-	-	-	-	-	-	-	-	-	-	-	-
2.2	1382	31.9	7.3	2.8	1455	34.2	12.0	2.9	1025	13.61112	3.84	0.91
2.3	-	-	-	-	-	-	-	-	-	-	-	-
2.4	1333	29.6	8.3	2.6	1458	34.4	11.9	2.9	1391	13.72926	3.84	0.97
2.5	-	-	-	-	-	-	-	-	-	-	-	-
2.6	1390	28.5	7.8	2.4	1253	34.3	11.9	3.0	1370	13.85304	3.75	0.94
2.8	1196	28.7	7.3	2.2	1023	33.9	11.8	3.0	1639	14.1114	3.83	0.94
3.0	1150	27.0	7.9	2.1	1112	33.9	11.6	2.9	1855	14.51874	3.98	0.98
3.2	1443	26.8	8.7	2.0	1356	33.7	11.6	2.9	2117	14.74212	4.02	1.08
3.4	1438	26.0	9.5	1.9	1319	33.8	11.5	3.0	2344	14.96538	4.19	1.08
3.6	1986	27.6	10.4	1.8	1992	33.9	11.8	3.0	2369	15.38382	4.32	1.08
3.8	2083	27.4	10.5	1.7	1455	33.7	11.6	2.9	2649	15.92478	4.51	1.17
4.0	1993	26.7	10.6	1.6	1683	33.7	11.7	2.9	2655	16.34994	4.51	1.29
4.2	2180	26.0	10.6	1.6	2110	33.7	12.0	2.9	2642	16.60338	5.01	1.35
4.4	2301	26.2	11.4	1.9	2206	34.0	12.1	2.9	2695	17.0307	5.23	1.43
4.6	2523	27.4	12.7	2.3	2417	34.4	12.1	3.0	2895	17.23068	5.42	1.55
4.8	2182	27.3	12.7	2.2	2224	34.4	12.1	3.0	2891	17.62938	5.62	1.55
5.0	2342	28.4	12.8	2.1	2150	34.6	12.4	3.2	2651	17.84586	5.69	1.59
5.2	2268	28.0	12.4	2.0	2448	34.6	12.4	3.1	2913	17.90988	5.89	1.59
5.4	2205	29.5	13.1	2.0	1873	34.8	12.7	3.1	2794	18.21126	6.19	1.65
5.6	1905	29.2	13.1	2.3	2053	34.8	12.9	3.1	2703	18.32184	6.4	1.65
5.8	1676	29.7	12.6	2.2	1676	34.6	13.6	3.0	2729	18.81582	6.65	1.73
6.0	1796	31.3	12.2	2.1	1457	34.6	13.5	3.0	2655	18.9627	6.75	1.73
6.2	1888	32.3	12.4	2.1	1588	35.0	13.7	3.2	2576	19.3881	6.79	1.77
6.4	1710	32.7	12.6	2.0	1717	35.3	13.7	3.1	2152	19.63026	6.85	1.69
6.6	1759	33.0	12.3	2.0	1712	35.5	13.6	3.2	2151	19.67118	6.92	1.76
6.8	1690	32.5	11.9	2.1	1735	35.5	13.7	3.3	1767	19.96572	7.07	1.83
7.0	1988	33.1	11.6	2.4	2235	35.3	13.7	3.2	1433	20.09142	7.3	1.75
7.2	1870	33.5	11.7	2.4	1962	35.5	13.8	3.2	1604	20.27292	7.25	1.78
7.4	2223	34.3	11.4	2.3	2030	35.6	13.8	3.3	1723	20.34534	7.25	1.82
7.6	1913	34.2	11.1	2.2	1879	35.9	13.8	3.3	1751	20.36262	7.31	1.95
7.8	1766	34.1	11.9	2.2	1891	36.1	13.7	3.3	1318	20.50098	7.44	1.95
8.0	1788	33.7	11.6	2.1	1437	36.2	13.6	3.4	1341	20.47752	7.51	1.95
8.2	1937	34.0	11.7	2.1	1768	36.2	13.4	3.4	1472	20.95752	7.67	2
8.4	2153	33.9	11.7	2.0	1892	36.5	13.5	3.5	1448	21.33762	7.71	2
8.6	2063	34.4	11.6	2.2	1980	36.6	13.6	3.5	1384	21.46242	7.68	2.05
8.8	1738	34.3	11.4	2.1	1622	36.6	13.6	3.4	1388	21.58614	7.66	2.05
9.0	1664	34.6	11.1	2.1	1581	36.6	13.5	3.5	1215	21.55962	7.72	2.05
9.2	1384	34.9	11.4	2.0	1607	36.4	13.5	3.5	1122	21.69378	7.72	2.12
9.4	1520	35.0	11.4	2.0	1443	36.2	13.6	3.5	1167	21.84408	7.75	2.15
9.6	1601	34.6	11.9	2.6	1511	35.9	13.7	3.6	1078	21.82728	7.7	2.19
9.8	1502	34.4	11.9	2.6	1205	35.8	13.7	3.6	1284	21.6804	7.77	2.26
10.0	1391	34.4	11.6	2.5	1237	35.9	13.7	3.5	944	21.66384	7.84	2.33
10.2	1247	34.3	11.4	2.5	1503	36.0	13.7	3.5	873	21.63414	7.91	2.33
10.4	1067	34.2	11.7	2.4	1490	36.1	13.7	3.5	996	21.77538	8.05	2.33
10.6	1358	34.0	11.5	2.4	1293	36.3	13.7	3.4	822	21.85368	8.12	2.36
10.8	1595	33.8	11.7	2.3	1463	36.3	13.7	3.4	834	21.91692	8.19	2.43
11.0	1597	33.8	12.3	2.3	1480	36.3	13.7	3.4	743	22.05642	8.19	2.43
11.2	1816	33.8	12.4	2.3	1605	36.4	13.7	3.4	761	22.19538	8.26	2.5
11.4	1687	33.7	12.2	2.2	1592	36.5	13.6	3.3	847	22.35834	8.31	2.55
11.6	2009	33.7	12.0	2.2	1791	36.8	13.5	3.3	752	22.48986	8.23	2.55
11.8	2288	33.8	12.2	2.1	1916	37.0	13.5	3.3	851	22.48308	8.06	2.55
12.0	1696	34.1	12.2	2.1	1904	37.2	13.6	3.3	839	22.6617	8.06	2.55
12.2	-	-	-	-	1795	37.0	13.5	3.3	917	22.72746	8.04	2.55
12.4	-	-	-	-	2029	37.4	13.5	3.3	1143	22.99212	8.11	2.62
12.6	-	-	-	-	-	-	-	-	-	-	-	-

Note: The downhole gamma logging tool was equipped with a Thallium doped Sodium Iodide crystal (NaI(Tl)), which, when struck by gamma rays, emits pulses of light. These pulses are amplified by a photomultiplier tube and are converted into electrical pulses. The # of pulses are counted, digitized and transmitted to the surface acquisition system. In addition to the "total natural gamma counts" a real time process on the energy spectrum is applied and computes the concentration of the three main radioisotopes K, Th and U. 1: counts per minute; *Hole collapsed; **Encountered groundwater; -: no data; bgs: below ground surface; cpm: counts per minute; ft: feet; GR: gamma rate; K: Potassium; Th: Thorium; U: Uranium

Table 5-3. Downhole Gamma Scan Results																
	SB-14 Test 2				SB-15 Test 1				SB-15 Test 2				SB-16	SB-19	SB-23	SB-24
Depth (ft bgs)	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	K[1]	U[1]	Th[1]	GR Total[1]	GR Total[1]	GR Total[1]	GR Total[1]
-0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.0	782	22.90176	8.22	2.63	852	18.7	3.0	1.1	1154	36.8	14.8	3.5	2421	2110	2313	2568
0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.2	540	22.96716	8.13	2.55	1049	30.6	2.0	0.7	671	36.2	14.7	3.4	-	-	-	-
0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.4	732	22.90488	8.15	2.48	1170	32.1	3.8	0.5	856	35.4	14.9	3.3	-	-	-	-
0.5	-	-	-	-	-	-	-	-	-	-	-	-	3376	3021	3286	3321
0.6	968	23.02488	8.15	2.48	1242	31.4	5.0	0.4	807	35.3	14.8	3.3	-	-	-	-
0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.8	994	23.15742	8.2	2.48	1317	30.9	4.1	0.4	843	34.5	14.4	3.2	-	-	-	-
0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0	1172	23.52522	8.24	2.53	1226	31.8	4.9	0.3	1134	34.5	14.1	3.1	4016	3579	4316	5125
1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	1054	23.62284	8.29	2.53	1490	30.1	5.4	0.3	1147	34.3	14.2	3.1	-	-	-	-
1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	1289	23.72472	8.35	2.53	1452	28.8	5.8	0.2	1697	35.2	14.2	3.0	-	-	-	-
1.5	-	-	-	-	-	-	-	-	-	-	-	-	4267	3686	-	6532
1.6	1198	23.81718	8.47	2.53	1457	30.6	5.3	0.2	1424	35.1	14.3	3.1	-	-	-	-
1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8	1083	23.85342	8.58	2.53	1453	31.2	7.3	1.0	1237	34.8	14.0	3.0	-	-	-	-
1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	1091	23.99064	8.58	2.57	1572	34.7	6.7	1.0	1212	35.0	13.9	3.0	-	3406	-	7113
2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.2	957	23.79372	8.63	2.57	1489	36.0	7.5	0.9	1469	34.9	14.1	3.1	-	-	-	-
2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.4	1390	24.07428	8.7	2.64	1692	34.1	8.3	0.8	1510	34.8	14.1	3.0	-	-	-	-
2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.6	1357	24.25728	8.7	2.64	1818	32.4	10.2	0.8	1320	35.1	14.2	3.0	-	-	-	-
2.8	1409	24.41742	8.86	2.69	2073	32.2	9.5	2.5	1659	35.2	14.1	3.1	-	-	-	-
3.0	1574	24.5916	8.99	2.78	2096	31.9	10.6	2.9	1863	34.9	13.8	3.0	-	-	-	-
3.2	1769	25.09062	9.08	2.82	2528	35.2	11.6	2.7	2142	34.9	13.6	3.0	-	-	-	-
3.4	2038	25.35138	9.32	2.82	2553	37.1	11.4	2.6	2196	34.6	13.7	2.9	-	-	-	-
3.6	2353	25.32288	9.38	2.74	2305	38.5	11.8	2.5	2548	34.7	14.1	2.9	-	-	-	-
3.8	2545	25.87458	9.59	2.74	2017	39.2	11.2	2.8	2013	35.3	13.9	2.8	-	-	-	-
4.0	2789	26.10762	9.93	2.79	2340	37.9	12.0	2.7	2812	37.1	14.5	2.8	-	-	-	-
4.2	2571	26.1753	9.98	2.88	2419	37.4	12.2	2.9	2194	37.3	14.6	2.7	-	-	-	-
4.4	2700	26.30484	10.1	2.94	2657	38.3	12.4	2.8	2038	37.5	14.6	3.0	-	-	-	-
4.6	2640	26.70198	10.3	2.94	2457	38.2	13.7	3.4	2368	38.0	14.4	2.9	-	-	-	-
4.8	2795	26.96814	10.5	2.94	2941	37.5	14.9	3.3	2860	37.9	14.4	2.9	-	-	-	-
5.0	2847	27.45486	10.7	2.94	2648	38.9	15.1	3.2	2594	37.8	15.2	2.8	-	-	-	-
5.2	2569	27.64128	10.9	3.03	2126	38.8	15.6	3.4	2737	38.0	15.5	2.8	-	-	-	-
5.4	2811	28.1658	11	3.03	2363	39.7	15.7	4.2	2572	37.7	16.1	2.8	-	-	-	-
5.6	2532	28.22712	11.3	3.09	2029	39.9	15.4	4.1	1790	37.2	16.3	2.7	-	-	-	-
5.8	2271	28.43838	11.3	3.09	1763	39.8	14.9	4.0	2108	37.4	16.3	2.7	-	-	-	-
6.0	2544	28.8471	11.5	3.29	1635	39.2	14.8	3.8	2104	37.3	16.4	2.6	-	-	-	-
6.2	2410	29.30928	11.7	3.39	1546	38.9	15.5	3.7	1504	37.1	16.4	2.6	-	-	-	-
6.4	2321	29.67552	11.8	3.49	1614	38.3	15.3	3.9	1522	36.8	16.4	2.6	-	-	-	-
6.6	2202	29.91042	11.9	3.49	1398	37.7	15.3	3.8	1403	37.2	16.2	2.5	-	-	-	-
6.8	2062	29.87388	11.9	3.49	1411	37.1	15.4	3.7	1687	37.4	16.2	2.5	-	-	-	-
7.0	1936	29.96406	11.9	3.62	1482	36.9	15.2	3.6	1488	37.4	16.0	2.5	-	-	-	-
7.2	1637	30.14496	12	3.62	1306	37.2	15.1	3.5	1520	37.1	16.0	2.4	-	-	-	-
7.4	1498	30.23376	12.2	3.67	-	-	-	-	1302	37.3	15.8	2.4	-	-	-	-
7.6	1533	30.46926	12.2	3.67	-	-	-	-	1074	36.8	15.6	2.4	-	-	-	-
7.8	1604	30.70962	12.3	3.73	-	-	-	-	-	-	-	-	-	-	-	-
8.0	1532	30.906	12.5	3.73	-	-	-	-	-	-	-	-	-	-	-	-
8.2	1588	31.10364	12.8	3.73	-	-	-	-	-	-	-	-	-	-	-	-
8.4	1477	31.3668	12.8	3.73	-	-	-	-	-	-	-	-	-	-	-	-
8.6	1494	31.63842	12.8	3.73	-	-	-	-	-	-	-	-	-	-	-	-
8.8	1251	31.86474	12.9	3.73	-	-	-	-	-	-	-	-	-	-	-	-
9.0	1386	31.84866	12.9	3.73	-	-	-	-	-	-	-	-	-	-	-	-
9.2	1402	32.0604	13.1	3.73	-	-	-	-	-	-	-	-	-	-	-	-
9.4	1081	32.21568	13.1	3.79	-	-	-	-	-	-	-	-	-	-	-	-
9.6	1000	32.09046	13.1	3.79	-	-	-	-	-	-	-	-	-	-	-	-
9.8	1072	32.32704	13.1	3.83	-	-	-	-	-	-	-	-	-	-	-	-
10.0	1048	32.30616	13.1	3.83	-	-	-	-	-	-	-	-	-	-	-	-
10.2	1001	32.6574	13.1	3.83	-	-	-	-	-	-	-	-	-	-	-	-
10.4	921	32.64918	13.1	3.83	-	-	-	-	-	-	-	-	-	-	-	-
10.6	965	32.83218	13.1	3.83	-	-	-	-	-	-	-	-	-	-	-	-
10.8	842	32.84484	13	3.88	-	-	-	-	-	-	-	-	-	-	-	-
11.0	761	32.82486	13	3.88	-	-	-	-	-	-	-	-	-	-	-	-
11.2	932	32.88954	13	3.88	-	-	-	-	-	-	-	-	-	-	-	-
11.4	896	33.02088	13	4.01	-	-	-	-	-	-	-	-	-	-	-	-
11.6	688	33.30042	13	4.01	-	-	-	-	-	-	-	-	-	-	-	-
11.8	787	33.34542	13.1	4.05	-	-	-	-	-	-	-	-	-	-	-	-
12.0	901	33.39966	13.1	4.14	-	-	-	-	-	-	-	-	-	-	-	-
12.2	855	33.49668	13.1	4.14	-	-	-	-	-	-	-	-	-	-	-	-
12.4	887	33.68052	13.1	4.14	-	-	-	-	-	-	-	-	-	-	-	-
12.6	1310	34.02996	13.1	4.14	-	-	-	-	-	-	-	-	-	-	-	-

Note: The downhole gamma logging tool was equipped with a Thallium doped Sodium Iodide crystal (NaI(Tl)), which, when struck by gamma rays, emits pulses of light. These pulses are amplified by a photomultiplier tube and are converted into electrical pulses. The # of pulses are counted, digitized and transmitted to the surface acquisition system. In addition to the “total natural gamma counts” a real time process on the energy spectrum is applied and computes the concentration of the three main radioisotopes K, Th and U. 1: counts per minute; *Hole collapsed; **Encountered groundwater; -: no data; bgs: below ground surface; cpm: counts per minute; ft: feet; GR: gamma rate; K: Potassium; Th: Thorium; U: Uranium

Table 5-4. Results of Test Pit Soil Samples (Alpha and Gamma Spectroscopy)

		Analyte	**Actinium-228 (Ra-228)**				**Bismuth-212**				**Radium-226 (Bismuth-214)**				**Lead-212**			
		CAS#									**13982-63-3**							
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**NA**				**2.294**				**NA**			
		Project Screening Level	**735**				**NA**				**2.294**				**NA**			
		Source of Screening Level	**USEPA 2021 Residential**				**NA**				**USEPA 2008 Background**				**NA**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2 σ**	**MDA**	**Result**	**Qual**	**2 σ**	**MDA**	**Result**	**Qual**	**2 σ**	**MDA**	**Result**	**Qual**	**2 σ**	**MDA**
TS-01-0002	0-2	9/24/2021	1.74	J	0.298	0.417	2.11	J	0.887	1.42	**2.9**	J	0.31	0.215	1.41	J	0.214	0.29
TS-01-0204	2-4	9/24/2021	2.67	J	0.578	0.888	3.19	J	1.74	2.93	**4.02**	J	0.515	0.422	2.19	J	0.352	0.431
TS-02-0002	0-2	9/24/2021	1.36	U	1.49	3.34	2.56	UJ	6.28	11.5	**347**	J	30	1.72	-63.7	UJ	6.44	3.08
TS-02-0304	3-4	9/24/2021	1.9	J	0.715	1.48	-14.4	UJ	13.1	5.4	**35.1**	J	3.31	0.771	4.42	J	0.684	0.789
TS-DUP-01	3-4	9/24/2021	1.29	J	0.508	1.05	-2.59	UJ	8.79	3.77	**32**	J	2.92	0.539	-4.48	UJ	0.635	0.924
TS-03-0002	0-2	9/24/2021	1.61	J	0.305	0.463	2.35	J	0.896	1.36	**3.5**	J	0.349	0.226	1.49	J	0.229	0.31
TS-03-0204	2-4	9/24/2021	2.83	J	0.57	0.742	3.86	J	1.92	3.55	**3.26**	J	0.476	0.456	3.11	J	0.446	0.376
TS-04-0002	0-2	9/24/2021	1.27	J	0.303	0.583	2.29	J	0.992	1.57	**11.9**	J	0.919	0.289	-0.04	UJ	0.231	0.437
TS-DUP-02	0-2	9/24/2021	1.57	J	0.338	0.592	1.06	J	1.16	2.13	**12.7**	J	0.986	0.315	-0.11	UJ	0.242	0.465
TS-04-0406	4-6	9/24/2021	2.45	J	0.382	0.462	2.79	J	1.07	1.69	**2.74**	J	0.313	0.265	2.38	J	0.29	0.329

Table 5-4. Results of Test Pit Soil Samples (Alpha and Gamma Spectroscopy)

		Analyte	**Lead-214**				**Potassium-40**				**Thallium-208**				**Uranium-235**			
		CAS#					**13966-00-2**											
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**18.81**				**NA**				**Below MDA**			
		Project Screening Level	**NA**				**NA**				**NA**				**0.203**			
		Source of Screening Level	**NA**				**NA**				**NA**				**USEPA 2021 Residential**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
TS-01-0002	0-2	9/24/2021	3.39	J	0.33	0.227	5.83	J	1.41	2.02	0.56	J	0.101	0.125	0.356	UJ	0.0895	0.675
TS-01-0204	2-4	9/24/2021	4.65	J	0.532	0.458	12.6	J	2.69	2.14	1.01	J	0.203	0.223	0.359	U	0.126	0.886
TS-02-0002	0-2	9/24/2021	377	J	38.7	2.12	8.07	J	5.53	9.8	0.751	J	0.514	0.874	13.5	J	3.93	6.18
TS-02-0304	3-4	9/24/2021	35.8	J	4.05	0.842	13	J	2.98	3.96	0.799	J	0.26	0.422	2.74	J	0.419	2.7
TS-DUP-01	3-4	9/24/2021	34.8	J	3.65	0.603	14.1	J	2.59	3.02	0.596	J	0.182	0.272	0.498	U	1.12	1.91
TS-03-0002	0-2	9/24/2021	4.06	J	0.388	0.256	6.51	J	1.56	2.21	0.634	J	0.11	0.128	0.55	UJ	0.105	0.788
TS-03-0204	2-4	9/24/2021	3.38	J	0.496	0.457	7.14	J	2	2.26	0.798	J	0.19	0.245	0.292	U	0.146	1.33
TS-04-0002	0-2	9/24/2021	13.3	J	1.07	0.334	5.4	J	1.44	2.16	0.537	J	0.108	0.148	0.361	U	0.57	1.01
TS-DUP-02	0-2	9/24/2021	13.7	J	1.1	0.32	5.81	J	1.52	2.25	0.498	J	0.116	0.171	1.48	J	0.176	0.989
TS-04-0406	2-6	9/24/2021	3.2	J	0.331	0.257	5.68	J	1.48	2.07	0.863	J	0.137	0.154	0.475	UJ	0.102	0.784

Table 5-4. Results of Test Pit Soil Samples (Alpha and Gamma Spectroscopy)

		Analyte	**Thorium-234 (Uranium-238)**				**Uranium-234**				**Uranium-235**				**Uranium- 238**			
		CAS#					**13966-29-5**				**15117-96-1**				**7440-61-1**			
		Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**2.524**				**Below MDA**				**2.462**			
		Project Screening Level	**1220**				**5.83**				**0.203**				**6.48**			
		Source of Screening Level	**USEPA 2021 Residential**				**USEPA 2021 Residential**				**USEPA 2021 Residential**				**USEPA 2021 Residential**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
TS-01-0002	0-2	9/24/2021	1.16	UJ	1.33	2.65	**3.21**		0.346	0.128	**0.106**	J	0.0677	0.061	**3.27**	J	0.342	0.061
TS-01-0204	2-4	9/24/2021	2.95	J	1.51	2.53	**2.54**		0.311	0.123	**0.0888**	J	0.0778	0.0955	**2.63**		0.31	0.076
TS-02-0002	0-2	9/24/2021	-7.05	R	10.4	19.7	**73.6**		2.11	0.279	**3.8**	J	0.48	0.103	**73.3**		2.1	0.159
TS-02-0304	3-4	9/24/2021	-4.94	R	4.83	10.1	**9**		0.551	0.119	**0.384**	J	0.121	0.0799	**9.07**		0.549	0.057
TS-DUP-01	3-4	9/24/2021	1.86	U	3.06	6.08	**9.93**		0.693	0.127	**0.357**		0.136	0.0824	**9.77**	J	0.686	0.101
TS-03-0002	0-2	9/24/2021	3.16	J	1.77	2.73	**4.2**		0.427	0.137	**0.159**	J	0.0931	0.0882	**4.67**		0.445	0.101
TS-03-0204	2-4	9/24/2021	3.9	J	2.82	5.15	**3.22**		0.351	0.131	**0.118**		0.0765	0.0766	**3.1**		0.342	0.112
TS-04-0002	0-2	9/24/2021	3.21	J	2.14	3.67	**9.29**		0.604	0.191	**0.476**		0.137	0.0647	**9.69**	J	0.611	0.147
TS-DUP-02	0-2	9/24/2021	6.53	J	3.08	3.85	**9.85**		0.562	0.141	**0.572**	J	0.138	0.0657	**10.1**		0.563	0.083
TS-04-0406	2-6	9/24/2021	2.35	J	1.8	3.06	**2.43**		0.308	0.169	**0.11**	J	0.0672	0.0585	**2.32**		0.292	0.132

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

2σ: total uncertainty; CAS: Chemical Abstract Service; DUP: duplicate; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data Qualifer; R: rejected; TS: test pit; USEPA: U.S. Environmental Protection Agency; U: not detected at the associated level; *The DUP is a field duplicate of the preceding sample

Table 5-5. Water Quality Parameters for Groundwater Samples								
Sample ID	**Soil Boring ID**	**Depth (ft bgs)**	**Temperature (°C)**	**Specific Conductance (µS/cm)**	**Dissolved Oxygen (mg/L)**	**pH (S.U.)**	**ORP (mV)**	**Turbidity (NTU)**
GW-06-1205	SB-06	5-6.0	21	3418	5.84	6.47	39.1	110
GW-07-1215	SB-07	4	20.6	3191	5.67	6.18	42.6	156
GW-09-1210	SB-09	5-6.0	21.1	3290	4.99	6.18	43.9	218
GW-10-1220	SB-10	6-7.0	20.6	3308	4.93	6.2	45.1	94.7

bgs: below ground surface; °C: degrees Celsius; ft: feet; GW: groundwater; ID: identification; mg/L: milligrams per liter; mS/cm: microSiemens per centimeter; mV: millivolts; NTU: nephlometric turbidity unit; ORP; Oxidation-Reduction Potential; pH; potential of hydrogen; SB: soil boring; S.U.: Standard Unit

Table 5-6. Results of Groundwater Samples and Equipment Blanks																						
		Analyte	**Gross Alpha**				**Gross Beta**				**Radium-226**				**Radium-228**				**Uranium**		
		CAS#	**12587-46-1**				**12587-47-2**				**13982-63-3**				**15262-20-1**				**15262-20-1**		
		Units	**pCi/L**				**pCi/L**				**pCi/L**				**pCi/L**				**mg/L**		
		Project Screening Level	**15**				**50**				**5**				**5**				**0.03**		
Sample ID			**Unfiltered**				**Unfiltered**				**Unfiltered**				**Unfiltered**				**Unfiltered**		
Unfiltered	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDC**	**Result**	**Qual**	**2σ**	**MDC**	**Result**	**Qual**	**2σ**	**MDC**	**Result**	**Qual**	**2σ**	**MDC**	**Result**	**Qual**	**MDC**
GW-06-1205	5-6	9/27/2021	-54.6	U	66	126	**125**		75.6	96.1	2.55		0.624	0.194	-0.017	U	0.439	0.811	0.00755		0.001
GW-07-1215	4-5	9/27/2021	**663**		239	234	**803**	J	150	165	2.76		0.630	0.163	1.01		0.425	0.758	**0.152**		0.001
GW-09-1210	5-6	9/27/2021	**548**		214	223	**787**	J	175	200	1.95		0.549	0.174	0.447	J	0.402	0.729	0.001	U	0.001
GW-10-1220	6-7	9/27/2021	**40.1**	J	61	85.7	**198**	J	77.6	95.2	0.576		0.319	0.196	**5.83**		0.931	1.56	0.012		0.001
EQ-SD-1410	-	9/27/2021	-0.061	U	0.5	0.814	0.125	U	1.43	1.94	0.0348	U	0.086	0.179	-0.256	U	0.296	0.562	0.001	U	0.001
EQ-SB-1520	-	9/27/2021	0.11	U	0.6	0.883	-1.54	U	1.49	2.11	0.468		0.3	0.258	-0.575	U	0.291	0.562	0.001	U	0.001

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; EQ: equipment blank; ft: feet; GW: groundwater; J: estimated value; ID: identification; MDC: Minimum Detectable Concentration; mg/L: milligrams per liter; pCi/L: picocuries per liter; Qual: Data Qualifer; SB: soil boring; SD: sediment; U: not detected at the associated level

See http://water-epa.gov/drink/contaminants/index.cfm#Radionuclides for gross alpha and beta MCLs

Table 5-7. Results of Waste Characterization - Metal (Methods 6020A and 7471A)														
		Analyte	Arsenic			Barium			Cadmium			Chromium		
		CAS#	7440-38-2			7440-39-3			7440-43-9			7440-47-3		
		Units	mg/kg			mg/kg			mg/kg			mg/kg		
Location ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**
WC-01-0002	0-2	9/24/2021	9.32		1	313		2.5	1.58		1	32.9		5
WC-02-0001	0-2	9/24/2021	1.12	O1	1	5.23	J5 O1	2.5	ND	-	1	ND	-	5
SB-16-0000	0-0.5	9/27/2021	ND	-	0.1	1.15	-	0.1	ND	-	0.1	ND	-	0.1

		Analyte	Lead			Selenium			Silver			Mercury		
		CAS#	7439-92-1			7782-49-2			7440-22-4			7439-92-1		
		Units	mg/kg			mg/kg			mg/kg			mg/kg		
Location ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**
WC-01-0002	0-2	9/24/2021	942		2	ND		2.5	ND		0.5	0.71		0.04
WC-02-0001	0-2	9/24/2021	6.75	J5 O1	2	ND	-	2.5	ND	-	0.5	0.524	J3 J5 J6 O1	0.04
SB-16-0000	0-0.5	9/27/2021	2.12	O1	0.1	ND	-	0.1	ND	-	0.1	ND	-	0.01

bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; J: Detection confirmed by validator, but estimated value; MDL: Method Detection Limit; mg/kg: milligrams per kilogram; ND: non-detect; Qual: Qualifiers; SB: soil boring; WC: waste characterization

J3: batch QC outside range for precision

J5: batch QC outside range for accuracy

J6: sample matrix interference; spike value is low

O1: analyte failed serial dilution test or post spike criteria; matrix interference

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	1,2,4-Trichlorobenzene			2,2-Oxybis(1-Chloropropane)			2,4,6-Trichlorophenol			2,4-Dichlorophenol			2,4-Dimethylphenol			2,4-Dinitrotoluene			2,6-Dinitrotoluene			2-Chloronaphthalene		
		CAS#	120-82-1			108-60-1			88-06-2			88-06-2			105-67-9			121-14-2			606-20-2			91-58-7		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333
WC-02-0001	0-2	9/24/2021	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333
SB-16-0001	0-0.5	9/27/2021	--	--	--	--	--	--	ND	--	0.1	--	--	--	--	--	--	ND	--	0.1	--	--	--	--	--	--

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	2-Chlorophenol			2-Nitrophenol			3,3-Dichlorobenzidine			4-Bromophenyl-phenylether			4-Chloro-3-methylphenol			4-Chlorophenyl-phenylether			4-Nitrophenol			Acenaphthene		
		CAS#	95-57-8			88-75-5			91-94-1			101-55-3			59-50-7			7005-72-3			100-02-7			83-32-9		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333
WC-02-0001	0-2	9/24/2021	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333
SB-16-0001	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	Acenaphthylene			Anthracene			Nitrobenzene			Benzidine			Benzo(a)anthracene			Benzo(a)pyrene			Benzo(b)fluoranthene			Benzo(g,h,i)perylene		
		CAS#	208-96-8			120-12-7			98-95-3			92-87-5			56-55-3			50-32-8			205-99-2			191-24-2		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	0.374	--	0.333	0.371	--	0.333	--	--	--	ND	--	16.7	1.46	--	0.333	1.52	--	0.333	2.09	--	0.333	1.45	--	0.333
WC-02-0001	0-2	9/24/2021	ND	--	0.333	ND	--	0.333	--	--	--	ND	--	16.7	0.488	--	0.333	0.521	--	0.333	0.688	--	0.333	0.546	--	0.333
SB-16-0001	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	Benzo(k)fluoranthene			Benzylbutyl phthalate			Bis(2-chlorethoxy)methane			Bis(2-chloroethyl)ether			Bis(2-ethylhexyl)phthalate			Chrysene			Di-n-butyl phthalate			Di-n-octyl phthalate		
		CAS#	207-08-9			85-68-7			111-91-1			111-44-4			117-81-7			218-01-9			84-74-2			117-84-0		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	0.693	--	0.333	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	1.42	--	0.333	ND	--	3.33	ND	--	3.33
WC-02-0001	0-2	9/24/2021	ND	--	0.333	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	0.518	--	0.333	ND	--	3.33	ND	--	3.33
SB-16-0001	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; LOQ: Limit of Quantification; µg/kg: micrograms per kilogram; ND: non-detect; Qual: qualifiers; SB: soil boring; SVOC: semi-volatile organic compound; WC: waste characterization

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	Dibenz(a,h)anthracene			Diethyl phthalate			Dimethyl phthalate			Fluoranthene			Fluorene			Hexachloro-1,3-butadiene			Hexachlorobenzene			Hexachlorocyclopentadiene		
		CAS#	53-70-3			84-66-2			131-11-3			206-44-0			86-73-7			87-68-3			118-74-1			77-47-4		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	0.333	ND	--	3.33	ND	--	3.33	2.83	--	0.333	ND	--	0.333				ND	--	3.33	ND	--	3.33
WC-02-0001	0-2	9/24/2021	ND	--	0.333	ND	--	3.33	ND	--	3.33	1.03	--	0.333	ND	--	0.333				ND	--	3.33	ND	--	3.33
SB-16-0001	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	0.1	ND	--	0.1	--	--	--

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	Hexachloroethane			Indeno(1,2,3-cd)pyrene			Isophorone			n-Nitrosodi-n-propylamine			n-Nitrosodimethylamine			n-Nitrosodiphenylamine			Naphthalene			Nitrobenzene		
		CAS#	67-72-1			193-39-5			78-59-1			621-64-7			62-75-9			86-30-6			91-20-3			98-95-3		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	3.33	1.41	--	0.333	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333	ND	--	3.33
WC-02-0001	0-2	9/24/2021	ND	--	3.33	0.457	--	0.333	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	3.33	ND	--	0.333	ND	--	3.33
SB-16-0001	0-0.5	9/27/2021	ND	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	0.1

Table 5-8. Results of Waste Characterization - SVOC (Method 8270C)

		Analyte	Pentachlorophenol			Phenanthrene			Phenol			Pyrene			2,4-Dinitrophenol			4,6-Dinitro-2-methylphenol		
		CAS#	87-86-5			85-01-8			108-95-2			129-00-0			51-28-5			534-52-1		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	3.33	1.78	--	0.333	ND	--	3.33	2.34	--	0.333	ND	--	33.3	ND	--	33.3
WC-02-0001	0-2	9/24/2021	ND	--	3.33	0.61	--	0.333	ND	--	3.33	0.86	--	0.333	ND	--	33.3	ND	--	33.3
SB-16-0001	0-0.5	9/27/2021	ND	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; LOQ: Limit of Quantification; µg/kg: micrograms per kilogram; ND: non-detect; Qual: qualifiers; SB: soil boring; SVOC: semi-volatile organic compound; WC: waste characterization

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	1,1,1,2-Tetrachloroethane			1,1,1-Trichloroethane			1,1,2,2-Tetrachloroethane			1,1,2-Trichloroethane			1,1,2-Trichlorotrifluoroethane			1,1-Dichloroethane			1,1-Dichloroethene		
		CAS#	630-20-6			71-55-6			79-34-5			79-00-5			76-13-1			75-34-3			75-35-4		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Depth (ft bgs)**	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
WC-01-0002	0-2	9/24/2021	ND	--	0.00348	ND	--	0.00348	ND	--	0.00348	ND	--	0.00348	ND	--	0.00348	ND	--	0.00348	ND	--	0.0035
WC-02-0001	0-2	9/24/2021	ND	--	0.00408	ND	--	0.00408	ND	--	0.00408	ND	--	0.00408	ND	--	0.00408	ND	--	0.00408	ND	--	0.0041
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	0.5

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	1,1-Dichloropropene			1,2,3-Trichloropropane			1,2,3-Trimethylbenzene			1,2,4-Trichlorobenzene			1,2,4-Trimethylbenzene			1,2-Dibromo-3-Chloropropane			1,2-Dibromoethane		
		CAS#	563-58-6			96-18-4			526-73-8			120-82-1			95-63-6			96-12-8			106-93-4		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Depth (ft bgs)**	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
WC-01-0002	0-2	9/24/2021	ND	--	0.00348	ND	--	0.0174	0.0511	--	0.00695	ND	--	0.0174	0.133	--	0.00695	ND	--	0.0348	ND	--	0.0035
WC-02-0001	0-2	9/24/2021	ND	--	0.00408	ND	--	0.0204	ND	--	0.00815	ND	--	0.0204	0.0322	--	0.00815	ND	--	0.0408	ND	--	0.0041
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	1,2-Dichlorobenzene			1,2-Dichloroethane			1,2-Dichloropropane			1,3,5-Trimethylbenzene			1,3-Dichlorobenzene			1,3-Dichloropropane			1,4-Dichlorobenzene		
		CAS#	95-50-1			107-06-2			78-87-5			108-67-8			541-73-1			75-34-3			106-46-7		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Depth (ft bgs)**	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
WC-01-0002	0-2	9/24/2021	ND	--	0.00695	ND	--	0.00348	ND	--	0.00695	0.0565	--	0.00695	ND	--	0.00695	ND	--	0.00695	ND	--	0.007
WC-02-0001	0-2	9/24/2021	ND	--	0.00815	ND	--	0.00408	ND	--	0.00815	0.0118	--	0.00815	ND	--	0.00815	ND	--	0.00815	ND	--	0.0082
SB-16-0000	0-0.5	9/27/2021	--	--	--	ND	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	2,2-Dichloropropane			2-Butanone (MEK)			2-Chlorotoluene			4-Chlorotoluene			4-Methyl-2-pentanone (MIBK)			Acetone			Acrylonitrile		
		CAS#	594-20-7			78-93-3			95-49-8			106-43-4			108-10-1			67-64-1			107-13-1		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Depth (ft bgs)**	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
WC-01-0002	0-2	9/24/2021	ND	--	0.00348	ND	--	0.139	ND	--	0.00348	ND	--	0.00695	ND	--	0.0348	ND	--	0.0695	ND	--	0.0174
WC-02-0001	0-2	9/24/2021	ND	--	0.00815	ND	--	0.163	ND	--	0.00408	ND	--	0.00815	ND	--	0.0408	8260B	--	0.0815	ND	--	0.0204
SB-16-0000	0-0.5	9/27/2021	--	--	--	ND	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	Benzene			Bromobenzene			Bromodichloromethane			Bromoform			Bromomethane			Carbon tetrachloride			Chlorobenzene		
		CAS#	71-43-2			108-86-1			75-27-4			75-25-2			74-83-9			56-23-5			08-90-7		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Depth (ft bgs)**	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
WC-01-0002	0-2	9/24/2021	0.0081	--	0.00139	ND	--	0.0174	ND	--	0.00348	ND	--	0.0348	ND	--	0.0174	ND	--	0.00695	ND	--	0.0035
WC-02-0001	0-2	9/24/2021	0.0116	--	0.00163	ND	--	0.0204	ND	--	0.00408	ND	--	0.0408	ND	--	0.0204	ND	--	0.00815	ND	--	0.0041
SB-16-0000	0-0.5	9/27/2021	ND	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	0.05	--	--	--

bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; LOQ: Limit of Quantification; µg/kg: micrograms per kilogram; ND: non-detect; Qual: qualifiers; SB: soil boring; SVOC: semi-volatile organic compound; WC: waste characterization

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	Chlorodibromomethane			Chloroethane			Chloroform			Chloromethane			cis-1,2-Dichloroethene			cis-1,3-Dichloropropene			Di-isopropyl ether		
		CAS#	124-48-1			75-00-3			67-66-3			74-87-3			156-59-2			10061-01-5			108-20-3		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	0.00348	ND	--	0.00695	ND	--	0.00348	ND	--	0.0174	ND	--	0.00348	ND	--	0.00348	ND	--	0.0014
WC-02-0001	0-2	9/24/2021	ND	--	0.00408	ND	--	0.00815	0.0049	--	0.00408	ND	--	0.0204	ND	--	0.00408	ND	--	0.00408	ND	--	0.0016
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	ND	--	0.25	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	Dibromomethane			Dichlorodifluoromethane			Ethylbenzene			Hexachloro-1,3-butadiene			Isopropylbenzene			Methyl tert-butyl ether			Methylene Chloride		
		CAS#	74-95-3			75-71-8			100-41-4			87-68-3			98-82-8			1634-04-4			75-09-2		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	0.00695	ND	--	0.00348	ND	--	0.00348	ND	--	0.0348	0.0046	--	0.00348	ND	--	0.00139	ND	--	0.0348
WC-02-0001	0-2	9/24/2021	ND	--	0.00815	ND	--	0.00408	0.0059	--	0.00408	ND	--	0.0408	--	--	--	ND	--	0.00163	ND	--	0.0408
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	n-Propylbenzene			Naphthalene			p-Isopropyltoluene			sec-Butylbenzene			Styrene			tert-Butylbenzene			Tetrachloroethene		
		CAS#	103-65-1			91-20-3			99-87-6			74-83-9			100-42-5			98-06-6			127-18-4		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	0.0347	--	0.00695	0.0379	--	0.0174	0.012	--	0.00695	ND	--	0.0174	ND	--	0.0174	ND	--	0.00695	0.0181	--	0.0035
WC-02-0001	0-2	9/24/2021	0.009	--	0.00815	ND	--	0.0204	ND	--	0.00815	ND	--	0.0204	ND	--	0.0204	ND	--	0.00815	0.106	--	0.0041
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	0.05

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	Toluene			trans-1,2-Dichloroethene			trans-1,3-Dichloropropene			Trichloroethene			Trichlorofluoromethane			Vinyl chloride			Xylenes, Total		
		CAS#	108-88-3			156-60-5			10061-02-6			79-01-6			75-69-4			75-01-4			1330-20-7		
		Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	0.0117	--	0.00695	ND	--	0.00695	ND	--	0.00695	0.0039	--	0.00139	ND	--	0.00348	ND	--	0.00348	0.0462	--	0.009
WC-02-0001	0-2	9/24/2021	0.029	--	0.00815	ND	--	0.00815	ND	--	0.00815	0.0279	--	0.00163	ND	--	0.00408	ND	--	0.00408	0.0462	--	0.0106
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--	--	--	--	0.0279	--	0.05	--	--	--	ND	--	0.05	--	--	--

Table 5-9. Results of Waste Characterization - VOC (Method 8260B)

		Analyte	1,2,3-Trichlorobenzene			n-Butylbenzene		
		CAS#	87-61-6			10451-8		
		Units	µg/kg			µg/kg		
Location ID	Depth (ft bgs)	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ
WC-01-0002	0-2	9/24/2021	ND	--	0.0174	ND	--	0.0174
WC-02-0001	0-2	9/24/2021	ND	--	0.0204	ND	--	0.0204
SB-16-0000	0-0.5	9/27/2021	--	--	--	--	--	--

bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; LOQ: Limit of Quantification; µg/kg: micrograms per kilogram; ND: non-detect; Qual: qualifiers; SB: soil boring; SVOC: semi-volatile organic compound; WC: waste characterization

Table 5-10. Tidal Chart			
Date	High/Low	Tide Time	Height (feet)
09/19/22	Low	1:55 AM	-0.1
	High	7:48 AM	5.5
	Low	2:10 PM	0.1
	High	8:08 PM	6.1
09/20/22	Low	2:40 AM	-0.2
	High	8:33 AM	5.7
	Low	2:59 PM	0.1
	High	8:50 PM	6.0
09/21/22	Low	3:23 AM	-0.2
	High	9:13 AM	5.8
	Low	3:44 PM	0.1
	High	9:31 PM	5.9
09/22/22	Low	4:02 AM	-0.1
	High	9:52 AM	5.8
	Low	4:26 PM	0.2
	High	10:10 PM	5.6
09/23/22	Low	4:37 AM	0.1
	High	10:29 AM	5.7
	Low	5:05 PM	0.4
	High	10:50 PM	5.3
09/24/22	Low	5:09 AM	0.3
	High	11:05 AM	5.5
	Low	5:41 PM	0.6
	High	11:32 PM	4.9
09/25/22	Low	5:38 AM	0.6
	High	11:41 AM	5.3
	Low	6:17 PM	0.9
	-	-	-
09/26/22	High	12:18 AM	4.6
	Low	6:05 AM	0.9
	High	12:18 PM	5.1
	Low	6:55 PM	1.1
09/27/22	High	1:06 AM	4.4
	Low	6:35 AM	1.1
	High	1:00 PM	5.0
	Low	7:43 PM	1.4
09/28/22	High	1:57 AM	4.2
	Low	7:15 AM	1.4
	High	1:47 PM	4.9
	Low	8:55 PM	1.5

http://www.usharbors.com/harbor/new-york/bergen-point-west-reach-ny

Table 5-11. Results of Sediment Samples (Alpha and Gamma Spectroscopy)														
		Analyte	**Actinium-228 (Ra-228)**				**Bismuth-212**				**Radium-226 (Bismuth-214)**			
		CAS#									**13982-63-3**			
		Units	**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**NA**				**2.294**			
		Project Screening Level	**735**				**NA**				**2.294**			
		Source of Screening Level	**USEPA 2021 Residential**				**NA**				**USEPA 2008 Background**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SD-01-0813	0-0.5	9/29/2021	1.02	J	0.259	0.416	1.34	J	0.816	1.38	2.03	J	0.27	0.215
SD-02-0810	0-0.5	9/29/2021	1.09	J	0.296	0.462	2.22	J	1.02	1.5	0.972	J	0.222	0.278
SD-DUP-02	0-0.5	9/29/2021	0.902	J	0.389	0.738	1.51	J	1.43	2.59	1.01	J	0.287	0.4
SD-03-0815	0-0.5	9/29/2021	0.917	J	0.245	0.375	0.918	J	0.784	1.38	1.5	J	0.242	0.215
SD-04-0910	0-0.5	9/29/2021	1.1	J	0.323	0.528	1.28	J	1.18	2.12	1.16	J	0.263	0.319
SD-05-0800	0-0.5	9/29/2021	1.13	J	0.314	0.495	1.8	J	1.11	1.87	1.35	J	0.253	0.247
SD-06-0754	0-0.5	9/29/2021	1.29	J	0.197	0.226	1.05	J	0.588	1.05	**2.57**	J	0.259	0.139
SD-07-0758	0-0.5	9/29/2021	0.947	J	0.244	0.419	1.77	J	0.797	1.23	1.9	J	0.251	0.201
SD-08-0805	0-0.5	9/29/2021	1.35	J	0.308	0.446	0.841	J	0.959	1.79	1.04	J	0.217	0.264
SD-09-0750	0-0.5	9/29/2021	0.809	J	0.251	0.417	0.74	J	0.733	1.4	0.956	J	0.178	0.172
SD-10-0816	0-0.5	9/29/2021	0.836	J	0.245	0.386	1.49	J	0.883	1.47	1.32	J	0.225	0.243

Table 5-11. Results of Sediment Samples (Alpha and Gamma Spectroscopy)														
		Analyte	**Lead-212**				**Lead-214**				**Potassium-40**			
		CAS#									**13966-00-2**			
		Units	**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**NA**				**18.81**			
		Project Screening Level	**NA**				**NA**				**NA**			
		Source of Screening Level	**NA**				**NA**				**NA**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SD-01-0813	0-0.5	9/29/2021	1.15	J	0.176	0.197	2.34	J	0.264	0.211	10.5	J	1.69	1.27
SD-02-0810	0-0.5	9/29/2021	1.18	J	0.175	0.174	1.01	J	0.174	0.241	17.1	J	2.61	1.53
SD-DUP-02	0-0.5	9/29/2021	1.38	J	0.25	0.311	1.19	J	0.238	0.332	16	J	2.76	1.95
SD-03-0815	0-0.5	9/29/2021	0.922	J	0.169	0.186	1.59	J	0.229	0.182	8.58	J	1.58	1.27
SD-04-0910	0-0.5	9/29/2021	1.49	J	0.214	0.193	1.56	J	0.24	0.289	13.3	J	2.46	1.53
SD-05-0800	0-0.5	9/29/2021	1.48	J	0.241	0.222	1.37	J	0.23	0.255	12.4	J	2.07	1.2
SD-06-0754	0-0.5	9/29/2021	1.22	J	0.141	0.122	2.47	J	0.247	0.152	10.3	J	1.25	0.87
SD-07-0758	0-0.5	9/29/2021	1.16	J	0.171	0.193	1.98	J	0.234	0.224	10.2	J	1.62	1.35
SD-08-0805	0-0.5	9/29/2021	1.09	J	0.185	0.227	1.37	J	0.206	0.217	12.7	J	2.04	1.63
SD-09-0750	0-0.5	9/29/2021	1.03	J	0.151	0.143	0.939	J	0.16	0.226	8.81	J	1.91	2.17
SD-10-0816	0-0.5	9/29/2021	0.935	J	0.168	0.212	1.39	J	0.199	0.218	8.05	J	1.56	1.51

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data qualifer; SD: sediment; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample.

Table 5-11. Results of Sediment Samples (Alpha and Gamma Spectroscopy)														
		Analyte	**Thallium-208**				**Uranium-235**				**Thorium-234 (Uranium-238)**			
		CAS#												
		Units	**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**NA**				**Below MDA**				**NA**			
		Project Screening Level	**NA**				**NA**				**1220**			
		Source of Screening Level	**NA**				**NA**				**USEPA 2021 Residential**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SD-01-0813	0-0.5	9/29/2021	0.356	J	0.0884	0.119	0.233	J	0.0784	0.133	0.819	U	1.04	2.23
SD-02-0810	0-0.5	9/29/2021	0.397	J	0.107	0.138	0.151	J	0.0645	0.108	1.48	J	0.785	1.43
SD-DUP-02	0-0.5	9/29/2021	0.34	J	0.127	0.201	0.159	J	0.105	0.189	0.805	U	1.5	3.32
SD-03-0815	0-0.5	9/29/2021	0.232	J	0.0773	0.104	0.218	J	0.0867	0.14	1.59	J	1.17	2.08
SD-04-0910	0-0.5	9/29/2021	0.497	J	0.125	0.144	0.114	J	0.0794	0.14	1.13	J	0.793	1.75
SD-05-0800	0-0.5	9/29/2021	0.387	J	0.104	0.121	0.168	J	0.103	0.175	1.69	J	1.45	2.67
SD-06-0754	0-0.5	9/29/2021	0.364	J	0.0637	0.0712	0.25	J	0.0635	0.103	1.91	J	0.994	1.67
SD-07-0758	0-0.5	9/29/2021	0.336	J	0.0839	0.112	0.308	J	0.0878	0.137	-0.71	U	1.26	3.05
SD-08-0805	0-0.5	9/29/2021	0.389	J	0.0967	0.126	0.15	J	0.0784	0.139	1.24	J	1.12	2.29
SD-09-0750	0-0.5	9/29/2021	0.244	J	0.075	0.102	0.106	U	0.257	0.467	0.654	(U)J	0.601	1.47
SD-10-0816	0-0.5	9/29/2021	0.208	J	0.0795	0.121	0.11	J	0.0821	0.148	-2.52	U	1.6	3.21

Table 5-11. Results of Sediment Samples (Alpha and Gamma Spectroscopy)														
		Analyte	**Uranium-234**				**Uranium-235**				**Uranium-238**			
		CAS#	**13966-29-5**				**15117-96-1**				**7440-61-1**			
		Units	**pCi/g**				**pCi/g**				**pCi/g**			
		Background Soil	**2.524**				**Below MDA**				**2.462**			
		Project Screening Level	**5.83**				**0.203**				**6.48**			
		Source of Screening Level	**USEPA 2021 Residential**				**USEPA 2021 Residential**				**USEPA 2021 Residential**			
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**	**Result**	**Qual**	**2σ**	**MDA**
SD-01-0813	0-0.5	9/29/2021	2.66		0.347	0.166	0.167		0.103	0.11	3.09	J	0.361	0.0993
SD-02-0810	0-0.5	9/29/2021	0.618		0.187	0.184	0.0291	(U)J	0.047	0.0686	0.686	J	0.164	0.112
SD-DUP-02	0-0.5	9/29/2021	0.881		0.2	0.11	0.0275	(U)J	0.0471	0.071	0.913		0.199	0.087
SD-03-0815	0-0.5	9/29/2021	2.18		0.295	0.193	0.0455	(U)J	0.0838	0.121	2.18	J	0.276	0.125
SD-04-0910	0-0.5	9/29/2021	0.887		0.186	0.102	0.0599	J	0.0543	0.061	0.85		0.179	0.0854
SD-05-0800	0-0.5	9/29/2021	2.16		0.315	0.14	0.0286	U	0.0578	0.0902	1.69		0.276	0.114
SD-06-0754	0-0.5	9/29/2021	2.81		0.346	0.153	0.0877	J	0.0828	0.105	3.02		0.353	0.128
SD-07-0758	0-0.5	9/29/2021	1.83		0.267	0.14	0.104	J	0.0795	0.0926	2.39	J	0.292	0.0839
SD-08-0805	0-0.5	9/29/2021	1.24		0.23	0.177	0.102		0.066	0.0661	1.67		0.237	0.108
SD-09-0750	0-0.5	9/29/2021	0.995		0.223	0.196	0.0208	U	0.0799	0.122	1.22		0.215	0.127
SD-10-0816	0-0.5	9/29/2021	1.56		0.278	0.193	0.0674	J	0.0729	0.0953	1.57	J	0.259	0.122

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2021b)

2σ: total uncertainty; bgs: below ground surface; CAS: Chemical Abstract Service; ft: feet; ID: identification; J: Estimated value; MDA: Minimum Detectable Activity; pCi/g: picocuries per gram; Qual: Data qualifer; SD: sediment; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample.

Table 6-1. Project Screening Levels for Soil and Sediment						
Radionuclide	Project Screening Level (pCi/g)[2]	Background Soil (pCi/g) 95% Upper Prediction Limit[3]	Risk-Based Screening Level (pCi/g)[1], Target Risk of 10^{-6}			
			Residential[4]	Outdoor Worker[5]	Construction Worker[6]	Recreational Receptor[7]
Uranium-238	6.48	2.462	6.48	34.7	63.1	64.9
Uranium-235	0.203	Below MDA	0.203	0.35	9.28	5.46
Uranium-234	5.83	2.524	5.83	30.9	54.4	58.5
Radium-226	2.294	2.294	1.03	3.39	23.4	11.4
Thorium-234	1220	NA	1220	2720	2590	22500
Actinium-228	735	NA	735	1190	1240	21800

pCi/g: picocuries per gram

[1] From U.S. Environmental Protection Agency, Regional Screening Levels - Generic Table

[2] Project Screening Level set to higher of background soil and lowest Risk-Based Screening Level (residential)

[3] Source: Table 6-2, Site Inspection report (USACE 2017a)

[4] Default parameters; no food intake was used as the subject area is zoned as commercial/industrial and future residental land use is considered unlikely.

[5] Default exposure parameters

[6] Dust from Unpaved Roads. Default except for Area (2000 m2), 2 x 2-ton cars, 2 x 20 ton trucks, 150 days with >0.01" precipitation (from Figure 5-2 of Supplemental Screening Guide)

[7] Default except area is 1000 square meters, 26 years exposure as adult, 6 years exposure as child, 30 days/year, 4 hours/day

Table 6-2. Screening Levels for Radionuclides of Potential Concern in Groundwater		
Radionuclide	**MCL[1] (pCi/L)**	**Screening Level[2] (pCi/L)**
Gross Alpha[3]	15	15
Gross Beta[4]	50	50
Radium-226	5	5
Radium-228	5	5
Radionuclide	**MCL[1] (mg/L)**	**Screening Level[2] (mg/L)**
Uranium	0.03	0.03

MCL: Maximum Contaminant Level; mg/L: milligram per liter; pCi/L: picocuries per liter

[1] From U.S. Environmental Protection Agency, Regional Screening Levels - Generic Table

[2] Screening levels are based on the MCL values

[3] Excluding radon and uranium

[4] Excluding K-40

Table 7-1. Evaluation of Surface Soil Samples From the Staten Island Warehouse Site

		Analyte	Radium-226 (pCi/g)			Uranium-234 (pCi/g)			Uranium-235 (pCi/g)			Uranium- 238 (pCi/g)			Uranium-238/Uranium-234 Ratio		Uranium-238/Radium-226 Ratio	
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**		**2 σ**		**2 σ**
SS-01-0825	0-0.5	9/24/2021	2.76	0.35	0.25	3.45	0.358	0.128	0.25	0.10	0.07	3.52	0.36	0.07	1.02	0.14	1.28	0.16
SS-02-0835	0-0.5	9/24/2021	1.09	0.21	0.24	0.622	0.185	0.163	0.01	0.04	0.08	0.82	0.18	0.09	1.32	0.37	0.75	0.29
SS-03-0810	0-0.5	9/24/2021	2.23	0.30	0.27	3.43	0.365	0.133	0.14	0.09	0.09	3.96	0.38	0.06	1.15	0.14	1.78	0.16
SS-04-0926	0-0.5	9/22/2021	4.60	0.54	0.39	2.53	0.363	0.238	0.25	0.11	0.09	2.65	0.35	0.15	1.05	0.19	0.58	0.17
SS-05-0915	0-0.5	9/22/2021	4.05	0.53	0.35	2.78	0.366	0.161	0.21	0.10	0.08	2.80	0.36	0.08	1.01	0.18	0.69	0.18
SS-06-0936	0-0.5	9/22/2021	1.31	0.26	0.24	1.45	0.256	0.164	0.09	0.07	0.08	1.20	0.22	0.09	0.83	0.25	0.92	0.27
SS-07-1220	0-0.5	9/22/2021	0.43	0.14	0.20	0.719	0.213	0.164	0.02	0.08	0.13	0.81	0.21	0.09	1.13	0.39	1.89	0.41
SS-08-1400	0-0.5	9/23/2021	1.46	0.25	0.26	1.46	0.232	0.0928	0.03	0.04	0.06	1.59	0.24	0.07	1.09	0.22	1.09	0.22
SS-09-0840	0-0.5	9/23/2021	1.61	0.27	0.31	1.72	0.283	0.139	0.07	0.07	0.09	1.99	0.30	0.11	1.16	0.22	1.24	0.22
SS-10-0750	0-0.5	9/23/2021	2.58	0.39	0.38	2.17	0.335	0.204	0.21	0.11	0.09	2.35	0.34	0.16	1.08	0.21	0.91	0.21
SS-12-1115	0-0.5	9/23/2021	1.24	0.26	0.30	0.939	0.21	0.151	0.00	0.06	0.10	0.99	0.20	0.09	1.05	0.30	0.80	0.29
SS-13-1015	0-0.5	9/27/2021	1.43	0.16	0.14	0.813	0.199	0.169	0.04	0.05	0.06	0.87	0.19	0.13	1.07	0.33	0.61	0.25
SS-14-1205	0-0.5	9/23/2021	0.50	0.16	0.23	0.324	0.119	0.121	0.00	0.02	0.04	0.26	0.10	0.09	0.80	0.52	0.51	0.49
SS-15-1135	0-0.5	9/23/2021	0.98	0.19	0.22	0.628	0.229	0.228	0.03	0.06	0.09	0.84	0.22	0.15	1.33	0.45	0.86	0.33
SS-16-1300	0-0.5	9/23/2021	3.34	0.47	0.42	1.82	0.324	0.23	0.10	0.08	0.08	2.09	0.33	0.18	1.15	0.24	0.63	0.21
SS-17-1230	0-0.5	9/24/2021	15.50	1.28	0.31	24.9	1.02	0.111	1.19	0.23	0.07	24.90	1.02	0.09	1.00	0.06	1.61	0.09
SS-18-1250	0-0.5	9/24/2021	1.00	0.21	0.22	1.03	0.218	0.171	0.03	0.04	0.06	1.18	0.22	0.13	1.15	0.28	1.18	0.28
SS-19-1310	0-0.5	9/24/2021	1.23	0.14	0.11	0.962	0.193	0.158	0.05	0.07	0.09	0.96	0.18	0.13	0.99	0.28	0.78	0.22
SS-20-1020	0-0.5	9/27/2021	0.70	0.15	0.19	1.04	0.222	0.145	0.04	0.06	0.08	1.00	0.20	0.08	0.96	0.30	1.43	0.30
SS-21-1000	0-0.5	9/27/2021	0.90	0.12	0.13	0.669	0.185	0.16	0.03	0.05	0.08	0.68	0.18	0.14	1.01	0.38	0.75	0.30
SS-22-0935	0-0.5	9/27/2021	1.23	0.24	0.25	0.869	0.241	0.22	0.02	0.04	0.07	0.93	0.23	0.17	1.06	0.37	0.75	0.31
SS-23-1014	0-0.5	9/27/2021	0.98	0.16	0.15	0.61	0.209	0.209	0.07	0.06	0.07	0.77	0.20	0.16	1.26	0.43	0.78	0.31
SS-24-0941	0-0.5	9/27/2021	3.91	0.49	0.35	2.11	0.316	0.188	0.07	0.06	0.07	2.14	0.30	0.11	1.01	0.21	0.55	0.19
SS-25-0940	0-0.5	9/27/2021	1.99	0.26	0.20	0.932	0.209	0.141	0.07	0.07	0.08	1.14	0.22	0.12	1.22	0.30	0.57	0.24
SD-01-0813	0-0.5	9/29/2021	2.03	0.27	0.22	2.66	0.347	0.166	0.17	0.10	0.11	3.09	0.36	0.10	1.16	0.18	1.52	0.18
SD-02-0810	0-0.5	9/29/2021	0.97	0.22	0.28	0.618	0.187	0.184	0.03	0.05	0.07	0.69	0.16	0.11	1.11	0.39	0.71	0.33
SD-03-0815	0-0.5	9/29/2021	1.50	0.24	0.22	2.18	0.295	0.193	0.05	0.08	0.12	2.18	0.28	0.13	1.00	0.19	1.45	0.21
SD-04-0910	0-0.5	9/29/2021	1.16	0.26	0.32	0.887	0.186	0.102	0.06	0.05	0.06	0.85	0.18	0.09	0.96	0.30	0.73	0.31
SD-05-0800	0-0.5	9/29/2021	1.35	0.25	0.25	2.16	0.315	0.14	0.03	0.06	0.09	1.69	0.28	0.11	0.78	0.22	1.25	0.25
SD-06-0754	0-0.5	9/29/2021	2.57	0.26	0.14	2.81	0.346	0.153	0.09	0.08	0.11	3.02	0.35	0.13	1.07	0.17	1.18	0.15
SD-07-0758	0-0.5	9/29/2021	1.90	0.25	0.20	1.83	0.267	0.14	0.10	0.08	0.09	2.39	0.29	0.08	1.31	0.19	1.26	0.18
SD-08-0805	0-0.5	9/29/2021	1.04	0.22	0.26	1.24	0.23	0.177	0.10	0.07	0.07	1.67	0.24	0.11	1.35	0.23	1.61	0.25
SD-09-0750	0-0.5	9/29/2021	0.96	0.18	0.17	0.995	0.223	0.196	0.02	0.08	0.12	1.22	0.22	0.13	1.23	0.29	1.28	0.26
SD-10-0816	0-0.5	9/29/2021	1.32	0.23	0.24	1.56	0.278	0.193	0.07	0.07	0.10	1.57	0.26	0.12	1.01	0.24	1.19	0.24
		Average	**2.11**			**2.20**			**0.11**			**2.32**			**1.08**	**0.27**	**1.03**	**0.25**

2σ: total propagated uncertainty; MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; *The DUP is a field duplicate of the preceding sample

Table 7-2. Evaluation of Subsurface Soil Samples From the Staten Island Warehouse Site																		
		Analyte	**Radium-226 (pCi/g)**			**Uranium-234 (pCi/g)**			**Uranium-235 (pCi/g)**			**Uranium-238 (pCi/g)**			**Uranium-238/Uranium-234 Ratio**		**Uranium-238/Radium-226 Ratio**	
Sample ID	**Depth (ft bgs)**	**Sample Date**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**		**2 σ**		**2 σ**
SB-01-0501	0.5-1	9/24/2021	1.14	0.28	0.37	0.60	0.18	0.16	0.04	0.05	0.06	0.63	0.16	0.09	1.06	0.39	0.56	0.35
SB-01-0102	1-2	9/24/2021	0.79	0.21	0.24	1.66	0.25	0.13	0.12	0.08	0.08	1.74	0.25	0.06	1.05	0.21	2.21	0.30
SB-02-0501	0.5-1	9/24/2021	1.10	0.16	0.16	0.81	0.18	0.16	0.01	0.06	0.09	0.75	0.17	0.13	0.93	0.31	0.68	0.26
SB-02-0102	1-2	9/24/2021	1.03	0.16	0.17	0.63	0.17	0.15	0.05	0.05	0.07	0.92	0.18	0.11	1.45	0.33	0.89	0.25
SB-03-0815	0.8-1.5	9/24/2021	1.47	0.27	0.32	3.52	0.38	0.14	0.18	0.10	0.11	3.07	0.35	0.08	0.87	0.16	2.09	0.22
SB-03-0102	1-2	9/24/2021	1.46	0.26	0.30	3.21	0.34	0.15	0.18	0.09	0.07	3.19	0.34	0.13	0.99	0.15	2.18	0.21
SB-04-0406	4-6	9/22/2021	1.07	0.28	0.40	1.84	0.28	0.16	0.05	0.05	0.06	2.04	0.28	0.10	1.11	0.20	1.91	0.29
SB-04-0102	1-2	9/22/2021	3.59	0.44	0.38	4.81	0.44	0.17	0.29	0.11	0.08	4.78	0.43	0.10	0.99	0.13	1.33	0.15
SB-05-0505	0.5-5	9/22/2021	1.47	0.25	0.26	1.74	0.30	0.16	0.07	0.09	0.12	1.56	0.27	0.10	0.90	0.24	1.06	0.25
SB-05-0510	5-10	9/22/2021	1.20	0.18	0.20	1.35	0.27	0.20	0.02	0.04	0.07	1.43	0.26	0.12	1.06	0.27	1.19	0.24
SB-06-0501	0.5-1	9/22/2021	5.69	0.54	0.26	5.01	0.47	0.19	0.20	0.10	0.09	5.05	0.46	0.15	1.01	0.13	0.89	0.13
SB-06-0203	2-3	9/22/2021	3.06	0.41	0.25	2.54	0.38	0.18	0.01	0.09	0.16	2.60	0.37	0.09	1.02	0.20	0.85	0.19
SB-07-0102	1-2	9/22/2021	2.86	0.25	0.14	2.73	0.46	0.21	0.15	0.12	0.12	2.73	0.45	0.17	1.00	0.24	0.95	0.19
SB-07-0203	2-3	9/22/2021	1.33	0.23	0.20	1.40	0.26	0.14	0.04	0.06	0.09	1.48	0.26	0.11	1.06	0.26	1.11	0.25
SB-08-0102	1-2	9/23/2021	1.19	0.22	0.20	0.97	0.20	0.14	0.05	0.05	0.07	1.12	0.19	0.08	1.16	0.26	0.94	0.25
SB-09-0117	01-17	9/23/2021	1.35	0.29	0.41	1.59	0.29	0.18	0.03	0.08	0.12	1.48	0.27	0.15	0.93	0.26	1.10	0.28
SB-09-0506	5-6	9/23/2021	1.79	0.29	0.26	1.94	0.28	0.15	0.06	0.07	0.10	1.92	0.27	0.09	0.99	0.20	1.07	0.21
SB-10-0517	0.5-1.7	9/23/2021	2.64	0.38	0.37	2.55	0.32	0.12	0.07	0.08	0.10	2.73	0.32	0.06	1.07	0.17	1.03	0.19
SB-10-0465	4-6.5	9/23/2021	1.09	0.22	0.26	0.91	0.20	0.11	0.10	0.07	0.07	1.16	0.22	0.10	1.28	0.29	1.06	0.28
SS-11-1100	0-0.5	9/23/2021	0.60	0.19	0.28	0.78	0.24	0.18	0.09	0.09	0.11	0.80	0.24	0.15	1.02	0.43	1.34	0.43
SB-11-0405	4-5	9/23/2021	1.90	0.21	0.18	1.46	0.25	0.13	0.04	0.06	0.08	1.80	0.27	0.10	1.23	0.23	0.95	0.19
SB-11-0506	5-6	9/23/2021	1.08	0.25	0.30	1.02	0.24	0.17	0.03	0.07	0.12	1.06	0.23	0.14	1.04	0.32	0.98	0.32
SB-12-0304	3-4	9/23/2021	3.39	0.46	0.26	1.35	0.31	0.27	0.09	0.08	0.10	1.43	0.28	0.16	1.06	0.30	0.42	0.24
SB-12-0506	5-6	9/23/2021	1.76	0.29	0.31	1.20	0.24	0.20	0.04	0.08	0.12	1.69	0.25	0.13	1.41	0.25	0.96	0.22
SB-14-2540	2.5-4	9/23/2021	2.35	0.32	0.23	2.99	0.43	0.25	0.18	0.11	0.09	3.10	0.41	0.14	1.04	0.20	1.32	0.19
SB-14-0608	6-8	9/23/2021	2.44	0.26	0.21	2.08	0.31	0.20	0.11	0.10	0.12	2.27	0.30	0.13	1.09	0.20	0.93	0.17
SB-15-0406	4-6	9/23/2021	2.35	0.33	0.32	2.30	0.32	0.17	0.05	0.06	0.08	2.40	0.31	0.10	1.04	0.19	1.02	0.19
SB-15-0608	6-8	9/23/2021	0.94	0.15	0.19	0.83	0.19	0.16	0.02	0.06	0.09	0.81	0.15	0.07	0.97	0.29	0.86	0.25
SB-16-0235	2-3.5	9/23/2021	1.34	0.27	0.30	1.04	0.22	0.18	0.03	0.04	0.06	1.16	0.22	0.14	1.12	0.29	0.87	0.27
SB-17-0102	1-2	9/24/2021	19.80	1.64	0.53	22.00	0.84	0.14	0.97	0.18	0.07	22.10	0.84	0.08	1.00	0.05	1.12	0.09
SB-18-0102	1-2	9/24/2021	1.22	0.17	0.14	0.84	0.20	0.15	0.00	0.04	0.07	0.76	0.17	0.08	0.90	0.32	0.62	0.26
SB-19-0102	1-2	9/24/2021	1.14	0.22	0.21	0.69	0.20	0.19	0.10	0.07	0.07	1.01	0.21	0.14	1.46	0.36	0.89	0.29
SB-19-0203	2-3	9/24/2021	0.99	0.24	0.28	0.79	0.21	0.18	0.03	0.05	0.07	1.00	0.20	0.10	1.26	0.33	1.01	0.31
SB-23-0102	1-2	9/27/2021	3.85	0.56	0.50	2.94	0.40	0.18	0.27	0.13	0.11	2.90	0.39	0.16	0.99	0.19	0.75	0.20
SB-24-0102	1-2	9/27/2021	2.64	0.31	0.24	1.98	0.29	0.14	0.11	0.08	0.09	2.21	0.29	0.07	1.12	0.20	0.84	0.18
TS-01-0204	2-4	9/24/2021	4.02	0.52	0.42	2.54	0.31	0.12	0.09	0.08	0.10	2.63	0.31	0.08	1.04	0.17	0.65	0.17
TS-03-0204	2-4	9/24/2021	3.26	0.48	0.46	3.22	0.35	0.13	0.12	0.08	0.08	3.10	0.34	0.11	0.96	0.16	0.95	0.18
TS-02-0304	3-4	9/24/2021	35.10	3.31	0.77	9.00	0.55	0.12	0.38	0.12	0.08	9.07	0.55	0.06	1.01	0.09	0.26	0.11
TS-04-0406	2-6	9/24/2021	2.74	0.31	0.27	2.43	0.31	0.17	0.11	0.07	0.06	2.32	0.29	0.13	0.95	0.18	0.85	0.17
TS-01-0002	0-2	9/24/2021	2.90	0.31	0.22	3.21	0.35	0.13	0.11	0.07	0.06	3.27	0.34	0.06	1.02	0.15	1.13	0.15
TS-02-0002	0-2	9/24/2021	347.00	30.00	1.72	73.60	2.11	0.28	3.80	0.48	0.10	73.30	2.10	0.16	1.00	0.04	0.21	0.09
TS-03-0002	0-2	9/24/2021	3.51	0.35	0.23	4.20	0.43	0.14	0.16	0.09	0.09	4.67	0.45	0.10	1.11	0.14	1.33	0.14
TS-04-0002	0-2	9/24/2021	11.90	0.92	0.29	9.29	0.60	0.19	0.48	0.14	0.06	9.69	0.61	0.15	1.04	0.09	0.81	0.10
		Average	**11.48**			**4.46**			**0.21**			**4.53**			**1.07**	**0.22**	**1.03**	**0.22**

2σ: total propagated uncertainty; MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; *The DUP is a field duplicate of the preceding sample

Table 7-3. Reported Ground Pressure for Excavator Equipment			
	Ground Pressure		
Machinery	psi	psf	kPa
CAT 308D Mini Excavator	4.2	602	29
CAT 330L Excavator	7.6	1093	53
CAT 345L Excavator	12.1	1732	84

kPa: kilopascals; psf: pounds per square foot; psi: pounds per square inch

Table 7-4. Soil Classification

Soil Boring ID	Depth (ft bgs)	USCS	AASHTO	Description	Atterberg Limits LL	PL	PI	<#40	<#200	Moisture	% >3"	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines Silt	Fines Clay	C_U	C_C	
SB-06	0-2	SM	A-2-4(0)	Silty Sand with Gravel	NP	NP	NP	49	27	20.9	0	0	23	11	17	22	21	6	100.86	0.84	poorly graded
SB-06	2-5	CL	A-4(3)	Sandy Lean Clay	27	19	8	86	65	18.7	0	0	4	3	7	21	40	25	--	--	
SB-10	0-4	SM	A-2-4(0)	Silty Sand with Gravel	24	26	2	52	29	12.5	0	8	13	9	18	23	23	6	99.55	1.37	well graded
SB-10	4-8	GM	A-1-b	Silty Gravel with Sand	21	18	3	30	18	11.0	0	34	23	6	7	12	15	3	854.85	0.73	poorly graded
SB-12	6-8	SC-SM	A-4(0)	Silty, Clayey Sand with Gravel	21	17	4	64	42	21.7	0	3	14	6	13	22	28	14	105.27	1.18	well graded
SB-12	11-12	CL-ML	A-4(2)	Sandy Silty Clay	24	17	7	84	68	16.0	0	0	6	3	7	16	38	30	--	--	
SB-14	4-6	SM	A-1-b	Silty Sand with Gravel	NP	NP	NP	42	21	19.6	0	0	17	18	23	21	17	4	101.14	1.77	well graded
SB-14	8-12	CL	A-6(5)	Sandy Lean Clay with Gravel	34	22	12	71	58	52.0	0	8	7	6	8	13	27	31	100.84	0.22	
SB-16	0-2	SM	A-2-5(0)	Silty Sand with Gravel	41	36	5	46	28	22.3	0	5	18	11	20	18	23	5	109.17	0.58	poorly graded
SB-16	2-4	SC-SM	A-4(0)	Silty, Clayey Sand with Gravel	27	22	5	60	15	14.0	0	14	11	4	11	15	31	14	194.49	2.09	well graded

AASHTO: The American Association of State Highway and Transportation Officials; bgs: below ground surface; C_C: curvature coefficient; CL: lean clay; C_U: uniformity coefficient; GM: silty gravel; ID: identification; LL: liquid limit; ML: lean silt; PI: plasticity index; PL: plastic limit; MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; SB: soil boring; SC: clayey sand; SM: silty sand; USCS: Unified Soil Classification System

Table 7-5. Unconfined Pressure Test Results			
Boring	SB-12	SB-14	SB-16
Depth (ft bgs)	6-8	8-12	2-4
Unconfined compressive strength (psi)	39.941	8.627	17.649
Undrained shear strength (psi)	19.971	4.313	8.824
Failure strain (%)	5.1	12.8	2
Strain rate (inches/minute)	0.039	0.039	0.038
Water content (%)	13.4	20.9	18.9
Wet density (pcf)	140.1	126	120.9
Dry denstiy (pcf)	123.5	104.2	101.7
GS (assumed)	2.7	2.7	2.7
Saturation (%)	99.2	91.2	77.5
Void Ratio	0.3646	0.6173	0.6579
Diameter (inch)	1.635	1.616	1.643
Height (inch)	39.34	3.907	3.805
H/D ratio	2.41	2.42	2.32

bgs: below ground surface; ft: feet; H/D: height/diameter; %: percent; pcf: per cubic foot; psi: pounds per square inch; SB: soil boring

Table 7-6. Grain Size Analysis Results										
Boring	SB-06	SB-06	SB-10	SB-10	SB-12	SB-12	SB-14	SB-14	SB-16	SB-16
Depth (ft bgs)	0-2	2-5	0-4	4-8	6-8	11-12	4-6	8-12	0-2	2-4
Sieve Size										
1.5	-	-	100	100	-	-	-	100	100	100
1	-	-	94	81	100	-	-	94	95	86
0.75	100	100	92	66	97	100	100	92	95	86
0.5	95	99	88	55	92	99	98	90	91	84
0.375	89	98	85	50	90	97	95	89	87	81
#4	77	96	79	43	83	94	83	85	77	75
#10	66	93	70	37	77	91	65	79	66	71
#20	58	91	62	33	71	88	54	74	55	63
#40	49	86	52	30	64	84	42	71	46	60
#60	41	79	42	26	56	79	34	66	39	54
#140	31	69	32	21	46	72	25	60	31	48
#200	27	65	29	18	42	68	21	58	28	45
Coefficients										
D_{90}	9.8653	0.7277	14.5874	30.6609	10.1635	1.5471	6.9255	12.7493	11.708	30.1988
D_{85}	7.7516	0.382	9.2327	27.6642	5.7508	0.5076	5.3537	5.0953	8.5767	16.2004
D_{60}	1.065	0.0543	0.7179	15.9999	0.3198	0.0402	1.3784	0.1026	1.2588	0.4513
D_{50}	0.4509	0.0316	0.3805	9.1913	0.1582	0.0189	0.6659	0.0189	0.5715	0.1603
D_{30}	0.0974	0.0071	0.0843	0.4676	0.0338	0.0049	0.1825	0.0048	0.0914	0.0468
D_{15}	0.0229	0.0021	0.0138	0.0421	0.0063	0.0011	0.0445	0.0019	0.0386	0.0068
D_{10}	0.0106	-	0.0072	0.0187	0.003	-	0.0136	0.001	0.0115	0.0023

bgs: below ground surface; ft: feet; SB: soil boring

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FIGURES

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Coordinate System: NAD83 UTM Zone 18N
Image Date: 2022

0 100 200 400 Feet N

Figure 1-1. Site Location Map

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 2-1. Surface Characterization Area

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Figure 2-2. Bayonne Bridge and Western Side of the Surface Characterization Area (facing north)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: USEPA 2009a

Approximate Scale 1:1,067

Figure 2-3. Aerial Photograph of Staten Island Warehouse FUSRAP Site, April 1940

U.S. Army Corps of Engineers

GEO Consultants Corporation

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Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

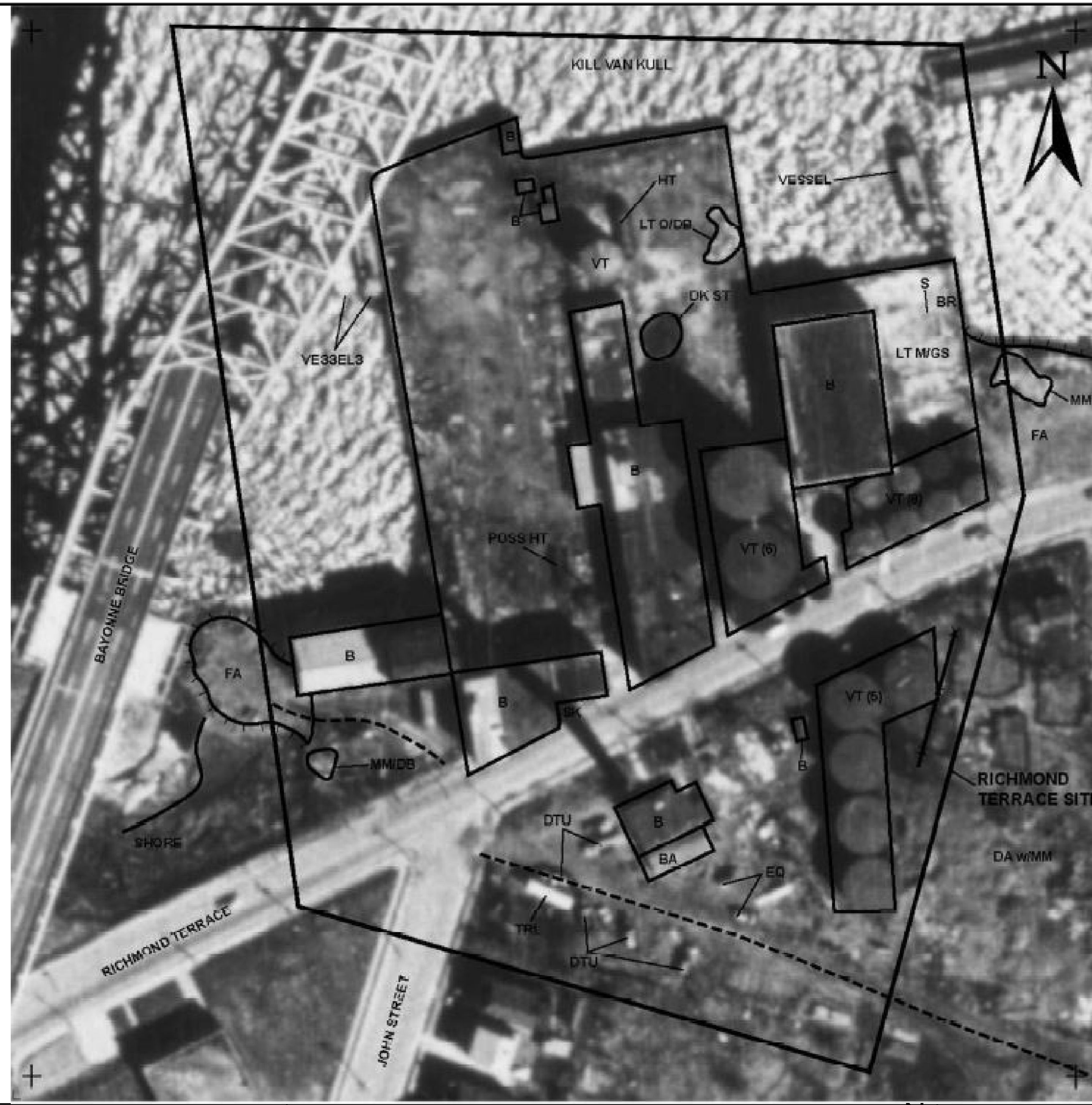

Image Source: USEPA 2009a

Approximate Scale 1:1,006

Figure 2-4. Aerial Photograph of Staten Island Warehouse FUSRAP Site, April 1961

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: USEPA 2009a

Approximate Scale 1:1,105

Figure 2-5. Aerial Photograph of Staten Island Warehouse FUSRAP Site, March 1988

U.S. Army Corps of Engineers

GEO Consultants Corporation

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Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Figure 2-6. Rocky Kill Van Kull Shoreline (facing north)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Figure 2-7. Block Wall and Concrete Pad in Southern Portion of Surface Characterization Area (facing northwest)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

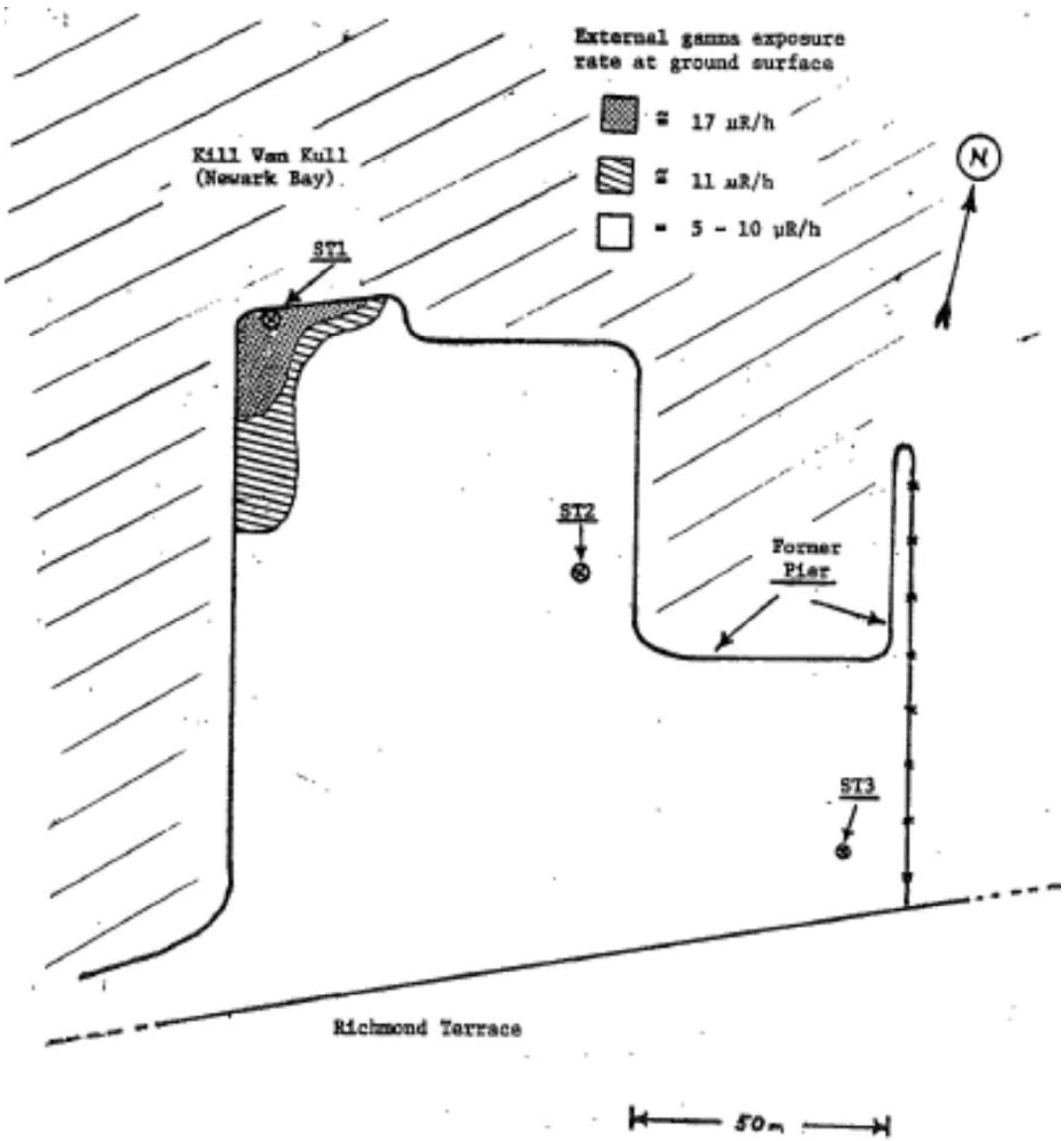


Image Source: ORNL 1980

Figure 4-1. 1980 ORNL Gamma Survey Results and Soil Sample Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

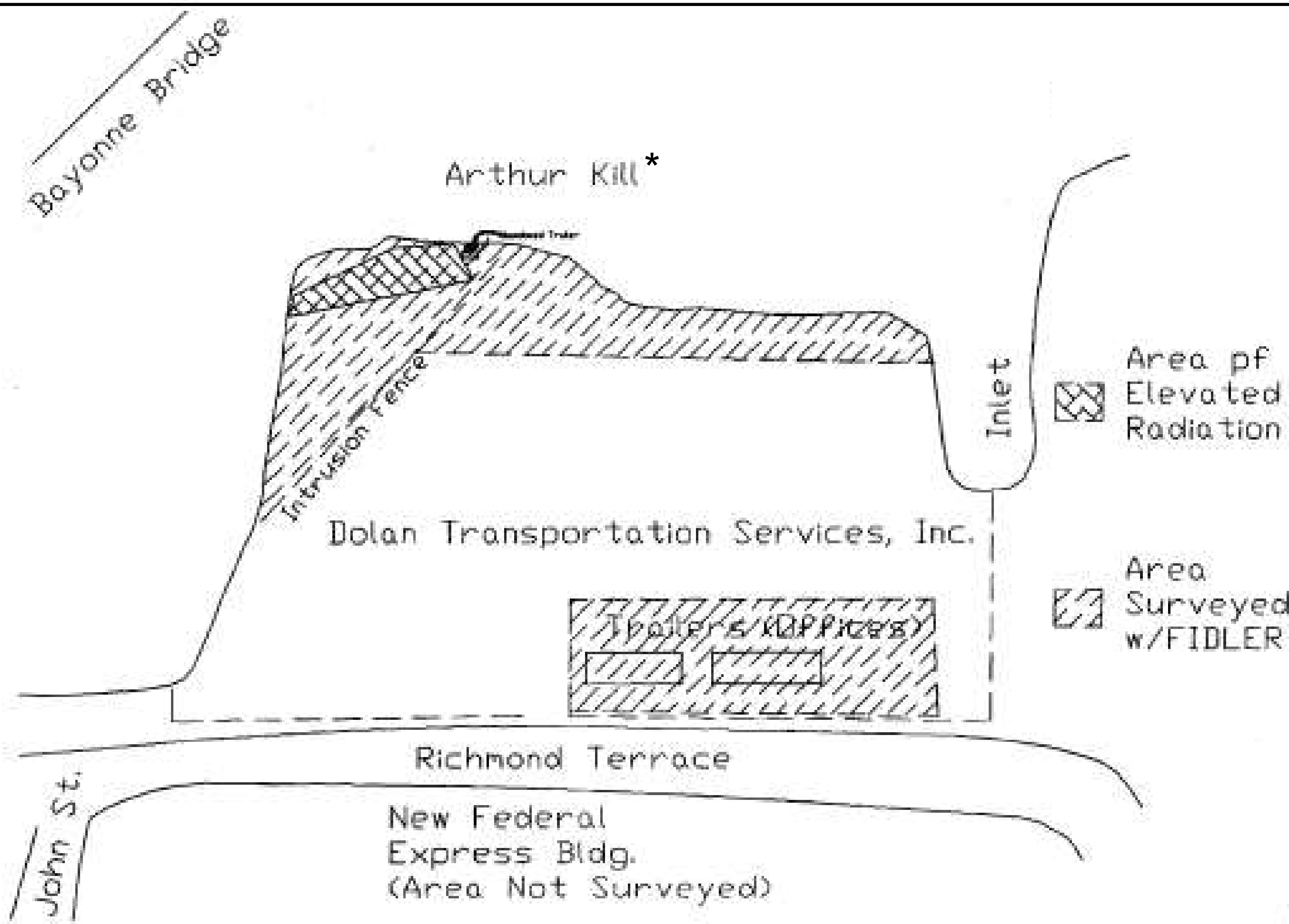


Image Source: NYSDEC 1992
*Note: The Kill Van Kull has been mislabeled as the Arthur Kill

Figure 4-2. 1992 NYSDEC Gamma Survey Results	**U.S. Army Corps of Engineers** **GEO Consultants Corporation**	**Staten Island Warehouse** **FUSRAP Site** **Port Richmond, Staten Island, New York**

Source: Aerial from U.S. Geological Survey. 2007.
Coordinate System: State Plane New York Long Island Zone 3104. Meters. NAD83

Figure 4-3. Surface Soil Sample and Test Pit Locations, 2011 SI

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York

Source: Aerial from U.S. Geological Survey. 2007.
Coordinate System: State Plane New York Long Island Zone 3104. Meters. NAD83

0 25 50 100 Feet

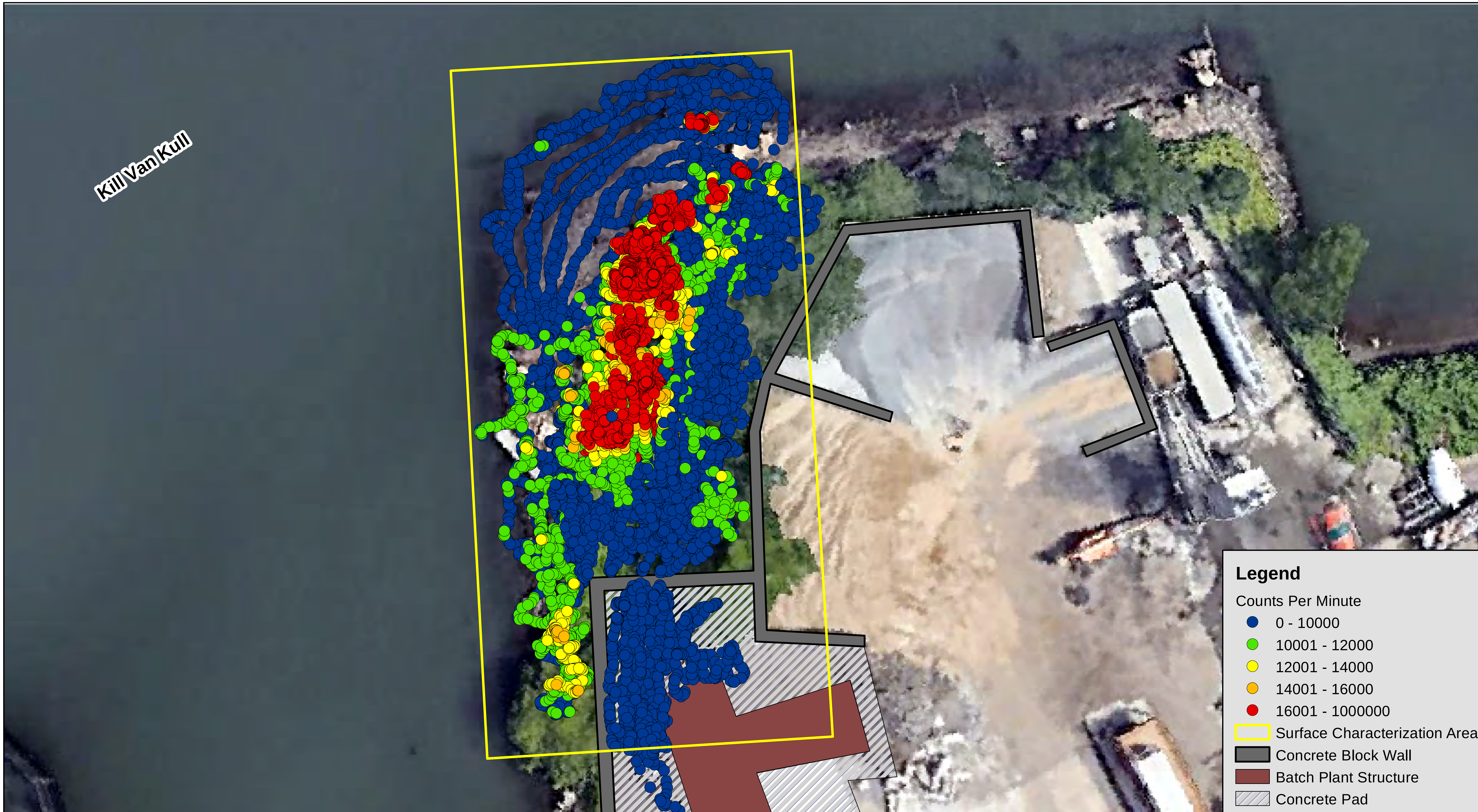
N

Figure 4-4. Groundwater Sample Locations, 2011 SI

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York



Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 5-1. Gamma Walkover Survey Results

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022
Note: Mid-tide level

Figure 5-2. Comparison of 2011 and 2021 Elevated Radiological Boundaries

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 5-3. Surface Soil Sample Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

0 25 50 100 Feet

N

Figure 5-4. Subsurface Soil Sample and Test Pit Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Figure 5-5. Groundwater Sample Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022
Note: Mid-tide level

Figure 5-6. Waste Characterization Sample Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022
Note: Mid-tide level

0 25 50 100 Feet

N

Figure 5-7. Sediment Sample Locations

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Figure 6-1. Surface Soil and Sediment Exceedances of Radium-226 in Soils From 0 to 0.5-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 6-2. Subsurface Soil Exceedances of Radium-226 in Soils From 0.5 to 4-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022
Note: Mid-tide level

Figure 6-3. Subsurface Soil Exceedances of Radium-226 in Soils Greater Than 4-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 6-4. Surface Soil and Sediment Exceedances of Uranium-234 in Soils From 0 to 0.5-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

0 25 50 100 Feet

N

Figure 6-5. Subsurface Soil Exceedances of Uranium-234 in Soils From 0.5 to 4-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 6-6. Surface Soil and Sediment Exceedances of Uranium-235 in Soils From 0 to 0.5-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 6-7. Subsurface Soil Exceedances of Uranium-235 in Soils From 0.5 to 4-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022
Note: Mid-tide level

Figure 6-8. Surface Soil and Sediment Exceedances of Uranium-238 in Soils From 0 to 0.5-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Source: Google Earth 2022

Note: Mid-tide level

Figure 6-9. Subsurface Soil Exceedances of Uranium-238 in Soils From 0.5 to 4-feet

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse FUSRAP Site
Port Richmond, Staten Island, New York

Figure 7-1.Shoreline and Highly Vegetated Surface Characterization Area (facing south)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Figure 7-2. Erosion Undercutting Shoreline (facing south)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Coordinate System: NAD83 UTM Zone 18N
Image Soutce/Date: ESRI ARCGIS/2020

Note: Low-tide level

0 25 50 100 Feet

N

Figure 7-3. Shoreline Erosion Map

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

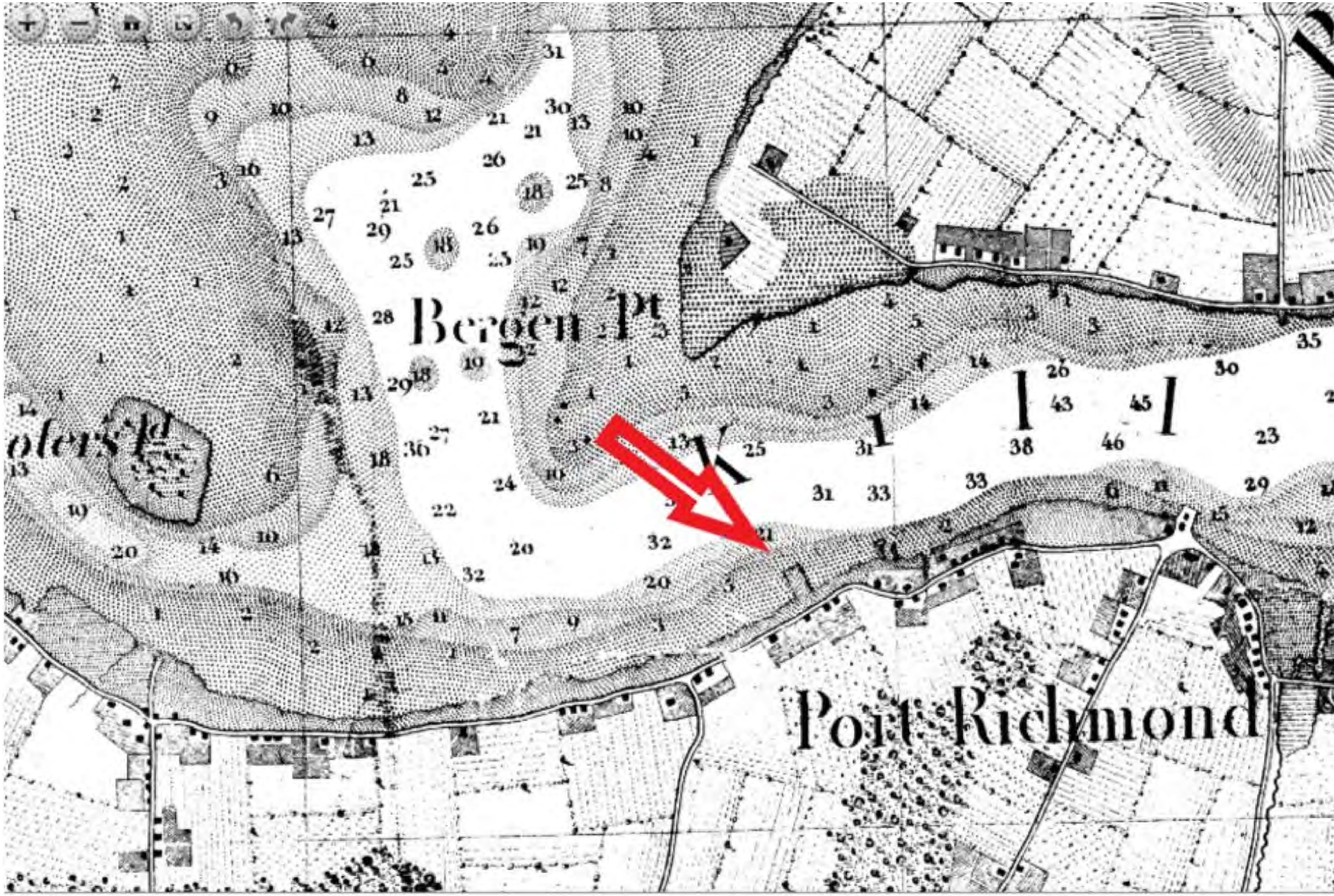


Image Source:
historicalcharts.noaa.gov

Figure 7-4. Staten Island Warehouse FUSRAP Site
1844 Historical Navigational Chart

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

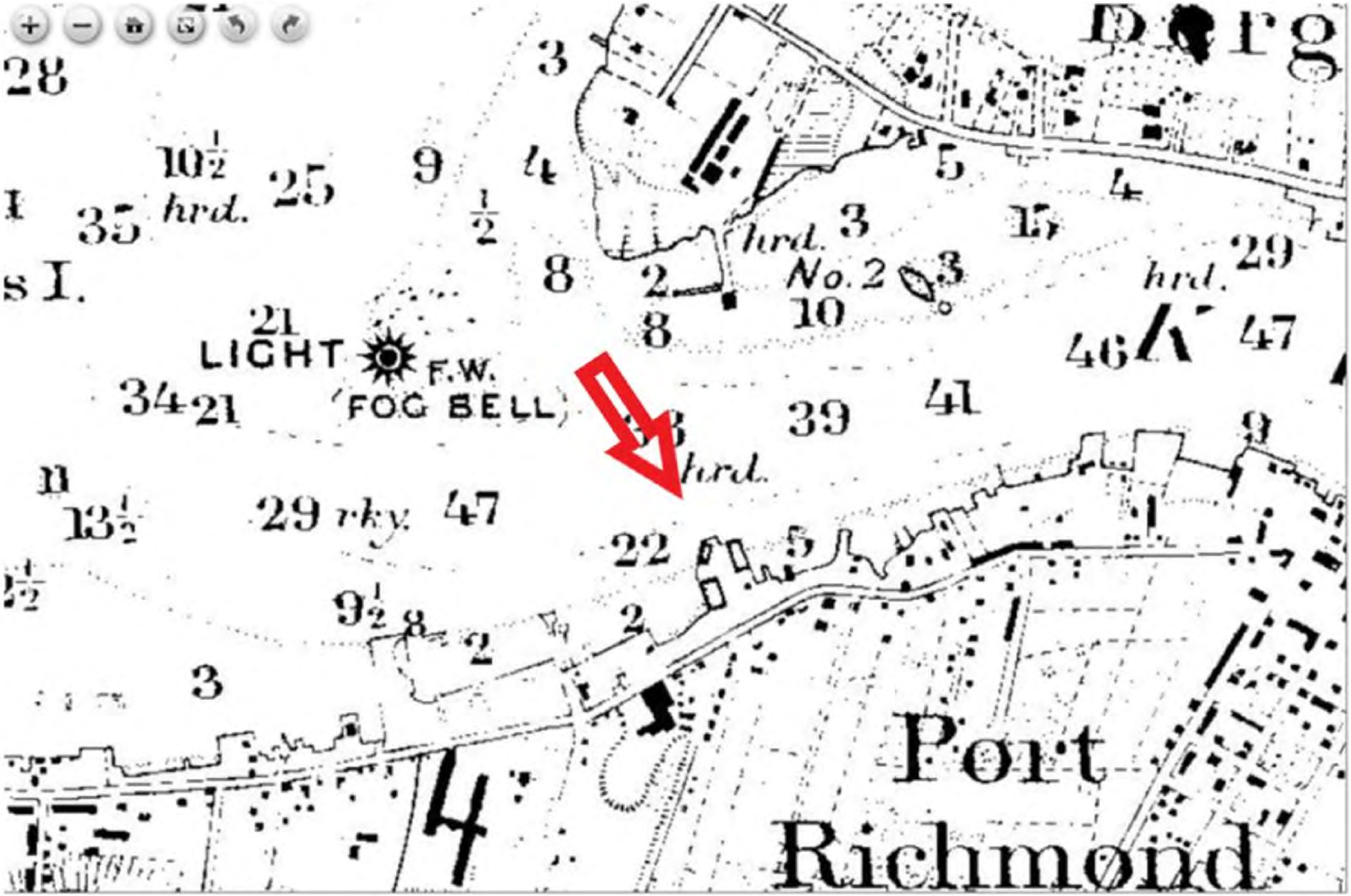


Image Source:
historicalcharts.noaa.gov

Figure 7-5. Staten Island Warehouse FUSRAP Site
1887 Historical Navigational Chart

U.S. Army Corps of Engineers

GEO Consultants Corporation

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Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

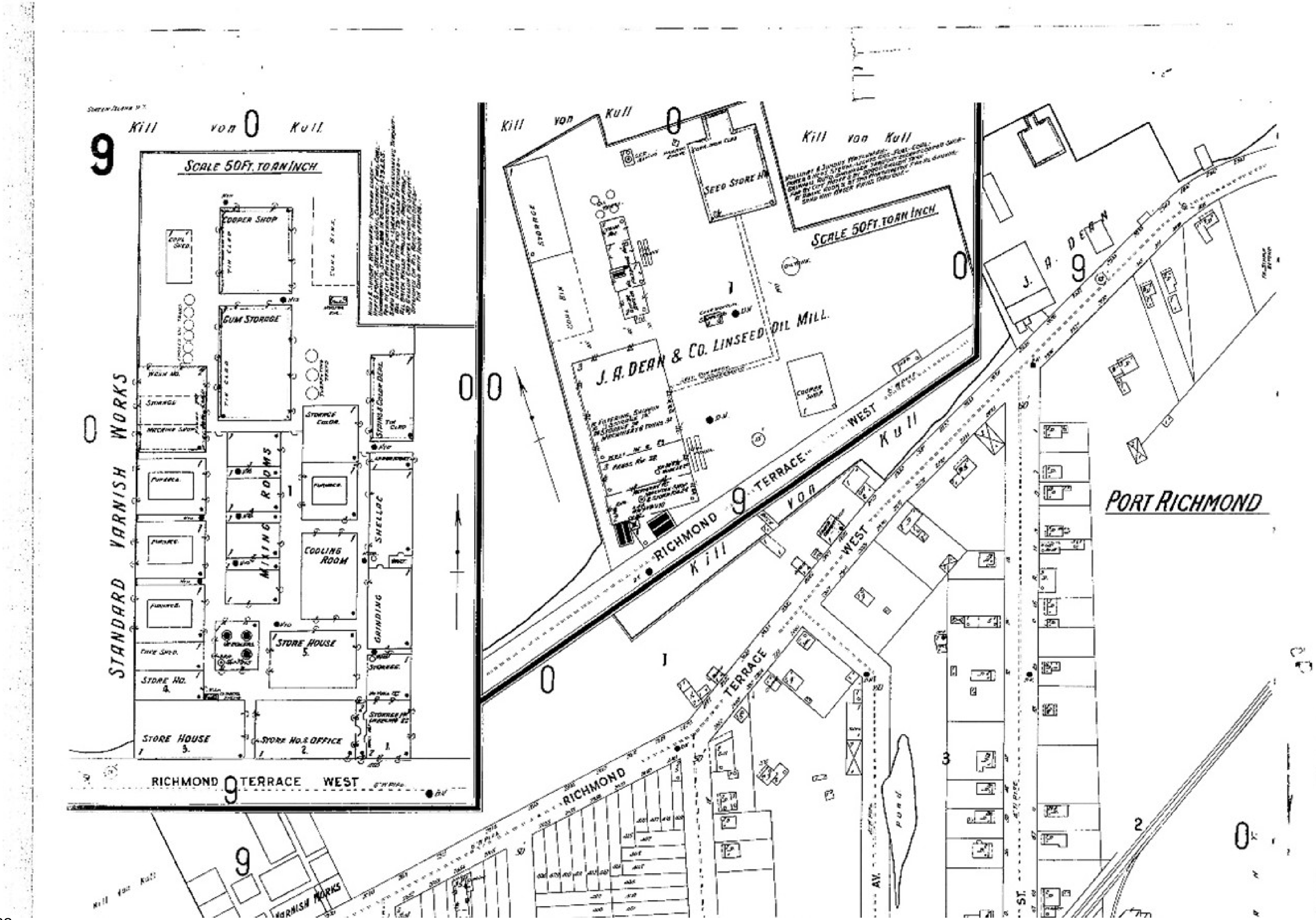

Image Source: loc.gov/resource

Figure 7-6. Sanborn Map of Staten Island Warehouse FUSRAP Site, 1898

N

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

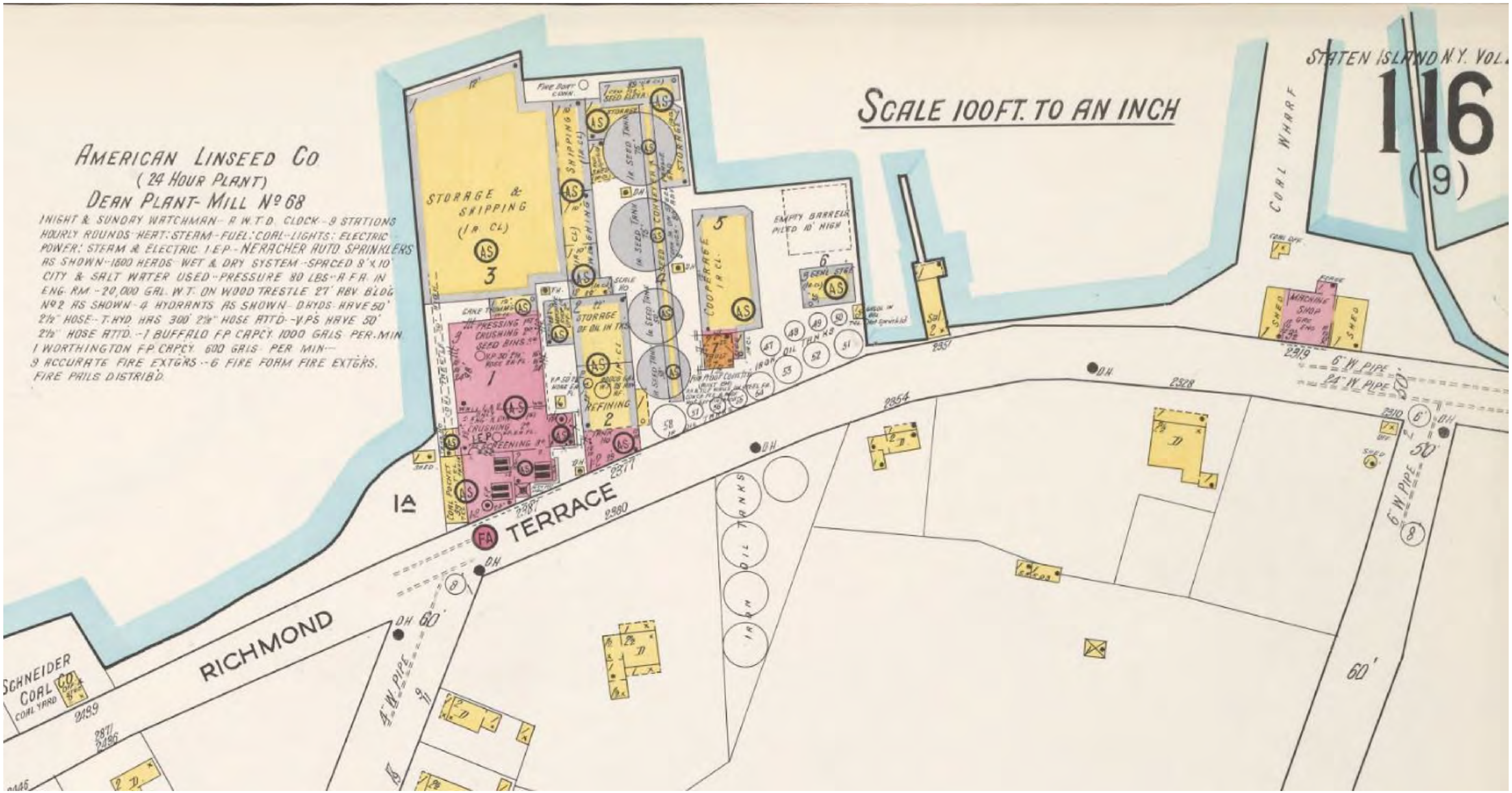

Image Source: loc.gov/resource

Approximate Scale: 1-inch = 100-feet

Figure 7-7. Sanborn Map of Staten Island Warehouse FUSRAP Site, 1917

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: https://maps.nyc.gov/then&now/

Figure 7-8. Aerial Photograph of Staten Island Warehouse FUSRAP Site, 1924

U.S. Army Corps of Engineers

GEO Consultants Corporation

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Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

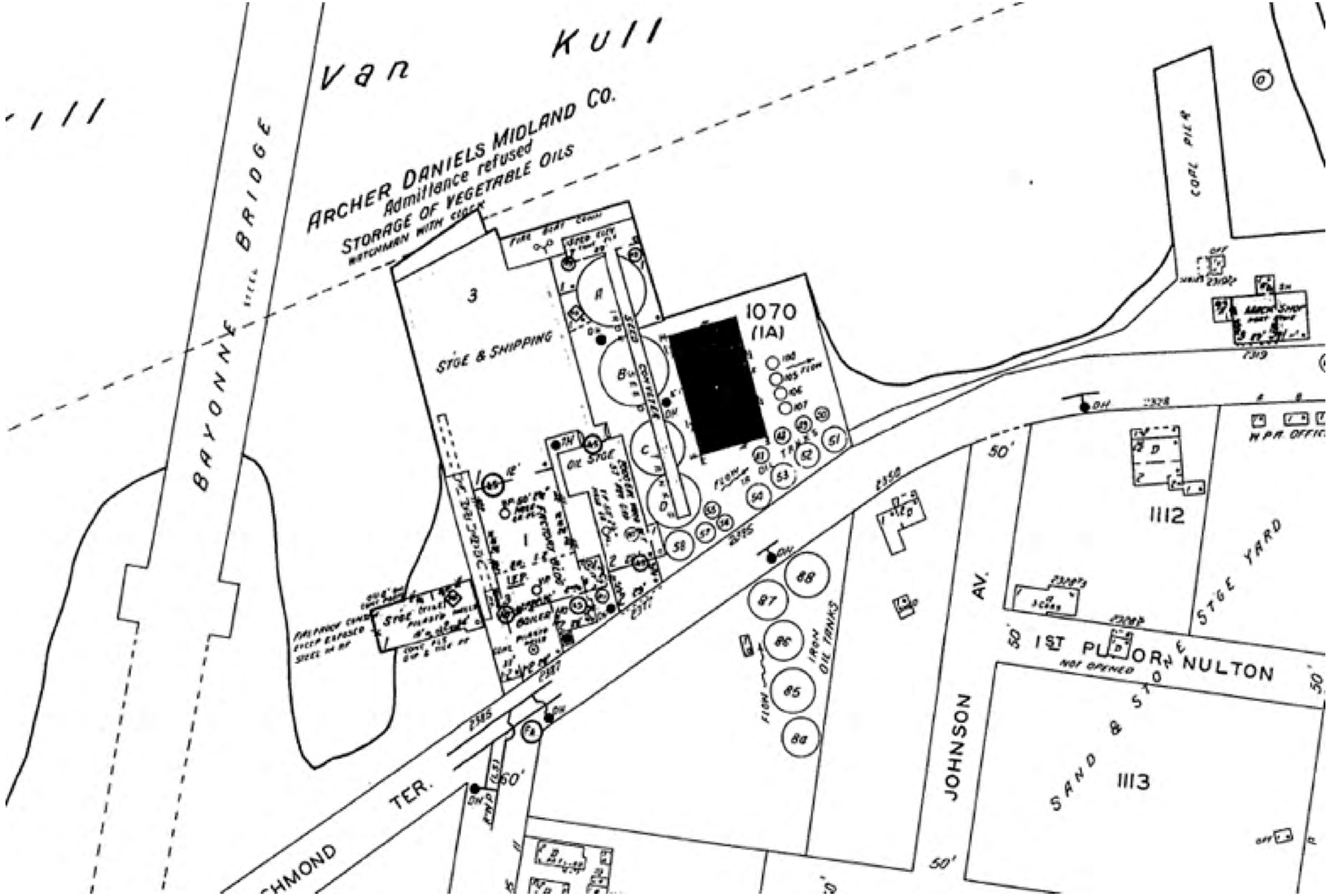

Image Source: loc.gov/resource

Figure 7-9. Sanborn Map Staten Island Warehouse FUSRAP Site, 1938

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: https://maps.nyc.gov/then&now/

Figure 7-10. Aerial Photograph of Staten Island Warehouse FUSRAP Site, 1944

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: https://maps.nyc.gov/then&now/

Approximate Scale 1-inch = 100-feet

N

Figure 7-11. Aerial Photograph of Staten Island Warehouse FUSRAP Site, 1951

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

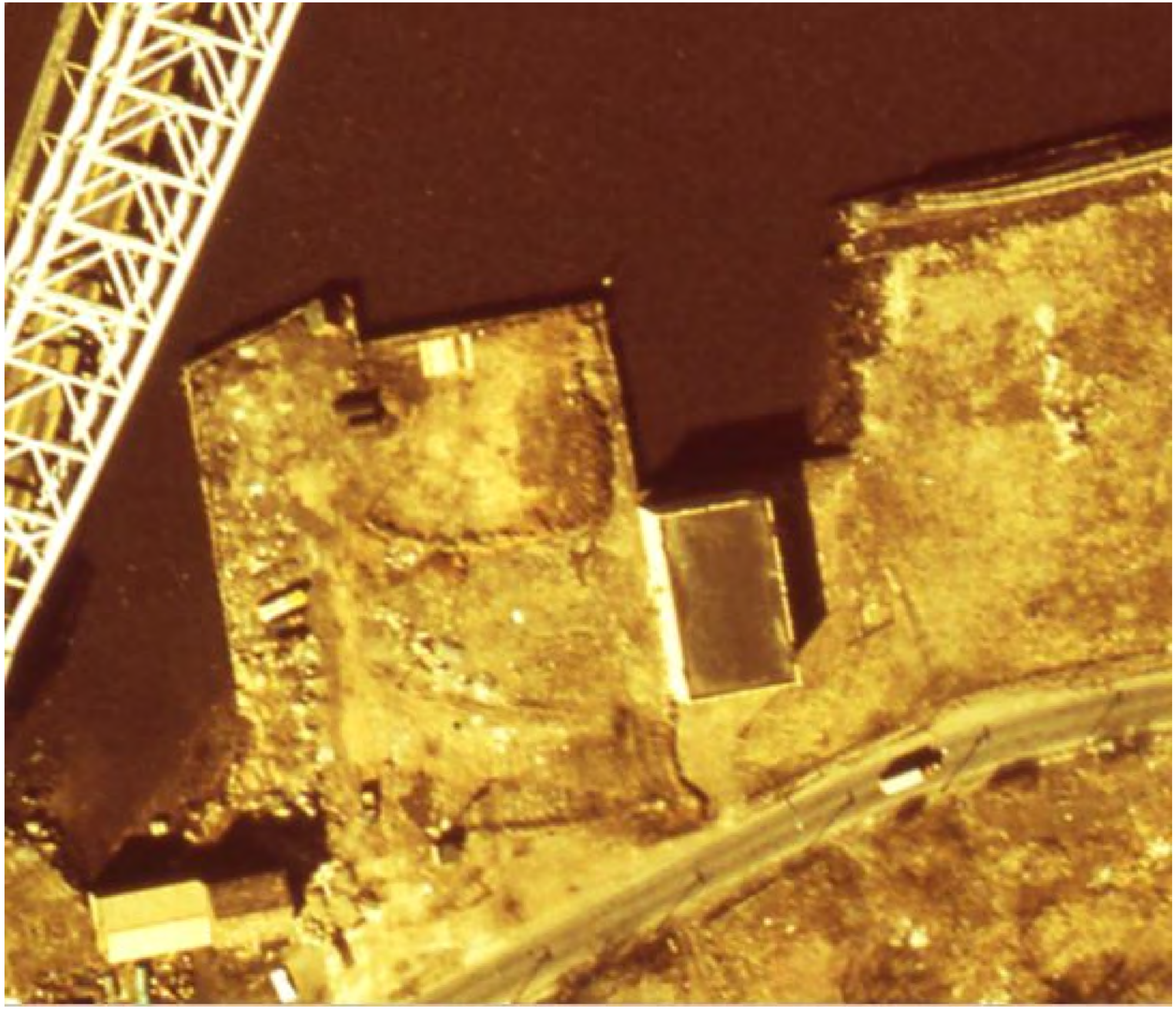

Image Source: unknown

Approximate Scale 1-inch = 100-feet

Figure 7-12. Aerial Photograph of Staten Island Warehouse FUSRAP Site, 1970

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source:
https://www.historicaerials.com/viewer/279927

Figure 7-13. Aerial Photograph of Staten Island Warehouse FUSRAP Site, 1980

U.S. Army Corps of Engineers

GEO Consultants Corporation

N

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Image Source: https://maps.nyc.gov/then&now/

Figure 7-14. Aerial Photograph Comparison of Shoreline Erosion
SIW Site - Northern Edge (2001 to 2018)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

Source: https://maps.nyc.gov/then&now/
Note: Low-tide level

Figure 7-15. Aerial Photograph Comparison of SIW Site Northwestern Corner of SCA (2001 to 2010, to 2018)

U.S. Army Corps of Engineers

GEO Consultants Corporation

Staten Island Warehouse
FUSRAP Site
Port Richmond, Staten Island, New York

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APPENDICES

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APPENDIX A

FIELD DOCUMENTS

(Field Logs, Sampling Forms, Daily Quality Control Report, Summary Reports, and Chain of Custody Forms)

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Daily Safety Tailgate Meeting Form

Job Name: Staten Island Number: 1 Date: 7-20-2021

Start Time: 0709 Completed: 0715 Site Location: Staten Island

SAFETY ISSUES

Tasks (this shift)	site set-up, mark-out soil boring locations, grubbing clearing
Protective Clothing/Equipment	hard-hat ~~[illegible]~~ safety glasses
Chemical Hazards	Radiation
Physical Hazards	traffic, construction equipment, fall hazards, water
Control Methods	PPE, zone set-up
Special Equipment/Techniques	Air monitors, rad scanning equipment
Hazard Communication Overview	Poison Ivy, Slippery Rocks
Nearest Phone	cell
Name/Address	2351 Richmond Terrace / Richmond University Hospital
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
David Lindsey	[signature]
JEFFREY J. WARREN	[signature]
Ben Hooks	[signature]
Megan Sherman	Megan Sherman

Meeting Conducted by: [signature]

Health and Safety Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island New York

Date: 9/20/2021

Briefed on-site Personnel regarding: Active "construction" business onsite, careful of cement mixing trucks, biological hazards, Radiological hazards, slip hazards water hazards, drilling hazards

Complete weekly for each site. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Documentation	Yes	No	N/O	N/A
1. Is the Site Health and Safely Plan (SSHP) on the Site?	✓			
2. Has the SSHP been reviewed, dated, and signed within the last year?	✓			
3. Are the tasks being completed reflected in the hazard task analysis?	✓			
4. Are emergency maps posted at the site and maintained in vehicles?	✓			
5. Were daily safety checklists completed and fire extinguishers checked?	✓			
6. Were applicable Material Safety Data Sheets at the Site?	✓			
Observations	Yes	No	N/O	N/A
7. Is required personal protective equipment available and correctly used, maintained, and stored?	✓			
8. Is the following emergency equipment located at each site:	✓ (All)			
-Fire extinguisher?	✓			
-Eyewash (15 minutes fresh water)?	✓			
-Communications (walkie-talkie or phone)?	✓			
-First aid kit?	✓			
9. Is the buddy system in use?	✓			
10. Is the site organized to allow the use of lifting equipment, avoid tripping hazards and spreading contamination?	✓			
11. Was a random employee asked if he/she knew site hazard and emergency procedures?	✓			
12. Is the drill rig kill switch clearly marked and easily accessible?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-20-2021

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 1

Sampling Date: 9-20-21

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?				✓
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?				✓
8. Were bottles adequately protected from contamination prior to sample identification?				✓

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?				✓
10. Was a field sampling form completed?				✓
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?				✓
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-20-2021

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/20/2021

Weather: ☒Clear, ☐Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☐50-70 °F, ☒70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: Northwest

Humidity: ☒ Dry, ☐Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	4		4	1
Zone set-up	4	Signs	4	4
Calibrate/set-up equipment	2	Air monitors, Gamma scan	2	5
Brush clearing	2	Wood-chipper, brush clearer	2	15
Scanning of equipment and personnel	1	Gamma scan		15

Problems Encountered	Corrective Action Taken
Physical set-up/condition of site is different than anticipated.	Will work in areas where it is physically possible and reasonable to work. Set up call to discuss plans moving forward.
Woodchipper stopped working towards end of shift.	Will have equipment running by morning or have replacement picked up.
Tripod for downhole scanning equipment driven back to shop for repair.	Tripod replaced. Did not effect todays work.

Tests: (List type and location of the tests performed and the results of these tests.)

N/A

Total Daily Hours Worked by all Personnel: 40

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
N/A	

Remarks:

Brush is thicker than anticipated, still should have it cleared tomorrow morning. Current tenant stated that it should be no problem removing concrete blocks to gain better/safer access to surface characterization area. Tomorrows activities will include safety tailgate meeting, completion of grubbing and clearing, gamma walkover scan, topographic and hydrographic surveys, completion of marking scheduled soil boring locations, and possible collection of sediment and surface samples.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoob

Date: 9-20-2021

Daily Safety Tailgate Meeting Form

Job Name: Staten Isand Number: 2 Date: 9-21-21

Start Time: 0707 Completed: 0715 Site Location: Staten Island

SAFETY ISSUES

Tasks (this shift)	complete brush clearing, gamma walkover survey
Protective Clothing/Equipment	PPE, long sleeve shirts, protective boot covers
Chemical Hazards	N/A (Radiation)
Physical Hazards	construction traffic, biological, slips trips, falls
Control Methods	different working zones, PPE
Special Equipment/Techniques	gamma scan, brush clearing equipment
Hazard Communication Overview	Sips, falls, Rad zones
Nearest Phone	cell
Name/Address	2351 Richmond Terrace / Richmond University Hospital
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
David Lindsey	[signature]
Ben Hooks	[signature]
JEFFREY J. WARREN	[signature]
Megan Sherman	Megan Sherman
Dan Kennedy	[signature]

Meeting Conducted by: David Lindsey

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 2

Sampling Date: 9-21-21

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?				✓
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?				✓
8. Were bottles adequately protected from contamination prior to sample identification?				✓

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?				✓
10. Was a field sampling form completed?				✓
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?				✓
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-21-21

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/21/2021

Weather: ☒Clear, ☐Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☐50-70 °F, ☒70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: Northwest

Humidity: ☒ Dry, ☐Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	4		4	1
Calibrate/set-up equipment	2	Air monitors, Gamma scan	2	10
Brush clearing	2	Wood-chipper, brush clearer	2	8
Walkover scan	2	Gamma scan	2	10
Site preparation; meet with USACE; site map	2	GPS	2	10
Supplies; return rental equipment	2		2	5

Problems Encountered	Corrective Action Taken
Physical set-up/condition of site is different than anticipated.	Site tenet moved barrier to provide access for drill rigs; coordinated with tenet and driller for advancing boring through concrete.
Woodchipper stopped working.	Stockpiled cuttings in area that will not impact subsequent site work.
Survey crew delayed and did not arrive on site today.	Will work with survey crew to reschedule and have work completed in a timely manner.

Tests: (List type and location of the tests performed and the results of these tests.)

Total Daily Hours Worked by all Personnel: 44

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
N/A	

Remarks:

The woodchipper was not functional and excess brush was stockpiled onsite and was moved away from the active work zones. The tenet moved the barrier wall blocks to provide access for the drill rig. The walkover gamma scan was conducted for the northern portion of the site, the area with concrete cover was not conducted. The survey crew did not arrive and the survey will likely be completed later this week. Tomorrow's activities will include safety tailgate meeting, planning meeting with USACE to discuss walkover survey results and boring locations, start of soil borings, and surface soil and sediment sampling.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoob

Date: 9-21-2021

Daily Safety Tailgate Meeting Form

Job Name: Staten Island Number: 3 Date: 9-22-21

Start Time: 0710 Completed: 0715 Site Location: Staten Island

SAFETY ISSUES

Tasks (this shift)	Sediment, surface and groundwater sampling
Protective Clothing/Equipment	PPE, Tyvek suits for those entering restricted zone
Chemical Hazards	~~NA~~ DU Radiation
Physical Hazards	Trips, slips, falls, biological, water, traffic
Control Methods	awareness, sectioned off zones
Special Equipment/Techniques	Gamma Scan
Hazard Communication Overview	Poison Ivy, water, slippery rocks
Nearest Phone	Cell
Name/Address	2351 Richmond Terrace / Richmond University Hospital
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
David Lindsay	[signature]
JEFFREY J. WARREN	[signature]
Megan Shurman	Megan Shur
Benjamin Hooks	[signature]
Robert Randazzo	[signature]
Jose Garcia	[signature]

Meeting Conducted by: [signature]

Borehole and Core Logging Checklist (Page 1 of 2)

Project Name/Number: Staten Island SSI Site: Staten Island, NY

Boring/Monitoring Well Number(s): SB-04, SB-05, SB-06, SB-07

Date: 9-22-2021

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a No is checked, provide an explanation on the noncompliance and Corrective Actions form.

Borehole Logging	Yes	No	N/O	N/A
1. Was boring logged by a geologist, geological engineer, or other qualified personnel?	✓			
2. Was log completed and entries printed legibly on the HTRW Drilling Log?	✓			
3. Was the log scale 1 inch = 1 foot?	✓			
4. Were logs completed in the field (originals)?	✓			
5. Does the log contain the following entries?				
-Unique borehole number	✓			
-Depositional type (alluvium, till, loess, etc.)	✓			
-Depths/Heights recorded in tenths of feet.	✓			
-Soils classified as per USCS and fully described with numerical percents of constituents.	✓			
-Soil moisture content and texture or cohesiveness.	✓			
6. Was general information (top of form HTRW drilling log) completed?	✓			
7. Were special conditions (i.e. intervals of hole instability) and their resolution recorded?	✓			
8. Were start and completion dates and time included for boring installation activities?	✓			
9. Were boundaries between soils noted (solid line at appropriate depth or dashed line if transitional or if observed in cuttings?	✓			
10. Were depths at which free water was encountered and stabilized water levels recorded?	✓			
11. Were soil sample depths recorded?	✓			
12. If changes in drilling or sampling methods or equipment and changes in sample or borehole diameter recorded?	✓			
13. Were soil sampling methods and recovery recorded?	✓			
14. Was observed evidence of contamination in samples, cuttings, or drilling fluids recorded?				✓
15. Were abbreviations used on the log defined?	✓			
16. Were drilling fluid losses including depth, rate, and volume in the subsurface recorded?				✓
Borehole Logging	Yes	No	N/O	N/A
17. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓
18. Were drilling pressures and driller's comments recorded?				✓
19. Was total depth recorded and marked with a double line?	✓			
20. Was monitoring well diagram completed and attached to log?				✓
21. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓

Borehole and Core Logging Checklist (Page 2 of 2)

Core Logging	Yes	No	N/O	N/A
22. Was rock described using standard geologic nomenclature; e.g. rock type, relative hardness, density, texture, color, weathering, bedding, fossils, crystals, and open or closed fractures, joints, bedding planes, or cavities and filling materials?	✓			
23. Was start and stop time of each core run recorded?	✓			
24. Were depths to top and bottom of each core run recorded?	✓			
25. Was length of core recovered in each core run recorded?	✓			
26. Were the size and type of coring bit and barrel recorded?	✓			
27. Was the depth to the bottom of the hole measured after the core was removed for each core run?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature:

Date: 9-23-21

Decontamination Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 1

Site: Staten Island, NY

Sampling Date: 9-22-21

Boring/Monitoring Well Number(s): SB-06, SB-07, SB-05, SB-04

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form. Complete Daily.

Equipment	Yes	No	N/O	N/A
1. Was all sampling equipment decontaminated properly prior to use and between sample intervals?	✓			
2. Was each decontamination event recorded in the logbook?	✓			
3. Was IDW (decontamination water) handled in accordance with the approved work plan?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-22-21

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/22/2021

Weather: ☐Clear, ☒Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☐50-70 °F, ☒70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: Northwest

Humidity: ☐ Dry, ☒Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	6		6	2
Calibrate/set-up equipment	2	Air monitors, Gamma scan	2	4
Drilling (direct push and SPT)	4	Geoprobe; PID	4	36
Downhole scan; sample scan	2	Gamma scan	2	18
Meet with USACE; project communication	2		2	4

Problems Encountered	Corrective Action Taken
Drill crew had equipment issues	Drill crew DPT equipment was inoperable, used SPT, hollow stem auger for first two boring (SB-6 and SB-7) while new barrel was being delivered.
Poor boring recovery	Multiple drill methods were tried (direct push, SPT, hollow stem auger) but little change in recovery. The mixed fill material is difficult to recover due to obstructions and when water saturated. We offset borings to find better recovery.
Survey crew delayed and did not arrive on site today	Survey crew has committed to being onsite tomorrow for topo and hydro surveys.

Tests: (List type and location of the tests performed and the results of these tests.)

Four soil borings were competed (SB-4, SB-5, SB-6, and SB-7), three were downhole scanned (SB-4 was not scanned)

Total Daily Hours Worked by all Personnel: 64

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
N/A	

Remarks:

Soil boring SB-4, SB-5, SB-6, and SB-7 were completed. Downhole logging of the borings was completed, except SB-4. New borings for SB-4, SB-6, and SB-7 will be completed using augers to provide a deeper hole for downhole scans. Tomorrow's activities will include safety tailgate meeting, continuation of soil borings, and surface soil and sediment sampling. We will also complete additional gamma walk over survey. Phone call made today with USACE regarding poor core recovery. A variety of options were discussed including replacing some soil borings with test pits, hand augering and a variety of drilling methods with the goal of bounding the elevated reading areas. GEO and Leidos will coordinate a plan going forward and discuss with USACE tomorrow.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoots

Date: 9-22-2021

Investigation-Derived Waste Management Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI

Site: Staten Island, New York

Sampling Date: 9-22-2021, 9-23-2021, 9-24-2021

Boring/Monitoring Well Number: SB-06, SB-07, SB-05, SB-04, SB-10, SB-09, SB-11, SB-12, SB-15, SB-14
SB-16, SB-08, SB-03, SB-01, SB-02, SB-17, SB-18, SB-19

Complete weekly for each site. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Investigation-Derived Waste Management	Yes	No	N/O	N/A
1. Was all IDW managed according to the Waste Management Plan?	✓			
2. Were soil cuttings, drilling fluids, decontamination water, development water, and PPE containerized?				✓
3. Were all containers properly labeled and stored?				✓
4. Were all containers in satisfactory condition?				✓

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-24-21

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / ~~3005~~ 3 DL 9-22-21

Sampling Date: 9-22-2021

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If “no” is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?	✓			
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?	✓			
8. Were bottles adequately protected from contamination prior to sample identification?	✓			

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?	✓			
10. Was a field sampling form completed?	✓			
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?	✓			
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-22-2021

Packing, Storing, and Shipment of Samples Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island, New York

Sampling Date: 9-22-2021

Boring/Monitoring Well Number(s): SB-04, SB-05, SB-06, SB-07

Sample ID(s): SS-04-0926, SB-04-0102, SB-04-0406, SS-05-0915, SB-05-0505, SB-05-0510, SS-06-0936, SB-06-0501, SB-06-0203, SS-07-0943, SB-07-0102, SB-07-0203

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Packing, Storing, and Shipment of Samples	Yes	No	N/O	N/A
1. Were the samples handled according to the Work Plan and QAPP?	✓			
2. Did the samples remain in ice from collection until cooler was taped for shipment?				✓
3. Were Chain of Custody forms filled out accurately and completely, including project name and number, sampling date, sampling time, analytical parameters, preservatives, size and number of containers for each analytical parameter, and media sampled?	✓			
4. Were Chain of Custody forms signed and dated by the preparer, placed in water resistant bagging, and included in the cooler?	✓			
5. Were signed and dated custody seals properly placed on the cooler and the cooler sealed with strapping tape?	✓			
6. Was a shipping label attached to the cooler?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-22-2021

Daily Safety Tailgate Meeting Form

Job Name: SIW Number: 4 Date: 9/23/21

Start Time: 0700 Completed: 0715 Site Location: Port Richmond

SAFETY ISSUES

Tasks (this shift)	Soil borings, gamma scan
Protective Clothing/Equipment	Tyvex
Chemical Hazards	Radiation
Physical Hazards	slip, trip, fall, struck-by,
Control Methods	awareness, sectioned off zones
Special Equipment/Techniques	gamma scan
Hazard Communication Overview	Poison ivy
Nearest Phone	Cell phone
Name/Address	2351 Richmond University / Richmond University Hospital
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
Benjamin Hooks	
David Lindsey	
Megan Sherman	
JEFFREY J. WARREN	
Jose Garcia	
Robert Randazzo	
Michael Bertelletti	
[illegible]	
STEVEN DIAZ	
Connor Rogers	
ALEXANDER JOSEPH	

Meeting Conducted by:

Borehole and Core Logging Checklist (Page 1 of 2)

Project Name/Number: Staten Island SSI Site: Staten Island, NY

Boring/Monitoring Well Number(s): SB-09, SB-10, SB-11, SB-12, SB-14, SB-15, SB-16

Date: 9-23-2021

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a No is checked, provide an explanation on the noncompliance and Corrective Actions form.

Borehole Logging	Yes	No	N/O	N/A
1. Was boring logged by a geologist, geological engineer, or other qualified personnel?	✓			
2. Was log completed and entries printed legibly on the HTRW Drilling Log?	✓			
3. Was the log scale 1 inch = 1 foot?	✓			
4. Were logs completed in the field (originals)?	✓			
5. Does the log contain the following entries?				
-Unique borehole number	✓			
-Depositional type (alluvium, till, loess, etc.)	✓			
-Depths/Heights recorded in tenths of feet.	✓			
-Soils classified as per USCS and fully described with numerical percents of constituents.	✓			
-Soil moisture content and texture or cohesiveness.	✓			
6. Was general information (top of form HTRW drilling log) completed?	✓			
7. Were special conditions (i.e. intervals of hole instability) and their resolution recorded?	✓			
8. Were start and completion dates and time included for boring installation activities?	✓			
9. Were boundaries between soils noted (solid line at appropriate depth or dashed line if transitional or if observed in cuttings?	✓			
10. Were depths at which free water was encountered and stabilized water levels recorded?	✓			
11. Were soil sample depths recorded?	✓			
12. If changes in drilling or sampling methods or equipment and changes in sample or borehole diameter recorded?	✓			
13. Were soil sampling methods and recovery recorded?	✓			
14. Was observed evidence of contamination in samples, cuttings, or drilling fluids recorded?				✓
15. Were abbreviations used on the log defined?	✓			
16. Were drilling fluid losses including depth, rate, and volume in the subsurface recorded?				✓
Borehole Logging	Yes	No	N/O	N/A
17. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓
18. Were drilling pressures and driller's comments recorded?				✓
19. Was total depth recorded and marked with a double line?	✓			
20. Was monitoring well diagram completed and attached to log?				✓
21. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓

Borehole and Core Logging Checklist (Page 2 of 2)

Core Logging	Yes	No	N/O	N/A
22. Was rock described using standard geologic nomenclature; e.g. rock type, relative hardness, density, texture, color, weathering, bedding, fossils, crystals, and open or closed fractures, joints, bedding planes, or cavities and filling materials?	✓			
23. Was start and stop time of each core run recorded?	✓			
24. Were depths to top and bottom of each core run recorded?	✓			
25. Was length of core recovered in each core run recorded?	✓			
26. Were the size and type of coring bit and barrel recorded?	✓			
27. Was the depth to the bottom of the hole measured after the core was removed for each core run?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: Date: 9-23-2021

Decontamination Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 2

Site: ~~9-23-2021~~ Staten Island, NY

Sampling Date: 9-23-2021

Boring/Monitoring Well Number(s): SB-10, SB-09, SB-11, SB-12, SB-15, SB-14, SB-16, SB-[illegible]

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form. Complete Daily.

Equipment	Yes	No	N/O	N/A
1. Was all sampling equipment decontaminated properly prior to use and between sample intervals?	✓			
2. Was each decontamination event recorded in the logbook?	✓			
3. Was IDW (decontamination water) handled in accordance with the approved work plan?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-23-21

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI/4

Sampling Date: 9-23-2021

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?	✓			
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?	✓			
8. Were bottles adequately protected from contamination prior to sample identification?	✓			

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?	✓			
10. Was a field sampling form completed?	✓			
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?	✓			
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-23-2021

Packing, Storing, and Shipment of Samples Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island, New York

Sampling Date: 9-23-2021

Boring/Monitoring Well Number(s): SB-08, SB-09, SB-10, SB-11, SB-12
SB-13, SB-14, SB-15, SB-16

Sample ID(s): SS-08-1400, SB-08-0102, SB-09-0117, SB-09-0506,
SS-10-0750, SB-10-0517, SB-10-0004, SB-10-0465, SB-10-0408, SS-09-0840
SB-09-0117, SB-09-0506, SS-11-1100, SB-11-0405, SB-11-0506, SS-12-1115
SB-12-0304, SB-12-0506, SB-12-0608, SB-12-1112, SS-15-1135,

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Packing, Storing, and Shipment of Samples	Yes	No	N/O	N/A
1. Were the samples handled according to the Work Plan and QAPP?	✓			
2. Did the samples remain in ice from collection until cooler was taped for shipment?				✓
3. Were Chain of Custody forms filled out accurately and completely, including project name and number, sampling date, sampling time, analytical parameters, preservatives, size and number of containers for each analytical parameter, and media sampled?	✓			
4. Were Chain of Custody forms signed and dated by the preparer, placed in water resistant bagging, and included in the cooler?	✓			
5. Were signed and dated custody seals properly placed on the cooler and the cooler sealed with strapping tape?	✓			
6. Was a shipping label attached to the cooler?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-23-2021

SB-15-0406, ~~SB-15-0406~~ SB-15-0608, SS-14-1205, SB-14-2540, SB-14-0406, SB-14-0608
SB-14-0812, SS-16-1300, SB-16-0002, SB-16-0235, SB-16-0204, ~~SB~~SS-08-1400
SB-08-0102, SB-16-0000

Surveying Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island, New York

Date: 9-23-2021

Complete one time for project. Answer each question by checking the appropriate column [yes, no, not observed (N/O) or not applicable (N/A)]. If a "No" is checked, provide an explanation on the Noncompliance and Corrective Action form.

Surveying	Yes	No	N/O	N/A
1. Was the Scope of Work reviewed with the surveyor?	✓			
2. Was the schedule for the work provided to the surveyor?	✓			
3. Was the survey completed by a licensed land surveyor?	✓			
4. Were locations surveyed for horizontal and vertical control?	✓			
5. Were conditions measured to the closest 0.1 feet and elevations measured to the closest 0.01 feet?	✓			
6. Was the survey marker and TOC surveyed for each monitoring well?				✓
7. Were surveyor's closure calculations reviewed?	✓			
8. Was surveyor interviewed by QC Inspector before leaving the Site?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-23-2021

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/23/2021

Weather: ☐Clear, ☒Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☐50-70 °F, ☒70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: West

Humidity: ☐ Dry, ☒Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	GEO, Leidos, AARCO Environmental, Rogers Surveying		10	2
Calibrate/set-up equipment	Leidos	Air monitors, Gamma scan	2	2
Drilling (direct push and SPT)	AARCO, GEO	Geoprobe; PID	4	14
Downhole scan; walkover scan	Leidos	Gamma scan	2	18
Sample collection	GEO	PID	2	14
Meet with USACE; project communication	GEO		1	1
Topographic and hydrographic survey	Rogers Surveyors	GPS; remote control boat	4	24
Equipment rental returns	GEO		1	3

Problems Encountered	Corrective Action Taken

Tests: (List type and location of the tests performed and the results of these tests.)

Seven soil borings were competed (SB-9, SB-10, SB-11, SB-12, SB-14, SB- 15, and SB-16) and associated surface and subsurface soil samples were collected.

Additional walk over survey was completed, downhole survey was completed on seven borings

Hydrographic survey was completed; topographic survey was started.

Total Daily Hours Worked by all Personnel: 78

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
Piece of overhead metal sheeting was ripping/coming apart south of our staging area.	Current tenant was informed and field crew was notified to try and avoid walking underneath that area.

Remarks:

All soil borings using the Geoprobe have been completed. All other borings will be done using hand augers due to location access. Test pits will be completed tomorrow and sediment samples will be collected. Additional boring will be started. Conducted phone conversation regarding placement of biased soil borings and test pits. SB-16 will be placed northwest of SB-05 and Northeast of SB-04. SB-17 will be placed north of SB-04 and SB-18 will be placed west of SB-04. SD-01 will be moved approximately 5-10 feet southeast of current proposed location. SD-10 will be used to sample "slag" material found west of SB-04, testing for waste characterization. SB-20 will be placed between SD-09 and SB-11. SB-19 (and it's 3 samples) will not be placed for the time being. SB-01, SB-02, SB-03, SB-08, SB-13, SB-17, SB-18, and SB-20 will be sampled using a hand auger instead of drill rig. Asked current tenant if they use or store of fly/coal ash on site, he informed me that they do not use that at this site, nor do they store it there.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoob

Date: 9-23-2021

Daily Safety Tailgate Meeting Form

Job Name: Staten Island Number: 5 Date: 9-24-2021

Start Time: 0730 Completed: 0745 Site Location: Staten Island

SAFETY ISSUES

Tasks (this shift)	test pit excavation
Protective Clothing/Equipment	PPE, Tykek suits
Chemical Hazards	N/A (Radiation)
Physical Hazards	slippery, muddy ground, overhead metal sheeting, biological
Control Methods	awareness / sectioned off zones
Special Equipment/Techniques	Mini excavator, gamma scanning equipment
Hazard Communication Overview	Slips, trips, mini excavator awareness
Nearest Phone	cell
Name/Address	2351 Richmond Terrace / Richmond University Hospital
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
David Lindsay	[signature]
Rob Randazzo	[signature]
Benjamin Hooks	[signature]
JEFFREY J. WARREN	[signature]
JOSE GARCIA	[signature]
Megan Sherman	Megan Sherman

Meeting Conducted by: [signature]

Borehole and Core Logging Checklist (Page 1 of 2)

Project Name/Number: Staten Island SSI Site: Staten Island, NY

Boring/Monitoring Well Number(s): SB-03, SB-01, SB-02, SB-19

Date: 9-24-2021

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a No is checked, provide an explanation on the noncompliance and Corrective Actions form.

Borehole Logging	Yes	No	N/O	N/A
1. Was boring logged by a geologist, geological engineer, or other qualified personnel?	✓			
2. Was log completed and entries printed legibly on the HTRW Drilling Log?	✓			
3. Was the log scale 1 inch = 1 foot?	✓			
4. Were logs completed in the field (originals)?	✓			
5. Does the log contain the following entries?				
-Unique borehole number	✓			
-Depositional type (alluvium, till, loess, etc.)	✓			
-Depths/Heights recorded in tenths of feet.	✓			
-Soils classified as per USCS and fully described with numerical percents of constituents.	✓			
-Soil moisture content and texture or cohesiveness.				
6. Was general information (top of form HTRW drilling log) completed?	✓			
7. Were special conditions (i.e. intervals of hole instability) and their resolution recorded?	✓			
8. Were start and completion dates and time included for boring installation activities?	✓			
9. Were boundaries between soils noted (solid line at appropriate depth or dashed line if transitional or if observed in cuttings?				
10. Were depths at which free water was encountered and stabilized water levels recorded?	✓			
11. Were soil sample depths recorded?	✓			
12. If changes in drilling or sampling methods or equipment and changes in sample or borehole diameter recorded?	✓			
13. Were soil sampling methods and recovery recorded?	✓			
14. Was observed evidence of contamination in samples, cuttings, or drilling fluids recorded?				✓
15. Were abbreviations used on the log defined?	✓			
16. Were drilling fluid losses including depth, rate, and volume in the subsurface recorded?				✓
Borehole Logging	Yes	No	N/O	N/A
17. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓
18. Were drilling pressures and driller's comments recorded?				✓
19. Was total depth recorded and marked with a double line?	✓			
20. Was monitoring well diagram completed and attached to log?				✓
21. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓

Borehole and Core Logging Checklist (Page 2 of 2)

Core Logging	Yes	No	N/O	N/A
22. Was rock described using standard geologic nomenclature; e.g. rock type, relative hardness, density, texture, color, weathering, bedding, fossils, crystals, and open or closed fractures, joints, bedding planes, or cavities and filling materials?	✓			
23. Was start and stop time of each core run recorded?	✓			
24. Were depths to top and bottom of each core run recorded?				✓
25. Was length of core recovered in each core run recorded?				✓
26. Were the size and type of coring bit and barrel recorded?				✓
27. Was the depth to the bottom of the hole measured after the core was removed for each core run?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: Date: 9-24-2021

Decontamination Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 3

Site: Staten Island, NY.

Sampling Date: 9-24-2021

Boring/Monitoring Well Number(s): SB-03, SB-01, SB-02, TS-01, TS-02, TS-03, TS-04, SB-17, SB-18, SB-19

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form. Complete Daily.

Equipment	Yes	No	N/O	N/A
1. Was all sampling equipment decontaminated properly prior to use and between sample intervals?	✓			
2. Was each decontamination event recorded in the logbook?	✓			
3. Was IDW (decontamination water) handled in accordance with the approved work plan?	✓			

Corrective Actions: ______________________________

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-24-21

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 5

Sampling Date: 9-24-2021

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?	✓			
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?	✓			
8. Were bottles adequately protected from contamination prior to sample identification?	✓			

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?	✓			
10. Was a field sampling form completed?	✓			
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?	✓			
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions: __________

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-24-2021

Packing, Storing, and Shipment of Samples Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island, New York

Sampling Date: 9-24-2021

Boring/Monitoring Well Number(s): SB-03, SB-01, SB-02, SB-17, SB-18
SB-19, Test Pits TS-01, TS-02, TS-03, TS-04

Sample ID(s): SS-03-0810, SB-03-0501, SB-03-0102, SS-01-0825
SB-01-0102, SB-01-0501, SS-02-0835, SB-02-0501, SB-02-0102
TS-01-0002, TS-01-0204, TS-02-0002, ~~to~~ WC-01-0002, TS-02-0304
TS-03-0002, TS-03-0204, SS-17-1230, SB-17-0102, SS-18-1250

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Packing, Storing, and Shipment of Samples	Yes	No	N/O	N/A
1. Were the samples handled according to the Work Plan and QAPP?	✓			
2. Did the samples remain in ice from collection until cooler was taped for shipment?	✓			
3. Were Chain of Custody forms filled out accurately and completely, including project name and number, sampling date, sampling time, analytical parameters, preservatives, size and number of containers for each analytical parameter, and media sampled?	✓			
4. Were Chain of Custody forms signed and dated by the preparer, placed in water resistant bagging, and included in the cooler?	✓			
5. Were signed and dated custody seals properly placed on the cooler and the cooler sealed with strapping tape?	✓			
6. Was a shipping label attached to the cooler?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-24-2021

SB-18-0125, SS-19-1310, SB-19-0102, SB-19-0225, WC-02-0001
TS-04-0002, TS-04-0406, TS-DUP-01, TS-DUP-02

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/24/2021

Weather: ☒Clear, ☐Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☒50-70 °F, ☐70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: West

Humidity: ☒ Dry, ☐Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	9		9	2
Calibrate/set-up equipment	2	Air monitors, Gamma scan	2	2
Test pits	4	Geoprobe; PID	4	32
Drilling (hand auger)	3		3	8
Scan soils, test pit samples	2		2	12
Downhole scan; compile data	1	Gamma scan	1	12
Topographic survey	3	GPS	3	24

Problems Encountered	Corrective Action Taken
Mini-excavator operator encountered refusal and groundwater in test pits at approximately 6 feet.	Attempted to dewater 2 of the test pits, attempts were unsuccessful. Pumped approximately 35-40 gpm for 15 minutes, water level did not lower.

Tests: (List type and location of the tests performed and the results of these tests.)

Eight soil borings were competed (SB-1, SB-2, SB-3, SB-8, SB-17, SB-18, and SB-19) and samples collected

Four test pits were completed and samples collected

Topographic survey was completed

Total Daily Hours Worked by all Personnel: 92

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
N/A	

Remarks:

Test pits have been completed. Two soil borings remain to complete. Sediment sampling will be completed on Monday.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoch

Date: 9-24-2021

Daily Safety Tailgate Meeting Form

Job Name: Staten Island Number: 6 Date: 9-27-2021

Start Time: 0705 Completed: 0712 Site Location: Staten Island

SAFETY ISSUES

Tasks (this shift)	Groundwater samples, sediment sampling, SB sampling, downhole logging
Protective Clothing/Equipment	Tyvek Suits, PPE YSI water quality meter & gamma scanner
Chemical Hazards	standards (Radiation)
Physical Hazards	steep slopes, water, slippery surfaces
Control Methods	awareness / sectioned off zones
Special Equipment/Techniques	gamma scan meter
Hazard Communication Overview	slips, falls, rad awareness
Nearest Phone	Cell
Name/Address	2351 Richmond Terrace / Hospital Richmond University
(incidents, actions taken, etc.)	

ATTENDEES

Print Name	Sign Name
David Lindsey	[signature]
Ben Hoover	[signature]
JEFFREY J. WARREN	[signature]
Megan Shuman	Megan Shu

Meeting Conducted by: [signature]

Borehole and Core Logging Checklist (Page 1 of 2)

Project Name/Number: Staten Island SSI Site: Staten Island, NY

Boring/Monitoring Well Number(s): SB-24, SB-23,

Date: 9-27-2021

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a No is checked, provide an explanation on the noncompliance and Corrective Actions form.

Borehole Logging	Yes	No	N/O	N/A
1. Was boring logged by a geologist, geological engineer, or other qualified personnel?	✓			
2. Was log completed and entries printed legibly on the HTRW Drilling Log?	✓			
3. Was the log scale 1 inch = 1 foot?	✓			
4. Were logs completed in the field (originals)?	✓			
5. Does the log contain the following entries?				
-Unique borehole number	✓			
-Depositional type (alluvium, till, loess, etc.)	✓			
-Depths/Heights recorded in tenths of feet.	✓			
-Soils classified as per USCS and fully described with numerical percents of constituents.	✓			
-Soil moisture content and texture or cohesiveness.	✓			
6. Was general information (top of form HTRW drilling log) completed?	✓			
7. Were special conditions (i.e. intervals of hole instability) and their resolution recorded?	✓			
8. Were start and completion dates and time included for boring installation activities?	✓			
9. Were boundaries between soils noted (solid line at appropriate depth or dashed line if transitional or if observed in cuttings?	✓			
10. Were depths at which free water was encountered and stabilized water levels recorded?	✓			
11. Were soil sample depths recorded?	✓			
12. If changes in drilling or sampling methods or equipment and changes in sample or borehole diameter recorded?	✓			
13. Were soil sampling methods and recovery recorded?	✓			
14. Was observed evidence of contamination in samples, cuttings, or drilling fluids recorded?				✓
15. Were abbreviations used on the log defined?	✓			
16. Were drilling fluid losses including depth, rate, and volume in the subsurface recorded?				✓
Borehole Logging	Yes	No	N/O	N/A
17. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓
18. Were drilling pressures and driller's comments recorded?				✓
19. Was total depth recorded and marked with a double line?	✓			
20. Was monitoring well diagram completed and attached to log?				✓
21. Was drilling fluid described (water source, additive brand, product name, and mixture)?				✓

Borehole and Core Logging Checklist (Page 2 of 2)

Core Logging	Yes	No	N/O	N/A
22. Was rock described using standard geologic nomenclature; e.g. rock type, relative hardness, density, texture, color, weathering, bedding, fossils, crystals, and open or closed fractures, joints, bedding planes, or cavities and filling materials?	✓			
23. Was start and stop time of each core run recorded?	✓			
24. Were depths to top and bottom of each core run recorded?				✓
25. Was length of core recovered in each core run recorded?				✓
26. Were the size and type of coring bit and barrel recorded?				✓
27. Was the depth to the bottom of the hole measured after the core was removed for each core run?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-27-2021

Decontamination Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI / 4

Site: Staten Island NY

Sampling Date: 9-27-21

Boring/Monitoring Well Number(s): Sediment samples, surface samples, SB-24, SB-23, groundwater samples

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form. Complete Daily.

Equipment	Yes	No	N/O	N/A
1. Was all sampling equipment decontaminated properly prior to use and between sample intervals?	✓			
2. Was each decontamination event recorded in the logbook?	✓			
3. Was IDW (decontamination water) handled in accordance with the approved work plan?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-27-2021

FIELD DATA SHEET

Project Data

Site: Staten Island SSI | **Contract No:** W912DQ-19-D-3005
Client: USACE | **Delivery Order:** W912DQ21F3015

Sample Data

Sample ID(s): GW-06-1205 | Field Duplicate: YES NO | ID: None
Sample Time: 1205 | MS/MSD collected: YES NO | ID: None

Analysis Data (circle required)

VOCs SVOCs Radiological CO2 Waste Alkalinity Metals
Pesticides PAHs Herbicides PCBs Explosives TCLP Sulfides

Well Data

Soil Boring/Sediment ID: SB-06 | Depth to water: DL 9-27-21 +5 ft btoc
Date: 9-27-21 | Total depth of well: ______ ft btoc
Sampler(s): David Lindsey/Ben Hooks | Height of purge column: ______ ft
Sample type: Groundwater | **Pump, Controller settings**
Sample Depth: 5-6 ft bgs | Pressure: Bailer psi
Field Fe II: ______ mg/L | Refill/discharge time: ______ sec

Not enough water to fill more than one bottle asking lab to create Dup if possible

Weather Conditions (circle):

Cloudy	Snowy	Temperature: 78 °F
Sunny	Fog	Barometric
Rainy	Other:	Pressure: in Hg

Purge Data

Time	Pump Flow Rate (mL/min)	Depth to GW (ft botc)	Water Quality Parameters Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH S.U.	ORP (mV)	Turbidity (NTU)
Initial Stablization Criteria	Stable Water Level	Stable or Decreasing	±0.5°C	±1% of full-scale; default ±20 µS/cm	±0.1 if < 1 mg/L; ±10% if > 1 mg/L	±0.1 S.U.	±10mV	<50 NTU
1204	Bailer	5	21.0	3418	5.84	6.47	39.1	110

DL 9-27-21

FIELD DATA SHEET

Project Data

Site: Staten Island SSI | **Contract No:** W912DQ-19-D-3005
Client: USACE | **Delivery Order:** W912DQ21F3015

Sample Data

Sample ID(s): GW-07-1215 | Field Duplicate: YES NO | ID: None
Sample Time: 1215 | MS/MSD collected: YES NO | ID: None

Analysis Data (circle required)

VOCs SVOCs Radiological CO2 Waste Alkalinity Metals
Pesticides PAHs Herbicides PCBs Explosives TCLP Sulfides

Well Data

Soil Boring/Sediment ID: SB-07 | Depth to water: 4 ft btoc
Date: 9-27-21 | Total depth of well: ft btoc
Sampler(s): David Lindsey/Ben Hooks | Height of purge column: ft
Sample type: Groundwater | **Pump, Controller settings**
Sample Depth: 4 ft bgs | Pressure: Bailer psi
Field Fe II: mg/L | Refill/discharge time: sec

Weather Conditions (circle):

Cloudy	Snowy	Temperature: 78 °F
Sunny	Fog	Barometric
Rainy	Other:	Pressure: in Hg

Purge Data

Time	Pump Flow Rate (mL/min)	Depth to GW (ft botc)	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH S.U.	ORP (mV)	Turbidity (NTU)
			Water Quality Parameters					
Initial Stablization Criteria	Stable Water Level	Stable or Decreasing	±0.5°C	±1% of full-scale; default ±20 µS/cm	±0.1 if < 1 mg/L; ±10% if > 1 mg/L	±0.1 S.U.	±10mV	<50 NTU
1214	Bailer	4	20.6	3191	5.67	6.18	42.6	156

DL 9-27-21

FIELD DATA SHEET

Page of

Project Data

Site: Staten Island SSI — **Contract No:** W912DQ-19-D-3005

Client: USACE — **Delivery Order:** W912DQ21F3015

Sample Data

Sample ID(s): GW-09-1210 — Field Duplicate: YES NO — ID: None

Sample Time: 1210 — MS/MSD collected: YES NO — ID: None

Analysis Data (circle required)

VOCs	SVOCs	Radiological	CO2	Waste	Alkalinity	Metals
Pesticides	PAHs	Herbicides	PCBs	Explosives	TCLP	Sulfides

Well Data

Soil Boring/Sediment ID: SB-09 — Depth to water: 5 ft btoc

Date: 9-27-21 — Total depth of well: ft btoc

Sampler(s): David Lindsey/Ben Hooks — Height of purge column: ft

Sample type: Groundwater — **Pump, Controller settings**

Sample Depth: 5-6 ft bgs — Pressure: Bailer psi

Field Fe II: mg/L — Refill/discharge time: sec

Weather Conditions (circle):

Cloudy	Snowy	Temperature: 77 °F
Sunny	Fog	Barometric
Rainy	Other:	Pressure: in Hg

Purge Data

Time	Pump Flow Rate (mL/min)	Depth to GW (ft botc)	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH S.U	ORP (mV)	Turbidity (NTU)
Initial Stablization Criteria	Stable Water Level	Stable or Decreasing	±0.5°C	±1% of full-scale; default ±20 µS/cm	±0.1 if < 1 mg/L; ±10% if > 1 mg/L	±0.1 S.U.	±10mV	<50 NTU
1209	Bailer	5	21.1	3290	4.99	6.18	43.9	218

DL 9-27-21

FIELD DATA SHEET

Page ____ of ____

Project Data

Site: Staten Island SSI **Contract No:** W912DQ-19-D-3005

Client: USACE **Delivery Order:** W912DQ21F3015

Sample Data

Sample ID(s): GW-10-1220 Field Duplicate: YES NO ID: None

Sample Time: 1220 MS/MSD collected: YES NO ID: None

Analysis Data (circle required)

VOCs SVOCs Radiological CO2 Waste Alkalinity Metals

Pesticides PAHs Herbicides PCBs Explosives TCLP Sulfides

Well Data

Soil Boring/Sediment ID: SB-10 Depth to water: 6 ft btoc

Date: 9-27-21 Total depth of well: ______ ft btoc

Sampler(s): David Lindsey/Ben Hooks Height of purge column: ______ ft

Sample type: Groundwater **Pump, Controller settings**

Sample Depth: 6-7 ft bgs Pressure: Bailer psi

Field Fe II: ______ mg/L Refill/discharge time: ______ sec

Weather Conditions (circle):

Cloudy Snowy Temperature: 78 °F

Sunny Fog Barometric

Rainy Other: Pressure: in Hg

Purge Data

Time	Pump Flow Rate (mL/min)	Depth to GW (ft botc)	Water Quality Parameters Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH S.U.	ORP (mV)	Turbidity (NTU)
Initial Stablization Criteria	Stable Water Level	Stable or Decreasing	±0.5°C	±1% of full-scale; default ±20 µS/cm	±0.1 if < 1 mg/L; ±10% if > 1 mg/L	±0.1 S.U.	±10mV	<50 NTU
1219	bailer	6	20.6	3308	4.93	6.20	45.1	94.7

BC 9-27-21

Health and Safety Checklist (Page 1 of 1)

Project Name/Number: Staten Island SI / 3005

Site: Staten Island, New York

Date: 9-27-2021

Briefed on-site Personnel regarding: Radiological hazards, water hazards slippery surfaces (Rocks) tripping hazards, large moving trucks, equipment.

Complete weekly for each site. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Documentation	Yes	No	N/O	N/A
1. Is the Site Health and Safely Plan (SSHP) on the Site?	✓			
2. Has the SSHP been reviewed, dated, and signed within the last year?	✓			
3. Are the tasks being completed reflected in the hazard task analysis?	✓			
4. Are emergency maps posted at the site and maintained in vehicles?	✓			
5. Were daily safety checklists completed and fire extinguishers checked?	✓			
6. Were applicable Material Safety Data Sheets at the Site?	✓			
Observations	Yes	No	N/O	N/A
7. Is required personal protective equipment available and correctly used, maintained, and stored?	✓			
8. Is the following emergency equipment located at each site:	✓(All)			
-Fire extinguisher?	✓			
-Eyewash (15 minutes fresh water)?	✓			
-Communications (walkie-talkie or phone)?	✓			
-First aid kit?	✓			
9. Is the buddy system in use?	✓			
10. Is the site organized to allow the use of lifting equipment, avoid tripping hazards and spreading contamination?	✓			
11. Was a random employee asked if he/she knew site hazard and emergency procedures?	✓			
12. Is the drill rig kill switch clearly marked and easily accessible?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-27-2021

Investigation-Derived Waste Management Checklist (Page 1 of 1)

Project Name/Number: Staten Island

Site: Staten Island, New York

Sampling Date: 9-27-2021

Boring/Monitoring Well Number: SB-24, SB-23,

Complete weekly for each site. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Investigation-Derived Waste Management	Yes	No	N/O	N/A
1. Was all IDW managed according to the Waste Management Plan?	✓			
2. Were soil cuttings, drilling fluids, decontamination water, development water, and PPE containerized?				✓
3. Were all containers properly labeled and stored?				✓
4. Were all containers in satisfactory condition?				✓

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature:

Date: 9-27-2021

Mobilization/Demobilization Check list (Page 1 of 3)

Project Name/Number: Staten Island SSI

Site: Staten Island, NY

Date: 9-20-2021 to 9-27-2021

Complete as indicated. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a No is checked, provide an explanation on the noncompliance and Corrective Actions form.

Complete 4 weeks prior to start of field activities.

Site Access and Security	Yes	No	N/O	N/A
1. Has a copy of the Right of Entry Permit(s) been received?	✓			
2. Are the time frames of the Right of Entry Permit(s) adequate for the entire job including IDW disposal?	✓			

Permits and Licenses	Yes	No	N/O	N/A
3. Are all subcontractors licensed to operate in the state?	✓			
4. Are license numbers of subcontractors recorded in the project files?	✓			
5. Have subcontractors provided proof of insurance?	✓			
6. Have variances been obtained from the state?				✓
If yes, provide a lists of variances obtained:				

Coordination with Property Owners and Tenants	Yes	No	N/O	N/A
7. Has the property owner been contacted?	✓			
8. Did the property owner designate a contractor staging area?				✓
9. Did the property owner designate a contractor IDW staging area?				✓
10. Did the property owner approve a source for water?	✓			

Coordination with Environmental Authorities	Yes	No	N/O	N/A
11. Has the State approved the Work Plan?	✓			
12. Has the State been informed of planned sampling events?	✓			
13. Has USEPA approved the Work Plan?				✓
14. Has USEPA been informed of planned sampling events?				✓

Mobilization/Demobilization Check list (Page 2 of 3)

Complete 1 week prior to start of field activities.

Safety Planning and Equipment	Yes	No	N/O	N/A
15. Has the SSHP been submitted to the subcontractors for review?	✓			
16. Have all personnel read and signed the SSHP?	✓			
17. Was the local hospital contacted to verify the phone number and address?	✓			
18. Can the hospital treat anticipated chemical exposures?	✓			
19. Have all field personnel been fit-tested for respirator use?				✓
20. Were all training certificates, including subcontractors, in a file to take to the field?	✓			
21. Are all training certificates current?	✓			
22. Are all MSDSs in a file to take to the field?	✓			
23. Are all required instruments reserved and complete with calibration standards and manuals?	✓			
24. Do the instruments meet manufacture maintenance and calibration standards?	✓			
25. Does the PID have the correct lamp?				✓
26. Does the LEL meter have the correct sensors?				✓
27. Are the detector tubes current and stored properly?				✓

Complete within 1 week of Notice to Proceed.

Logistical Planning	Yes	No	N/O	N/A
28. Have the Work Plan documents been approved by USACE?	✓			
29. Has the SSHP been approved by Health and Safety Services?				✓
30. Has Notice to Proceed from USACE been received?	✓			
31. Are the project personnel available and scheduled?	✓			
32. Are subcontractors available?	✓			
33. Do subcontractors' SOWs correspond to the approved Work Plan?	✓			
34. Has the laboratory agreed to the planned sample volume load?	✓			
35. Has the bottle order been placed?	✓			
36. Have the correct sample containers been received?	✓			
37. Has USACE been notified of schedule?	✓			

Complete not less than 1 week before fieldwork is scheduled to begin.

Utility Clearances	Yes	No	N/O	N/A
38. Has the State or Local utility clearance agency been contacted and a meeting scheduled?	✓			
39. Has a representative from each notified utility agency been called to confirm the utility meeting?	✓			
40. Was a utility work authorization number recorded?	✓			
41. Was the property owner asked about the existence of any underground utilities or tanks?	✓			
42. Has a UXO survey been conducted at the site?				✓
43. If yes to Question 42, is a report available?				✓

Mobilization/Demobilization Check list (Page 3 of 3)

Environmental Site Protection	Yes	No	N/O	N/A
44. Are drilling and sampling locations accessible without property damage?	✓			
45. Is work area limited to prevent property damage?	✓			
46. Is IDW area greater than 100 feet away from a major stream, tributary, or drinking water well?				✓
47. If field activities damage property, will measures be taken to restore the Site (explain below)?				✓

Demobilization	Yes	No	N/O	N/A
48. Was the site returned, as much as possible, to its original condition?	✓			
49. Was each work area policed for trash?	✓			
50. Did the site point of contact inspect the site?	✓			
51. Was the integrity of each drum of IDW inspected?				✓

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-28-2021

Sample Collection Checklist (Page 1 of 1)

Project Name/Number: Staten Island SSI /6

Sampling Date: 9-27-2021

Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If "no" is checked, provide an explanation on the form.

General	Yes	No	N/O	N/A
1. Were new protective gloves worn between sampling locations and/or intervals?	✓			
2. Were samples collected using methods described in the Work Plan?	✓			
3. Were sample containers filled in the correct order?	✓			
4. Was sampling equipment appropriate for the purpose and site conditions?	✓			
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?	✓			
6. Were procedures for collecting QA/QC samples followed as per the Work Plan?	✓			
7. Were sampling locations properly identified by land survey or GPS locator?	✓			
8. Were bottles adequately protected from contamination prior to sample identification?	✓			

Soil samples for chemical analysis	Yes	No	N/O	N/A
9. Were samples collected according to the Work Plan?	✓			
10. Was a field sampling form completed?	✓			
11. Were the analytical parameters and QA/QC samples recorded on the Field Data Sheet?	✓			
12. Was headspace in sample containers for volatiles eliminated?				✓

Air samples for chemical analysis	Yes	No	N/O	N/A
13. Were the following forms filled out completely for each building sampled for Vapor Intrusion?				✓
-the Building Questionnaire				✓
-the Field Data Air Sampling Form	✓			
-the Indoor Air Quality Building Survey				✓
-the Air Sampling Log, including barometric pressure				✓
14. Were samples collected according to the Work Plan?	✓			
15. Were sampling port and canister valves open and closed in correct sequence?	✓			

Corrective Actions:

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-27-2021

Packing, Storing, and Shipment of Samples Checklist (Page 1 of 1)

Project Name/Number: Staten Island

Site: Staten Island, New York

Sampling Date: 9-27-2021

Boring/Monitoring Well Number(s): SB-23, SB-24, SB-06, SB-07, SB-09, SB-10 [groundwater]

Sample ID(s): SD-09-0750, SD-06-0754, SD-07-0758

SD-05-0800, SD-08-0805, SD-02-0810, SD-DUP-02, SD-01-0813

SD-03-0815 SD-10-0816, SD-04-0910, SD-MS, SD-MS-DUP

SS-22-0935, ~~SS-25~~ SS-25-0940, SS-24-0941, SS-21-1000

Complete daily. Answer each question by checking the appropriate column [yes, no, not observed (N/O), or not applicable (N/A)]. If a "no" is checked, provide an explanation on the Noncompliance or Corrective Actions form.

Packing, Storing, and Shipment of Samples	Yes	No	N/O	N/A
1. Were the samples handled according to the Work Plan and QAPP?	✓			
2. Did the samples remain in ice from collection until cooler was taped for shipment?				✓
3. Were Chain of Custody forms filled out accurately and completely, including project name and number, sampling date, sampling time, analytical parameters, preservatives, size and number of containers for each analytical parameter, and media sampled?	✓			
4. Were Chain of Custody forms signed and dated by the preparer, placed in water resistant bagging, and included in the cooler?	✓			
5. Were signed and dated custody seals properly placed on the cooler and the cooler sealed with strapping tape?	✓			
6. Was a shipping label attached to the cooler?	✓			

The QC inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: [signature]

Date: 9-27-2021

SB-24-1000, ~~SB-24-1000~~ SB-MS-24, SB-MSD-24, SS-23-1014, SS-13-1015

SS-20-1020, SB-23-0102, SB-DUP-23, SB-06-1205, SB-09-1210, SB-07-1215

SB-10-1220

FIELD ENVIRONMENTAL INSTRUMENTS, INC.
www.fieldenvironmental.com

301 Brushton Ave
Suite A
Pittsburgh, PA 15221
Toll Free (800) 393-4009
Local (412) 436-2600
Fax (412) 436-2616

YSI 6-Series Calibration Certificate

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 7 @ 25^C	8012081	12/17/2021	7.08	7.00	(6.86 to 7.14)
			pH mV value	-23.4	(0 mV +/- 50mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 4 @ 25^C	7007637	8/14/2022	4.05	4.00	(3.92 to 4.08)
			pH mV value	146.80	(141.6mV to 156.6mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 10 @ 25^C	7007076	7/1/2022	9.94	10.00	(9.80 to 10.20)
			pH mV value	-189.30	(-188.4mV to -203.4mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
Conductivity	8012061	12/16/2022	1.211	1.409	(1.338 to 1.479)

Dissolved Oxygen

	Pre-Cal Reading	Post-Cal Reading	
100% Saturation	8	8.43	mg/L

Check Standard	Temp °C	Relative Reading	Acceptable Range
ORP	24.0	220.0	(+/- 20mV)
	mV Offset	24.3	(0 +/- 100)

Turbidity	Pre-Cal Reading	Post-Cal Reading
0 NTU	0.0	0.0
124 NTU	100.0	124.0

Model	YSI Pro DSS
Cable Length	10 Meter
Cable SN	
S/N	18L104691
Barcode	U94329X
Order #	466038

Calibrated By: Nevin Yenchenko

Date of Calibration: 9/20/2021

*Solutions provided by LabChem (412-826-5230)

All calibrations performed by FEI conform to manufacturer's specifications. Please report any issues within 24 hours of receiving equipment.
All calibration solutions used are traceable to NIST. Additional documentation is available upon request.

Daily Quality Control Report (Page 1 of 2)

Project Name/Number: Staten Island Supplemental Site Inspection W912DQ21F3015

Site: Staten Island, New York

Date: 9/27/2021

Weather: ☒Clear, ☐Overcast, ☐Rain, ☐Thunderstorm, ☐Snow

Temperature: ☐ <32°F, ☐ 32-50 °F, ☐50-70 °F, ☒70-85 °F, ☐85+ °F

Wind: ☐Still, ☐Gusty, ☒Moderate, ☐High; Direction: West

Humidity: ☒ Dry, ☐Moderate, ☐ Humid

Activity	Contractor/ Subcontractor	Equipment	Number of Workers	Total Hours Worked
Safety tailgate meeting	4		4	1
Calibrate/set-up equipment	2	Air monitors, Gamma scan, YSI water quality meter	2	2
Collect sediment, surface and subsurface samples	2		2	8
Scan soil samples	1	Gamma scan	1	2
Downhole scan; compile data	1	Gamma scan	1	6
Sample groundwater	2		2	6
Demobilize site; drop off samples/rental equipment	4		4	13

Problems Encountered	Corrective Action Taken
Due to the location of SB-13 and SB-20, only a surface sample was accessible.	The two subsurface samples for SB-13 and SB-20 each (4 total) were replaced by SB-23 and SB-24. SB-13 and SB-20 were changed to surface samples only.

Tests: (List type and location of the tests performed and the results of these tests.)

Surface and sediment samples were collected, groundwater was sampled from 4 borings

Two additional borings were advanced (SB-23 and SB-24). Samples shipped for remaining samples not shipped last week.

SB-23, SB-24, SB-19, SB-16, SB-3, SB-2, and SB-1 were downhole gamma scanned. Surface samples SS-21, SS-22, and SS-25 were added in replacement for the individual samples not used for SB-08, SB-17, and SB-18.

Total Daily Hours Worked by all Personnel: 38

Daily Quality Control Report (Page 2 of 2)

Safety: Activity Safety Inspection	
Safety Deficiencies Observed	Corrective Action Taken
N/A	

Remarks:

Fieldwork activities have been completed.

Safety Statistics	
Number of First Aid Incidents:	0
Number of Recordable Incidents:	0
Number of Lost Time Days:	0

The FOM shall complete and sign a DQCR daily, all DQCRs to be submitted at conclusion of field work.

FOM Signature: Bryan P Hoob

Date: 9-27-2021

PROJECT NOTEBOOK

GEO CONSULTANTS

NOTEBOOK

Staten Island Supplemental Site Inspection Contact List					
Contact	**Title**	**Oranization**	**Telephone Number**	**Mobile Number**	**E-mail Address**
Dan Kennedy	USACE Project Manager	CENAN	716-289-7888		daniel.m.kennedy@usace.army.mil
Ann Ewy	USACE Technical Project Manager	CENWK	816-389-3863	816-982-5995	ann.ewy@usace.army.mil
Dave Hays	USACE Health Physicist	CENWK	816-585-5110	816-585-5115	david.c.hays@usace.army.mil
Tom Papura	State Regulator	NYSDEC	518-402-8579		thomas.papura@dec.ny.gov
Margaret Dubbin	Project Manager	GEO Consultants	281-339-7786	575-640-3424	mdubbin@geoconsultantscorp.com
Ben Hooks	Field Operations Manager	GEO Consultants	270-462-3882	270-627-3733	hooksb@geoconsultantscorp.com
David Lindsey	Site Safety and Health Officer	GEO Consultants	270-462-3882	208-221-7397	lindseyd@geoconsultantscorp.com
John Wells	Project Safety and Health Officer	GEO Consultants	270-462-3882	618-727-1921	wellsj@geoconsultantscorp.com
Steve Passig	Subcontractor Health Physicist	Leidos	314-770-3026	314-581-6085	michael.s.passig@leidos.com
Chuck Finkenbine	Subcontractor Health Physicist	Leidos	341-770-3074	314-249-9092	charles.d.finkenbine@leidos.com
Megan Sherman	Site Radiation Safety Officer	Leidos		636-352-5964	megan.p.sherman@leidos.com
Jeff Warren	Preoject Personnel	Leidos	717-315-9328	610-360-1345	jeffrey.j.warren@leidos.com
Donna Edison	Laboratory Project Manager/Technician	Pace Analytical	615-773-5923	918-520-7887	donna.eidson@pacelabs.com
Tim Goodall	Laboratory Project Manager	Terrcon Consultants	513-612-9027	513-623-1312	tim.goodall@terracon.com
Chuck Blumberg	Drilling Manager	AARCO Environmental	631-586-5910	607-437-5512	cblumberg@aarcoenvironmental.com
Daniel Rogers	Surveying Manager	Rogers Surveying	718-447-7311	917-335-4536	drogers@rogerssurveying.com
Thomas Garrity*	Land Owner		347-865-2700		
Frank*	Current Tenant			917-529-7590	
(* Contact with land owner and tenant will go through David Lindsey)					
Emergency Services					
Hospital	Richmond University Medical Center 355 Bard Avenue Staten Island, New York 10310		911 717-818-1234		
USGS, National Response Center	Chemical Spill Notification		800-424-8802		
National Capital Poison Center	Poison Control		800-222-1222		
Richmond County Sheriff 350 Saint Marks Place Staten Island, New York 10301	Richmond County Sherriff		911 718-815-8407		

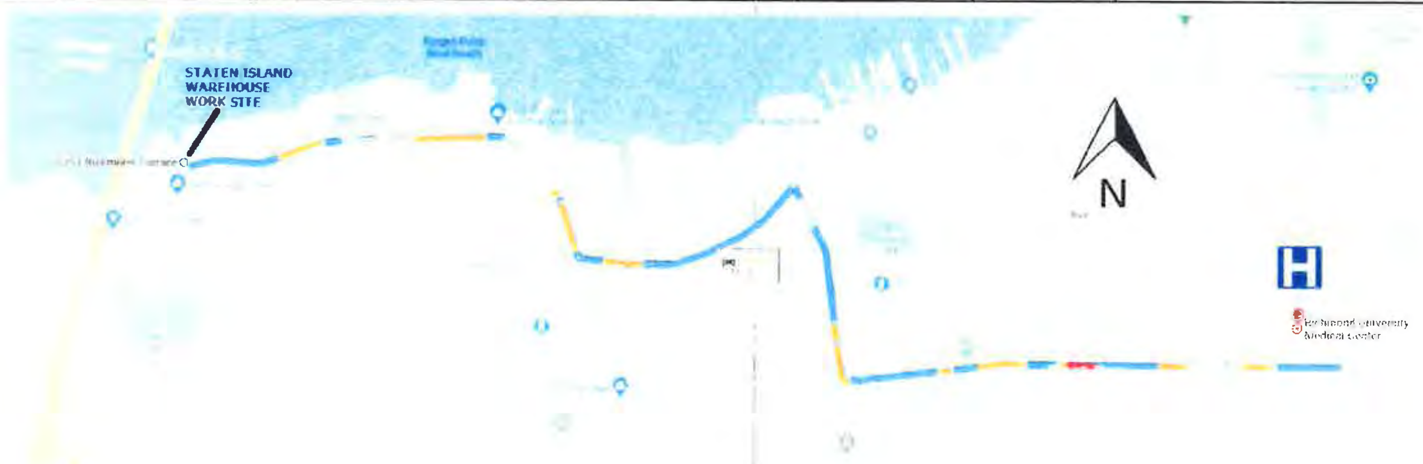

TABLE OF CONTENTS

BOOK ______

TITLE Staten Island **PROJECT** SIW SS1

Continued from Page N/A Sunday 9-19-2021

1335 David Lindsey and Ben Hooks arrived on-site, sunny 79°F current tenant, Frank Viassi, was also onsite. conducted safety tailgate meeting.

1345 Conducted site assessment. Observed new site conditions, new buildings / Structures, took photos of physical changes from working plan documents to current site conditions

1358 Discussed possible access points to surface characterization area with Frank

1415 Depart site, getting materials for tomorrow's field work

9-19-21

DL

Continued to Page N/A

SIGNATURE

DATE 9-19-21

DISCLOSED TO AND UNDERSTOOD BY

DATE

PROPRIETARY INFORMATION

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BOOK PAGE

TITLE **PROJECT** SIW SSI

Continued from Page N/A Monday September 20, 2021

0700 Ben and David arrive on-site. Sunny 64°F
0703 Jeff Warren from Leidos onsite, already here, waiting for GEO
0709 Safety tailgate meeting with Ben, Jeff, David
0715 Megan Sherman with Leidos arrived on-site
0730 Briefed megan on safety tailgate meeting
0740 Visual inspection of on-site conditions with Leidos team, determine different zone placements
0755 met with Frank, current tenant, on-site crew set up safety and decon zones.
0815 David left to get some rental equipment and to check route to emergency medical center
0820 Ben began to mark soil borings
0821 David calls for driller to come access site conditions for access to soil borings
0945 David returns with brush clearing equipment
1000 Megan signed work permit / Safety sheets, Jeff warren signs sheet.
1010 Megan scans equipment to be used for brush clearing / grubbing
1030 Setting up air monitoring stations, David leaves to get supplies / fuel
1035 Jeff checking down hole gamma scanning equipment
1110 Jeff leaves site to retrieve tripod equipment / repair current tripod equipment
1230 Finish setting up air monitoring equipment / stations
1232 Ben starts clearing brush
1240 David leaves to get wood chipper
1400 David returns with wood chipper and helps with brush clearing
1420 David calls driller again to perform site visit / assesment of access points.
1630 Jeff calls to inform team that he has obtain replacement tripod
1640 Megan inspects brush clearing, most of area is acceptable for gamma walkover survey, GEO will continue to clear brush where needed
1645 Mechanical issues with wood chipper
1650 Begin site clean up. Putting away air monitors / collecting sample pads from monitors
1700 GEO and Leidos employees depart site

DL 9-20-21

Continued to Page N/A

SIGNATURE [signature] DATE 9-20-21

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

TITLE **PROJECT**

Continued from Page N/A Tuesday 9-21-2021

0700 Arrived on site (David Lindsey and Ben Hooks), Jeff already at site, cloudy 63°F

0707 Megan arrived onsite

DL 9-21-21
0708 Begin ~~setting up~~ safety tailgate meeting David, Ben, Megan, Jeff

0720 Begin setting up equipment / air monitors

0730 David on progress status meeting with USACE

0815 David, Ben continue with brush clearing

0816 Jeff and Megan calibrating / checking scanning equipment

0850 David called for status on porta-potties, continuing to use restrooms onsite (main office)

0855 Recieved call on restrooms, should be delivered today.

1030 David calls surveyors, they inform GEO they can not make it out til tomorrow

1040 Megan begins gamma walkover survey

DL 9-21-21
1044 moved north ~~air~~ air monitor to the west approx. 100 feet

1150 David leaves to Return weed whacker

1200 Jeff testing new tripod

BH 9-21-21
1230 Megan stops gamma walkover, completed portion in ~~a~~ vegetative area, outside of concrete pad, in upper portion of area (not near shoreline)

1235 onsite crew waiting for shoreline to subside to continue walkover scan

1250 David returns to site with gas for equipment

1255 David on phone call with Ann and Dave (USACE) to discuss progress, work schedule
Inform Ann and Dave that gamma scan (walkover) image will be sent to them ASAP.

1315 Recieved call from porta-potty rental that porta-potties will be dilivered tomorrow

1330 David calls surveyors to stress importance of them arriving as soon as possible

1340 David calls drilling company to update status on access to soil borings

1345 Talk with Frank (tenant) to make sure blocks will be moved today to gain access to soil borings

1346 Ben leaves to hotel to work on integrating gamma scan survey into updated map

1400 Dan Kennedy (USACE) Arrived on site, NY District PM. David shows him around site

1405 Megan returns to gamma walkover survey to scan closer to shoreline

1415 David and Dan view surface characterization Area, observe Megan peforming scan

1530 Ben returns to site with updated site map, with change in physical features on site

Continued to Page 4

SIGNATURE DATE

9-21-21

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

- 4
BOOK PAGE

TITLE **PROJECT**

Continued from Page 3 Tuesday 9-21-21

1602 Megan stops gamma walkover survey along shoreline
1603 Ann and Dave (USACE) are sent updated map showing gamma scan results from this morning with changes in site conditions. Map sent via text.
1610 Megan, Dan, Ben, and David leave scan area after removing air monitors
1630 Dan and David talk with Frank about moving blocks for drilling equipment to gain access to surface characterization area, Frank says blocks will be moved today
1655 Finish cleaning up site
1700 Dan departs site, states that he will be back on-site tomorrow afternoon.
1705 Megan and Jeff depart site
1730 David and Ben leave to pick up supplies (PVC pipe) for tomorrows drilling effort
1815 David and Ben return to make sure blocks are removed, ramp installed for drill rig
1830 David and Ben depart site

DL 9-21-21

Continued to Page N/A

SIGNATURE [signature] DATE 9-21-21

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

TITLE PROJECT

Continued from Page N/A Wednesday 9-22-21

0700 Arrived on-site, cloudy 62°F

0710 conducted tailgate safety meeting David, Ben, Megan, Jeff

0720 moved decontamination zone on south area of surface characterization area where blocks were removed, for access (drill rig)

0730 Phone meeting with USACE (Ann, Dave, Dan) Chuck F, Megan (Leidos) Margaret Ben, David (GEO). Discussed initial walkover survey results, where to move soil borings or sediment samples based on current physical site conditions. Discussions include moving SB-15 to the west along block wall, south of SB-11 Move SB-14 to west along brick wall. SB-10 will need to move west along other brick wall. SB-13 will be hand augered to depth of 2-3 feet (if possible), move SD-10 to area near ~~SD-03/SD-04~~ DL-9-22-21 SD-01/SD-02. Will meet with driller to determine accessability of SB-8, SB-3, SB-1, SB-2. Megan will conduct another gamma scan survey, walking east and west, to try and fill in gaps in data from walkover scan performed yesterday, on higher, vegetative area. GEO and Leidos will conduct phone call to discuss placement of biased sample locations

0740 Drilling company emailed, stating that drilling company crew had blow-out on mobilization, will be delayed in arriving

~~0820~~ 0750 ~~B~~ DL 9-22-21 David calls surveyors to check status on arrival, left voice mail.

0910 Set up to begin collecting surface samples

0915 SS-05 collected SS-05-0915 Scan reading 4614, decon hand shovel

0926 SS-04 collected SS-04-0926 Scan reading 4520 decon shovel

0930 Drilling crew on-site (Robert Randazzo and Jose Garcia Jr) briefed drilling crew on tailgate safety meeting and scanned (Megan) drilling equipment

0936 SS-06 collected SS-06-0936 Scan reading 4306, decon hand shovel

0943 SS-07 collected SS-07-0943 Scan reading 4120, decon shovel

1030 Drillers having trouble with direct push rod, switching to hollow stem auger

1042 Drill rig set up on SB-06, soil recovery poor in first 5-foot section, decon auger

1055 Move drill rig over 2 to 3 feet, 1-foot retry with sand catcher attachment.

1105 0-2 foot collected SB-06-0501, geotechnical sample SB-06-0002 collected Continued to Page 6

SIGNATURE DATE

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

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BOOK PAGE

TITLE **PROJECT**

Continued from Page 5 Wednesday 9-22-21

1115 2 to 4 feet sample out, collected SB-06-0203, geotechnical sample collected SB-06-0205
1125 4 to 6-feet sample out, groundwater encountered approximately 4 to 5-feet, decon auger
1128 Called USACE (Ann and Dave) to discuss strategy going forward, stopping at groundwater
1130 Jeff set up to perform downhole gamma scan, testing equipment
1150 Megan collecting background/sample data, meter # 196062, Detector # 357755
Background CPM 3881 - checking samples collected again

	Reading
Sample SS-04	4520
Sample SS-05	4614
Sample SS-06	4306
Sample SS-07	4120

1205 Set up on SB-07
1215 SB-07 0 to 2-foot casing out collected SB-07-0102 (1220)
1225 SB-07 2 to 4 feet casing/core out collected SB-07-0203
1227 Called Ramsey Ferguson (GEO) to discuss recovery issues (less than 50% recovery on cores)
1230 Jeff begins downhole gamma scan on SB-06
1258 Jeff completes downhole gamma scan on SB-06
1300 Drilling crew will bring out new macro core, for direct push drilling. Decision is made to pause drilling until new macro core is brought in, drillers leave for new part
1301 Drilling manager said it is ok to keep drilling crew late today if needed, later than scheduled, due to time lost for inoperable equipment (original macro core)
1305 Jeff set up on SB-07 for downhole gamma logging
1325 Ben marking locations for SB-01, SB-02, SB-03, and SB-08
1326 Megan leaves to retrieve ~~get~~ DL 9-22-21 additional scanning equipment
1330 Drillers arrive with new macro core, set up on SB-05
1335 Set up on SB-~~05~~ (again), move over 2 feet to east, after hitting hard rock/debris
1340 Jeff finished downhole gamma scan SB-07
1345 0 to 5-feet core up on ~~SB-07~~ DL 9-22-21 SB05, poor recovery, sample collected SB-05-0505
1350 5 to 10-feet core up on SB-05, poor recovery, sample collected SB-05-0510
1354 Megan arrives back on-site
1356 groundwater encountered in ~~SB~~-05 at approximately 4 to 5-feet

Continued to Page 7

SIGNATURE DATE 9-22-21

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

TITLE PROJECT

Continued from Page 6 Wednesday 9-22-21

1357 Setting up on SB-07, trying new macro core, drilling again

1402 0 to 5 feet core up, poor recovery

1408 5 to 7-feet up, poor recovery, encountered groundwater

1415 Dan Kennedy arrives on site

1435 Phone call with USACE about poor recovery, discussed about how we have moved over in a variety of directions of original soil boring locations, changed drilling attachments, etc. Discussed using more test pits to get better representation of what is in ground. Will discuss with Leidos and let USACE know of our plan going forward.

1500 Discussed with Leidos, will proceed with original plan, doing best we can to obtain better core samples.

1510 Set up on SB-04 with hollow stem auger

1528 Move location of SB-04 several times, hitting refusal at 4-feet

1536 0 to 2-feet core up, no recovery, switching to direct push, macro core barrel

1542 2 to 4-feet core up, no recovery, with sand catcher

1550 Jeff setting up downhole gamma logging equipment over SB-05

1600 Begin downhole gamma scanning of SB-05

1602 Moving over again for SB-04, decon barrel

1610 0 to 4 feet core up. Sample collected SB-04-0102

1630 4 to 6-feet core up. Sample collected SB-040406 Refusal at 6-feet, groundwater also encountered at approx 6-feet below ground ~~surface~~ DL 9-22-21, decon barrel

1635 Scanning out equipment

1640 Jeff finishes downhole gamma scan on SB-05

1650 Drillers leaving site

1655 Scanning of downhole gamma scan equipment

1700 start packaging up samples

1707 Dan departs site

1720 Jeff and Megan depart site

1725 call surveyors to ensure they will be onsite tomorrow

1730 Ben and David depart site. DL 9-22-21

Continued to Page N/A

SIGNATURE DATE 9-22-21

DISCLOSED TO AND UNDERSTOOD BY DATE

TITLE **PROJECT**

Continued from Page N/A Thursday 9-23-21

0700 Arrived on-site, cloudy 62°F, drillers on-site, Jeff & megan onsite
0715 Safety Tailgate meeting
0720 Loading up rental equipment, David leaves to return rental equipment
0735 Set up on SB-10, getting equipment ready, setting up air monitors
0750 SS-10-0750 sample collected, gamma walkover start again (Megan)
0820 0 to 4' core up, sample collected SB-10-0517
0821 Sample collected SB-10-0004 geotechnical sample
0825 4-8' core up, sample collected
0827 Sample collected SB-10-0408 geotechnical sample
0830 Decon drilling equipment, install PVC Pipe in SB-10
0835 Survey crew arrive on-site, safety briefing
0840 SS-09-0840 Sample collected.
0850 Begin drilling SB-09
0913 0-5' core up, sample collected SB-09-0117, Poor recovery
0920 5-6' Core up, met refusal at 6 and groundwater, sample collected SB-09-0506
0925 Decon drilling equipment
0928 PVC installed in SB-09
0930 Dan (USACE) arrived, safety briefing
0935 Jeff set up on SB-04
0940 Start downhole gamma scan on SB-04
1000 Moving drilling rig to SB-11, scanning drilling rig out of decon zone
1020 Jeff completed downhole scanning of SB-04, decon equipment
1030 Jeff set up and began downhole scan of SB-10
1045 Began drilling on SB-11
BH 9-23-21
~~110~~ 1050 Jeff completes downhole scan of SB-10, decon equipment.
1100 SS-11-1100 Sample collected, SB-11 under concrete pad.
1101 Jeff set up and begin downhole gamma scan on SB-09
1105 David returns with supplies
1105 2 to 5-feet core up Sample collected SB-11-0405
1110 5 to 10-feet core up sample collected SB-11-0506, pvc to 12 feet Continued to Page 9

SIGNATURE DATE 9-23-21

DISCLOSED TO AND UNDERSTOOD BY DATE

PROPRIETARY INFORMATION

TITLE **PROJECT**

Continued from Page 8 Thursday 9-23-21

1112 Decon drill rig attachments

1113 set up on SB-12

1115 SS-12-1115 Sample collected

11120 2 to ~~4~~ 5 DL 9-23-21 -feet core up, sample collected SB-12-0304

1125 5 to 10-feet core up, sample collected SB-12-0506

1128 Sample collected SB-12-0608, geotechnical sample

1130 Jeff finished downhole gamma scan SB-09, decon equipment

1130 Sample collected SB-12-1112, 10 to 12-foot core up, decon drilling attachment

1132 move drilling rig to SB-15

1135 SS-15-1135 Sample collected, 0 to 2 feet core up

1138 Jeff set up and began downhole gamma scan on SB-07

1140 core 2 to 4-feet up

1145 core 4 to 8-feet up, samples collected SB-15-0406

1150 sample collected SB-15-0608

1155 Core up 8 to 12-foot water encountered at approx 10-feet bgs

1158 Decon drilling attachments

1200 move to SB-14

1202 Talk to Frank about storing/using coal or fly ash. Frank stated that they do not use or store fly or coal ash on-site.

1205 SS-14-1205 Sample collected

1210 2 to 4-feet core up, sample collected, SB-14-2540

1215 4 to 8-feet core up, samples collected SB-14-0406 geotechnical sample

1215 Sample collected SB-14-0608

1216 Jeff completed downhole gamma log on SB-07, decon equipment

1225 Core 8 to 12-feet up on SB-14 sample collected SB-14-0812 geotechnical sample

1228 Decon Drilling attachments

1232 Porta-potties arrive

1233 Send email to USACE to notify them that there is no fly/coal ash used or stored onsite

1235 set up on SB-16

Continued to Page 10

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BOOK PAGE

TITLE **PROJECT**

Continued from Page 9 Thursday 9-23-21

1245 core up 0-2-feet, sample collected SS-16-1245

1300 Moved 5 times (offset) SB-16 due to refusal at 4-feet, 0 to 2 feet core up, sample collected SS-16-1300, this sample will replace SS-16-1245 due to location accuracy

1305 Hydro survey complete, remaining survey crew continue with civil survey.

1318 Geotechnical sample collected, SB-16-0002, from 0 to 2-feet core of SB-16

1320 Jeff set up downhole gamma scan at SB-11

1324 Down hole gamma start on SB-11

1325 2 to 4-feet core up on SB-16, sample taken SB-16-0235

1335 sample taken from 2 to 4 foot core of SB-16, sample # SB-16-0204, geotechnical sample

1340 Decon drilling rig attachments, move air monitors, wind change direction

1345 Set up Drill Rig on ~~SB-05~~ DL 9-23-21 SB-08

DL 9-23-21 ~~14~~1350 Jeff completed downhole gamma scan on SB-11

1400 SS-08-1400 sample collected, hand shovel decon

1410 Ben noted that SB-08 was moved to the west to offset SB-10 and SB-09 moved west, SB-08 may not be accessible by drill rig with new location close to shoreline. Soil boring for SB-08 performed by hand auger. Sample collected SB-08-0102, hand auger decon.

1412 Began scanning out drilling rig and attachments

1415 Dan Kennedy and David observed black "slag" pieces along shoreline that had higher readings in walkover gamma scan and it was decided to collect a sample after discussion with Ann and Dave for waste characterization sample (TCLP) SB-16-0000

1430 Drilling crew off-site

1431 Recieved update figure of gamma walkover results from Leidos to discuss with USACE.

1435 Jeff setting up downhole gama scan on SB-12

1440 Jeff Begins downhole gamma scan on SB-12

1535 Jeff completes downhole gamma scan on SB-12

1545 Remove air monitors, scan out equipment

1550 Jeff offsite, radar for weather forecast shows rain, not starting new hole.

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PROPRIETARY INFORMATION

TITLE PROJECT

Continued from Page 10 Thursday 9-23-21

1565 Begin packing up samples
1600 Dan Kennedy off-site
1605 Megan off-site
1610 Civil survey crew off-site
1620 David and Ben offsite
* Below are Reading from scan (gamma scan) of sample bags

SS-08-1400	4276
SB-08-0102	4459
SS-09-0840	7348
SB-09-0117	7312
SB-09-0506	7164
SS-10-0750	6780
SB-10-0517	6320
SB-10-0465	6114
SS-11-1100	4314
SB-11-0405	4524
SB-11-0506	4524
SS-12-1115	5125
SB-12-0304	4929
SB-12-0506	4980
SS-14-1205	4215
SB-14-2540	4547
SB-14 0608	4482
SS-15-1135	4229
SB-15-0406	4436
SB-15-0608	4619
SS-16-1300	7116
SB-16-0235	7121
SS-16-0000	65,000

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BOOK PAGE

TITLE **PROJECT**

Continued from Page N/A Friday 9-24-21

0700 Arrived on-site, partly cloudy 63°F
0720 Drillers arrive
0730 Daily Safety Tailgate meeting
0742 Civil survey crew on-site to complete civil survey, safety briefing
0750 Began hand augering and using posthole digger for soil borings along shoreline
0800 Phone call with USACE for project progress and plan going forward
0806 Placing air monitors in work area, getting other equipment ready
0810 SS-03-0810 sample collected for SB-03
0815 SB-03-0501 sample collected (0.5 to 1-foot)
0820 SB-03-0102 sample collected (1-2-feet), decon shovel, digger
0822 Phone meeting update: Discussed updated photo with latest gamma scan walkover data, placement of testpits, eastern edge of higher reading area (gamma walkover scanning reading). Make sure to bound area around SB-02
DL 9-23-21 0825 SS-01-0825 sample collected from SB-01
0827 SB-01-0501 sample collected (0.5 to 1-foot)
0830 SB-01-0102 sample collected (1 to 2-feet)
0835 SS-02-0835 sample collected from SB-02
0840 SB-02-0501 Sample collected from SB-02
0845 SB-02-0102 Sample collected from SB-02, decon shovel, digger
0846 Recieved updated figure from Leidos, gamma walkover survey (0742)
0855 Scan drilling rig out of surface characterization area.
0910 Jeff set up downhole gamma scan equipment on SB-14
0920 Jeff Begins downhole scan of SB-14
0930 Scan in of mini excavator for test pit digging
0945 Begin to dig test pit #1, starting inside higher reading of gamma scan moving east outside of higher reading area to bound area to the east.
1015 Top 2-foot layer removed from TS (test pit) #1, sample collected TS-01-0002 DL 9-24-21, scan lift
1020 TS-01-0204, end lift, of TS#1 sample collected, scan lift, ~~groundwater~~ concrete slab DL 9-24-21 encountered 6-feet
1021 Downhole gamma scan complete on SB-14, decon equipment
1022 David leaves to get water pump for dewatering if needed

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PROPRIETARY INFORMATION

TITLE PROJECT

Continued from Page Friday September 24, 2021

1025 Jeff starts downhole gamma logging on SB-15

1035 Decon mini excavator

1050 Move to test pit 2 while waiting for pump

1055 Sample TS-020002 collected from test pit 2, lift scanned

1100 Waste characterization sample collected from test pit 1 and test pit 2, WC-01-0002

1105 Sample TS-02-0304 collected, lift scanned

1115 Jeff completed downhole gamma scan for SB-15

1120 David Returns

1125 4 to 6 foot lift removed TS #2 groundwater and very hard surface at 6 feet

1128 Begin dewatering TS #2, water level not subsiding. Area approx 2-feet wide, 6-feet in length and 6-inches deep. Pump ran for approx 15 minutes, 40-gallons per minute with no change in elevation. Water coming in as fast as being removed. Video sent to Ann and Dave. Continue to dewater if necessary, beneficial

1150 Decision made to move to TS #3, Decon mini excavator

1215 First lift of TS #3 removed, sample collected TS-03-0002, lift scanned

1225 David to start hand augering soil borings

1230 2nd lift of TS #3 removed, sample collected TS-03-0204, lift scanned.

1230 SS-17-1230 collected from SB-17

1235 3rd lift of TS #3 removed, groundwater and hard surface hit at approx 5 to 6-feet

1240 SB-17-0102 sample collected, shovel and digger decon.

1245 Begin dewatering of TS #3

1250 SS-18-1250 sample collected

1255 Similar results for dewatering for TS #3, not changing water elevation after 10 minutes of dewatering

1300 SB-18-0125 sample collected, shovel, hole digger decon

1303 Drilling crew replacing spoils from test pits back into test pits where they originated

1310 Sample collected from SB-19, SS-19-1310

1315 Sample collected from SB-19, SB-19-0102

1320 Sample collected from SB-19, SB-19-0225, shovel, digger decon Continued to Page 14

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PROPRIETARY INFORMATION

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BOOK PAGE

TITLE **PROJECT**

Continued from Page 13

Friday 9-24-21

1435 Change air monitor location due to change in wind direction
1500 TS #4 First lift sample collected TS-04-0002, lift scanned
1515 2nd lift from TS #4 removed, lift scanned
1530 3rd lift from TS #4 removed, lift scanned, sample collected TS-04-0406
1600 Waste characterization sample collected from Test pits #3 and #4 WC-02-0001
1630 Began scanning out Mini excavator, other equipment
1700 Collected duplicate samples for test pits TS-DUP-01 and TS-DUP-02
1705 Drilling crew departs site
1730 Packing coolers for shippment of some samples, coolers scanned
1755 GEO and Leidos crew depart site, GEO to ship samples
* Below are scan readings from sample bags collected today

SS-01-0825	4203
SB-01-0501	3966
SB-01-0102	3758
SS-02-0835	4199
SB-02-0840	4178
SB-02-0845	4245
SS-03-0810	4530
SB-03-0815	4290
SB-03-0820	4070
SS-17-1230	5317
SB-17-1240	6123
SS-18-1250	4705
SB-18-0125	4652
SS-19-1310	4400
SB-19-0102	4470
SB-19-0225	4566
WC-01-0002	12,287
WC-02-0001	5249

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PROPRIETARY INFORMATION

TITLE PROJECT

Continued from Page N/A Monday 9-27-21

0655 Arrive on site, cloudy (partly) 66°F

0705 Tailgate safety meeting Ben, David, Megan, Jeff

0706 David on call with Leidos and USACE to discuss placement / location of Remaining samples

0707 setting up air monitors, calibrating YSI water quality ~~meter~~, downhole gamma scan equipment

0720 Recieved Field change Request from USACE to ~~hand~~ DC 9-27-21 hand auger or dig soil borings where drill rig could not access the soil borings.

0721 Phone discussion: with drill rig unable to access some of the soil borings, there are left over samples available to gather more data. Instead of 3 samples in every soil boring (1 surface sample, 2 subsurface samples) we have determined where remaining locations will be. Surface sample at SB-13, remaining 2 samples will be located between SB-05 and SB-07 (SB-21). Surface sample at SB-20, remaining samples will be located between SB-07 and SB-10 (SB-22). Surface sample at SB-01, 2 samples between SB-09 and SB-11 (closer to SB-09) (SB-23). 2 samples between SB-08 and SB-09 (SB-24). 1 sample between SB-02 and SB-05.

0745 Begin to collect sediment samples during low tide (Ben and David)

0750 SD-09-0750 sample collected, shovel decon

0754 SD-06-0754 Sample collected, decon hand shovel

0758 SD-07-0758 Sample collected, decon hand shovel

0800 SD-05-0800 sample collected, decon hand shovel

0805 SD-08-0805 Sample collected, decon hand shovel

0810 SD-02-0810 and SD-DUP-02 samples collected, decon hand shovel

0813 SD-01-0813 sample collected, decon hand shovel

0815 SD-03-0815 Sample collected, decon hand shovel

0816 SD-10 0816 Sample collected, decon hand shovel

0905 Jeff begins downhole gamma scan on SB-01, decon equipment

0910 SD-04-0910 Sample collected, along with SD-MS and SD-MS-DUP, decon hand shovel

0910 Jeff Begins downhole gamma scan on SB-04, decon equipment

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BOOK PAGE

TITLE **PROJECT**

Continued from Page 15 Monday 9-27-21

Water Quality Meter Daily Calibration

YSI Pro-DSS

By: RF DS NM PL JW DY ~~TB~~ DL (BH)

Date: 9-27-2021

pH CALIBRATION

Buffer +/- .1 SU	Lot #	Exp. Date	Vendor	Time	Temp (Celsius)	pH	Adj. To
pH 4	8012084	12/17/22	Field Environmental	0714	19.3	4.01	3.89
pH 7	8012081	12/17/22	Field Environmental	0710	19.4	7.00	6.93
pH 10	8012077	12/16/22	Field Environmental	0720	19.3	10.00	9.95

D.O. AIR CALIBRATION

Solution Temp (C): 18.8 Local B.P.: 783.9

% Saturation: 99.1% % Saturation (fixed): 100%

DO mg/l Reading (+/- 0.2 mg/l): 9.63 @ 18.7 Deg Celsius

Does reading meet DO Saturation Values acceptance criteria? ✓ Yes ____ No

If No, Recalibrate or check Operations Manual for maintenance.

CONDUCTIVITY CALIBRATION

Standard Value: 1412 (umhos) 1.412 (mS) Lot #8012061 Exp: 12/16/22 Manufacturer: Field Environmental

Temperature(C): 19.9 Conductivity(+/- 20 umhos): 1381 Adjusted To: 1409

TURBIDITY CALIBRATION PERFORMANCE CHECK

4-Beam Turbidity Quick-Cal Cube QCC#:81181

GEO 481-1=75.0 +/- 20%
GEO 481-2=77.9 +/- 20%
GEO 481-3=77.0 +/- 20%

Reading ______________ NTU

0 FNU DI water Serve-A-Pure Lot 210607 Exp 12-4-21 4.78 -> 0.00

124 FNU YSI Incorporated Lot 21E211 60230 Exp 5/2022 125.89 -> 124.00

1010 FNU YSI Incorporated Lot 21 D211 30115 Exp 9/22 967.40 -> 1010

✓ Reading is within acceptance criteria of the Quick-Cal Cube for the instrument to be used

____ Reading is not within acceptance criteria of the Quick-Cal Cube for the instrument to be used. If reading is not within the Quick-Cal Cube acceptance criteria, perform primary calibration according to operational manual.

ORP Calibration

ZoBell Solution: Lot #: 8105632 Expiration Date: 3/6/2022

ZoBell Solution's ORP Value: 220 +/- 10 mV @ 25 Deg C

Reading Prior to Calibration: 261.4 mV @ 19.8 Deg C

Reading After Calibration: 237.7 +/- 10 mV @ 19.8 Deg C

0915 Jeff begins downhole gamma scan on SB-02, decon equipment
0920 Jeff begins down hole gamma scan on SB-19, decon equipment
0935 SS-22-0935 Sample collected, shovel decon
0940 SS-25-0940 Sample collected, decon hand shovel
0941 SS-24-0941 Sample collected, decon hand shovel
0945 Jeff started downhole scan of SB-16, decon equipment
1000 SS-21-1000 sample collected, decon hand shovel
1000 SB-24-1000, ~~SB-24~~ DL 9-27-21 SB-MS-24, SB-MSD-24 samples collected, digger/auger decon
1001 Jeff started downhole gamma scan of SB-24, decon equipment
1014 SS-23-1014 sample collected, hand shovel decon
1015 SS-13-1015 Sample collected, decon hand shovel

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TITLE **PROJECT**

Continued from Page 16 Monday 9-27-21

1020 Jeff starts downhole gamma scan on ~~SB-23~~ SB-25 DL 9-27-21, decon equipment
1020 SS-20-1020 Sample collected, decon hand shovel
1040 SB-23-0102 Sample collected, decon hand shovel
1040 SB-DUP-23 collected from SB-23
1055 Jeff starts downhole gamma scan on SB-23, decon equipment
1120 Scan out downhole gamma scan equipment
1130 Begin collection and sampling of groundwater
1205 Collect groundwater sample SB-06-1205, decon YSI
1210 Collect groundwater sample SB-09-1210
1215 Collect groundwater sample SB-07-1215
1220 Collect groundwater sample SB-10-1220
1235 Scan out remaining equipment
1430 Scan out coolers
1445 Jeff and Megan depart site
1520 David and Ben check site, depart to complete packing and shipping of samples
1900 Ship samples

DL 9-27-21

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HTW DRILLING LOG

HOLE NO. SB-1

1 COMPANY NAME: USACE	2. DRILLING SUBCONTRACTOR: Aarco Environmental	SHEET 1 OF SHEETS
3. PROJECT: Staten Island Warehouse	4. LOCATION: Staten Island NY	
5 NAME OF DRILLER: Jose Garcia	6 MANUFACTURER'S DESIGNATION OF DRILL: n/a	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8 HOLE LOCATION	
	9 SURFACE ELEVATION	
	10. DATE STARTED: 9/24/2021	11. DATE COMPLETED: 9/27/2021
12 OVERBURDEN THICKNESS: 2.6	15 DEPTH GROUNDWATER ENCOUNTERED: 2.4'	
13 DEPTH DRILLED INTO ROCK: n/a	16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE: 2.6	17 OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/a			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad.			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma Scan	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS PID d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS Gamma h
		Br to gray sand (coarse) with fine gravel, cobbles at surface. moist to wet loose	0.0	0-0.5			4203
			0.0	0.5-1			3966
	1	- dark gray to black, w/ML					
			0.0	1-2			3758
	2	- medium dense					
		- wet at 2.4'					
	3	EOB at 2.6' Hole saturated					See SB-06 for meter info.
							background 3862 9/24/21
		• down hole gamma scan completed 9/27/2021					

FORM MRK JUN 89 55 | PROJECT Staten Island Warehouse | HOLE NO. SB-1

HTW DRILLING LOG

HOLE NO.	SB-2
1 COMPANY NAME	USACE
2 DRILLING SUBCONTRACTOR	Aarco Environmental
SHEET 1 OF SHEETS	
3 PROJECT	Staten Island Warehouse
4 LOCATION	Staten Island
5 NAME OF DRILLER	Jose Garcia
6 MANUFACTURER'S DESIGNATION OF DRILL	n/a
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Hand auger
8 HOLE LOCATION	
9 SURFACE ELEVATION	
10 DATE STARTED	9/24/2021
11 DATE COMPLETED	9/27/2021
12 OVERBURDEN THICKNESS	2.1
13 DEPTH DRILLED INTO ROCK	n/a
14 TOTAL DEPTH OF HOLE	~~n/a~~ 2.1
15 DEPTH GROUNDWATER ENCOUNTERED	
16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
17 OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	
18 GEOTECHNICAL SAMPLES	n/a
DISTURBED	
UNDISTURBED	
19 TOTAL NUMBER OF CORE BOXES	n/a

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			RAD			

22 DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma Scan	[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS PID d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS Gamma h
		brown to dk gray sand with gravel loose to medium dense, moist with trace cobbles	0.0		0-0.5		4194
			0.0		0.5-1.0		4178
	1	Brownish red, ML, with trace sand/gravel, firm to soft, moist	0.0		1-2.0		4245
	2	• Rock or cement - Refusal					
		EOB at 2.1'					
		• down hole gamma scan completed 9/27/2021					

HTW DRILLING LOG

HOLE NO.	SB-3
1 COMPANY NAME	Staten Island Warehouse
2. DRILLING SUBCONTRACTOR	Aarco Env.
SHEET 1 OF 1 SHEETS	1
3. PROJECT	USACE
4. LOCATION	Staten Island NY
5 NAME OF DRILLER	J. Garcia
6. MANUFACTURER'S DESIGNATION OF DRILL	n/a
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Hand auger
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9/24/2021
11. DATE COMPLETED	9/27/2021
12 OVERBURDEN THICKNESS	1.5
13 DEPTH DRILLED INTO ROCK	n/a
14 TOTAL DEPTH OF HOLE	1.5
15. DEPTH GROUNDWATER ENCOUNTERED	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
n/a			n/a

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma Scan	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS PID d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS Gamma h
		Dark gray to reddish-gray sand with fine gravel, loose, wet	0.0	~~Ø~~ BPH	0-0.5		4530
		Dark gray to black sand with ML, firm/medium dense, wet	0.0		0.5-1.0		4290
	1	-hole saturated at 1.5'	0.0		1-2		4070
		End of boring at 1.5'					
	2						
		• Downhole gamma scan completed on 9/27/2021					

HTW DRILLING LOG

HOLE NO.	SB-4
1 COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	Aarco Environmental
SHEET 1 OF 1 SHEETS	2
3. PROJECT	Staten Island Warehouse
4. LOCATION	Staten Island NY
5 NAME OF DRILLER	J. Garcia
6. MANUFACTURER'S DESIGNATION OF DRILL	GeoProbe
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	SPT w/ 4" H.S. augers 3" casing
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	
11. DATE COMPLETED	
12 OVERBURDEN THICKNESS	6
15. DEPTH GROUNDWATER ENCOUNTERED	5.5'
13 DEPTH DRILLED INTO ROCK	n/a
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	6
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
n/a			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS PID d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS Gamma h
	0	ML, dk gray, w/ roots, soft (Topsoil)			0-0.5	6-7-7-10	4520
		Dark-gray to dark brown Sand, with gravel, trace ML, loose to medium dense, dry to moist.	PID: 0.0		1.0-2.0		6841
	1		Recovery 0.8/2				
	2	- Rock in drive shoe. - No Recovery	PID: 0.0			4-2-1-1	7512 (cuttings)
	3		Recovery 0.0/2.0				
	4	- Reddish brown to dark gray Sandy ML	PID: 0.0 Recov.		4.0-6.0	1-1-1-1	6608
	5						

HTW DRILLING LOG (CONT.)

HOLE NO. SB-4

PROJECT Staten Island Warehouse | INSPECTOR B. Hooks | SHEET 2 OF 2 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		- wet at 5.5'					
	6	End of Boring at 6' (groundwater)					
		PVC installed to 5.5'					

HTW DRILLING LOG

HOLE NO	SB-05	
1 COMPANY NAME: USACE	2. DRILLING SUBCONTRACTOR: Aarco Env.	SHEET 1 OF 1 SHEETS 2
3. PROJECT: Staten Island Warehouse	4. LOCATION: Staten Island NY	
5 NAME OF DRILLER: J. Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" x 5' macrocore - New liner for each run	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 9/22/2021	11. DATE COMPLETED: 9/22/2021
12 OVERBURDEN THICKNESS: 10	15. DEPTH GROUNDWATER ENCOUNTERED: GW @ 6.0'	
13 DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: dry 9/27/2021 (collapse to 7.5')	
14 TOTAL DEPTH OF HOLE: 10	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			RAD			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma scan	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (PID) d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS (Gama) h
	0	0-0.5 dk br ML w/ roots Topsoil			0-0.5		4614
	1	0.5-1.4 Gray-brown to dk brown Sand w/ gravel loose, dry	0.0				
	2	1.4- Red-brown ML to CL, Sandy, soft to firm, moist - brick fragments present			0.5-5.0		7679
	3		0.0				
	4	---Likely contact w/ ML					
	5		Rec 2.2/5.0				

HTW DRILLING LOG (CONT.)

HOLE NO.	SB-05
PROJECT	51 Warehouse
INSPECTOR	B. Hooks
SHEET 2 OF 2 SHEETS	

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		DO			5.0-6.0		
		Rock in shoe					
	6	-wet at 6.0	6.0				
	7						72714
	8						
		-hard drilling ↓					
	9		Rec: 1.4 / 5.0				
	10	End of boring at 10'					
		3" casing driven to ≈9.5' and 2" PVC installed for gama scan.					
		Gamma scan completed: 9/ /2021					

HTW DRILLING LOG

HOLE NO SB-6		
1 COMPANY NAME USACE	2. DRILLING SUBCONTRACTOR Aarco	SHEET 1 OF 1 SHEETS 2
3. PROJECT Staten Island Warehouse	4. LOCATION Staten Island	
5 NAME OF DRILLER Jose Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL Geoprobe	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" splitspoon; 3" casing	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED 9/22/21	11. DATE COMPLETED 9/22/21
12 OVERBURDEN THICKNESS 6	15. DEPTH GROUNDWATER ENCOUNTERED saturated at ~4'	
13 DEPTH DRILLED INTO ROCK n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE 6	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma Scan	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS PID d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS Gamma h
		dk br ML w/ Roots Topsoil			0-0.5		4306
	1	dk reddish-brown to dark brown sand w/ silt and fine gravel, loose, moist	0.0 Rec 1.3/2.0		0.5-2.0	6-8-9-12	7847
	2				2-3	4/6/8/8	
	3	2.4-3.5 Reddish-brown CL, with sand moist to wet, soft	0.0 Rec 1.1/2.0				6872
	4	Saturated Gravel, fine-grained, with fine to coarse sand and silt, dark brown to gray, saturated, loose	Rec 0.4/2.0			2, 1, 2	6991
	5						

HTW DRILLING LOG (CONT.)

HOLE NO
SB-6

PROJECT Stater Island Warehouse	INSPECTOR	SHEET OF 1 SHEETS 2

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6						
		End of boring - saturated					
		- PVC to ~5.5 feet					
		4410 detector (cal 9/8/22) sn 357755					
		2221 meter (cal 8/6/22) sn 196062					
		- background at SB-10 area					
		Background: 6800 9/22/21					

FORM MRK JUN 89 55-2 | PROJECT | HOLE NO.

HTW DRILLING LOG

HOLE NO	SB-7
1 COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	Aarco Env.
SHEET 1 OF SHEETS	
3. PROJECT	Staten Island Warehouse
4. LOCATION	Staten Island NY
5 NAME OF DRILLER	J. Garcia
6. MANUFACTURER'S DESIGNATION OF DRILL	Geoprobe
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	- 2" split spoon - 3" casing
8 HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9/22/21
11. DATE COMPLETED	9/23/21
12 OVERBURDEN THICKNESS	9.4
15. DEPTH GROUNDWATER ENCOUNTERED	~4.5'
13 DEPTH DRILLED INTO ROCK	n/a
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	9.4
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma scan	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0–1	Dark brown to red-brown, Sand, (fine-coarse) w/ gravel and ML, loose to m. dense, dry to moist	0.0		0-0.5	1 8 8 9	4120
	1–2		Rec 1.1/2.0		1.0-2.0		6256
	2–4	- brick fragment	0.0 Rec 1.0/2.0		2-3	17 10 9 17	6914
	4–	- with coarse gravel, saturated	0.0 Rec 0.5/2.0			13 45 14 10	6267

HTW DRILLING LOG (CONT.)

HOLE NO.	SB-7

PROJECT Steter Island	INSPECTOR B. Hooks	SHEET 1 OF SHEETS 2

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		End of boring - saturated - 3" casing advanced to 9.4' (refusal) and PVC installed					

MRK FORM JUN 89 55-2 PROJECT HOLE NO. SB-7

HTW DRILLING LOG

1 COMPANY NAME USACE	2. DRILLING SUBCONTRACTOR Aarco	HOLE NO. SB-9 SHEET 1 OF SHEETS
3. PROJECT Staten Island	4. LOCATION Staten Island	
5 NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL Geoprobe	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: ~~G~~ 4" Macrocore; 3" casing	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED 9/23/21	11. DATE COMPLETED 9/23/21
12 OVERBURDEN THICKNESS 9.8	15. DEPTH GROUNDWATER ENCOUNTERED	
13 DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
n/a			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		downhole gamma	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.2 Topsoil - dk br ML w/sand	0.0		0-0.5		7348
		0.2-12 dk br sand w/ ML and gravel, moist to wet, loose to m. dense			0.5-1.7		7312
	1						
	2						
			0.0				
	3						
			Rec. 1.7/4				
	4						
					~~4-6.5~~		

HTW DRILLING LOG (CONT.)

HOLE NO.

PROJECT | INSPECTOR | SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
						5-6	7164
	6		0.0				
		-wet					
	7						
			Rec: 1.1/4				
	8						
		End of boring at 8' - saturated					
		3" casing driven to 7.8' bgs and 2" PVC installed					

FORM MRK JUN 89 55-2 | PROJECT | HOLE NO. SB-09

HTW DRILLING LOG

HOLE NO. SB-10

1 COMPANY NAME USACE	2. DRILLING SUBCONTRACTOR Aarco	SHEET 1 OF SHEETS
3. PROJECT Staten Island Warehouse	4. LOCATION Staten Island NY	
5. NAME OF DRILLER J. Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL Geoprobe	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" Macro 4'; 3" Casing 5'	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED 9/23/21	11. DATE COMPLETED 9/23/21
12. OVERBURDEN THICKNESS 9.5'	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE 9.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma	[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h Gamma
	0	0-0.4 Brown, silt, moist, firm Topsoil				0-0.5	6780
		back to dark gray, sandy gravel (fine), moist, m. dense	PID - 0.0 - 4.0 Strong odor			0.5-1.7	6320
	1						~~6780~~ BH
	2	1.5-12 Red-brown, ML, sandy with gravel, moist to wet soft to v.soft	PID = 0.0				
	3						
	4		Rec 1.7/4				
						4-6.5	6114

HTW DRILLING LOG (CONT.)

HOLE NO.

PROJECT

INSPECTOR

SHEET
OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
			0.0				6114
	6	wet w/coarse gravel					
	7		Rec. 1.2/40				
	8	- saturated, coarse gravel	6.0				6667
	9	- Rock in shoe					
	10						
	11		Rec 0.2/4				
	12	EOB - 12' saturated 3" casing to 9.5' (refusal) 2" PVC well installed					

HTW DRILLING LOG

HOLE NO	SB-11
1 COMPANY NAME	USACE
2 DRILLING SUBCONTRACTOR	Aarco Env.
SHEET 1 OF SHEETS	
3 PROJECT	Staten Island
4 LOCATION	Staten Island
5 NAME OF DRILLER	J. Garcia
6 MANUFACTURER'S DESIGNATION OF DRILL	Geoprobe
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" x 4' Macrocore 3" x 5' Casing
8 HOLE LOCATION	
9 SURFACE ELEVATION	
10 DATE STARTED	9/23/21
11 DATE COMPLETED	9/23/21
12 OVERBURDEN THICKNESS	15'
15 DEPTH GROUNDWATER ENCOUNTERED	
13 DEPTH DRILLED INTO ROCK	n/a
16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	15'
17 OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19 TOTAL NUMBER OF CORE BOXES

20 SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21 TOTAL CORE RECOVERY %
			Rad			

22 DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23 SIGNATURE OF INSPECTOR
	X		Gamma	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO e	ANALYTICAL SAMPLE NO f	BLOW COUNTS g	REMARKS h
		Concrete				0-0.5	4314
	1	DGA fill to 3.6'					
	2						
	3						4524
	4	3.6- Gry-br sand w/ mL, dry to moist loose to m dense.	Rec 1.3/4.0				
						4-5	

FORM MRK JUN 89 55 | PROJECT | HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO.		
PROJECT	INSPECTOR	SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6					5-6	4524
	7						
		7.7 Red-brown ML moist, firm	Rec 1.8/4.0				
	8	w/gravel, soft to v. soft					
	9						4431
	10	-wet					
	11		Rec 1.7/4.0				
	12	EOB at 12' BGS 3" casing advanced to 15' Bgs, PVC installed					see SB-6 for meter info -Background 4132 on 9/23/21

FORM MRK JUN 89 55-2

PROJECT

HOLE NO. SB-11

HTW DRILLING LOG

1 COMPANY NAME USACE	2. DRILLING SUBCONTRACTOR Aarco	HOLE NO. SB-12 SHEET 1 OF SHEETS
3. PROJECT Staten Island Warehouse	4. LOCATION Staten Island NY	
5 NAME OF DRILLER J. Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL Geoprobe	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" x 4' Macrocore 3" x 5' casing	8. HOLE LOCATION
		9. SURFACE ELEVATION
		10. DATE STARTED 9/23/21 / 11. DATE COMPLETED 9/23/21
12 OVERBURDEN THICKNESS 15'		15. DEPTH GROUNDWATER ENCOUNTERED
13 DEPTH DRILLED INTO ROCK		16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14 TOTAL DEPTH OF HOLE 15'		17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Lead			
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		
	X		Gamma			

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.5 Concrete			~~0-0.5~~		~~5125~~
		0.5-1.5 DGA					
	1						
	2	1.5-12 black to dk-gray sand w/ gravel, ML, dry, m. dense	PID 2.8		0-0.5		5125
	2	- brick, ML					
	3	- wood, sandy			3-4		4929
		Red-br ML, moist, firm, w/ sand	Rec 2.6 / 4.0				
	4		0.0				

HTW DRILLING LOG (CONT.)

HOLE NO.

PROJECT	INSPECTOR	SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
							4980
	6						
					6-8		4959
	7	- gravelly					
			Rec 3.2/4.0				
	8	wet at 8.0'					
							4977
	9						
	10						4837
	11						
			Rec 2.4/4.0				4836
	12	EOB at 12' bgs 3" casing/PVC to 15' bgs					

MRK FORM JUN 89 55-2 | PROJECT SIW | HOLE NO. SB-12

HTW DRILLING LOG

HOLE NO: SB-14

1 COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET 1 OF SHEETS
USACE	Aarco	

3. PROJECT: Staten Island Warehouse	4. LOCATION: Staten Island NY
5. NAME OF DRILLER: J. Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" x 4' macrocore; 3" x 5' casing	8. HOLE LOCATION:
	9. SURFACE ELEVATION:
	10. DATE STARTED: 9/23/21 — 11. DATE COMPLETED: 9/23/21
12. OVERBURDEN THICKNESS: 15'	15. DEPTH GROUNDWATER ENCOUNTERED:
13. DEPTH DRILLED INTO ROCK:	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 15'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.5 Concrete					
		0.5-1.5 DGA					
	1						
		1.5-7.5 Sand w/ gravel, mc, black to red-br., loose to m. dense, dry to moist, w/ wood, brick			1.5-2.5		4215
	2						
					2.5-4.0		4547
	3						
	X						
			Rec 2.7/4.0				
	4						
							4392

HTW DRILLING LOG (CONT.)

HOLE NO.	
PROJECT	INSPECTOR
SHEET OF SHEETS	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6						
					6-8		4482
	7						
		7.5-12 Rd-br ML, w/ snd moist, firm to soft	Rec 2.4/4.0				
	8						
	9	wet					
	10						4334
	11						
	12		Rec 1.4/4.0				
		EOB at 12' BGS 3" casing to 15', PVC to 15'					

HTW DRILLING LOG

HOLE NO. SB-15		
1 COMPANY NAME USACE	2. DRILLING SUBCONTRACTOR Aarco Env.	SHEET 1 OF SHEETS
3 PROJECT Staten Island Warehouse	4. LOCATION Staten Island NY	
5 NAME OF DRILLER J. Garcia	6. MANUFACTURER'S DESIGNATION OF DRILL Geoprobe	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" x 4' Macrocore; 3" x 5' casing	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED 9/23/21	11. DATE COMPLETED 9/23/21
12 OVERBURDEN THICKNESS 15'	15. DEPTH GROUNDWATER ENCOUNTERED	
13 DEPTH DRILLED INTO ROCK n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE 15'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.5 Concrete					
	1	0.5-1.5 DGA					
	2	1.5-2.7 black to dk gray sand w/grav., loose, dry	1.5-2.0		1.5-2.0		4221
			0.0				
	3	2.7-3.1 Rd-brown ML, moist firm, sandy					
	4	3.1-6.3 bl. to dk gray sand w/ gravel, loose, dry to moist	Rec 3.5/4.0				4209
			0.0				

HTW DRILLING LOG (CONT.)

HOLE NO.	
PROJECT	INSPECTOR	SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
					5-6		4436
	6						
		6.3-12 Rd-br ML, sandy, moist, firm to soft	0.0				
	7						
			Rec ~~3.0~~ 4.0/4		7.8		4619
	8	-wet/saturated Strong petroleum odor/ sheen/stain					4426
	9						
			0.0				
	10						
	11						
			Rec 1.2/4.0				
	12						
	13	EOB at 12' bgs 3" casing/PVC to 15'					

HTW DRILLING LOG

HOLE NO.	SB-16
1 COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	Aarco
SHEET 1 OF SHEETS	
3. PROJECT	Staten Island Warehouse
4. LOCATION	
5 NAME OF DRILLER	
6. MANUFACTURER'S DESIGNATION OF DRILL	Geoprobe
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4' Macro
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9/23/21
11. DATE COMPLETED	9/23/21
12 OVERBURDEN THICKNESS	3.4
15. DEPTH GROUNDWATER ENCOUNTERED	
13 DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	3.4
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X		Gamma	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.6 brown, ML, moist, soft Topsoil			0-0.5		7116
	1	0.6-3.4 Redbr to br ML with sand, gravel, dry, firm	0.0				
	2				2-3		7121
	3	-Brick or concrete refusal	Rec 2.6/3.4				
		EOB 3.4' Refusal * hole was offset 5 times with consistent refusal					

FORM MRK JUN 89 55 | PROJECT | HOLE NO.

HTW DRILLING LOG

HOLE NO	SB-23
1 COMPANY NAME	Gee
2 DRILLING SUBCONTRACTOR	n/a
SHEET 1 OF SHEETS	
3 PROJECT	
4 LOCATION	Staten Island
5 NAME OF DRILLER	
6 MANUFACTURER'S DESIGNATION OF DRILL	n/a
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Hand Auger
8 HOLE LOCATION	
9 SURFACE ELEVATION	
10 DATE STARTED	9/24/21
11 DATE COMPLETED	9/24/21
12 OVERBURDEN THICKNESS	2.5
13 DEPTH DRILLED INTO ROCK	
14 TOTAL DEPTH OF HOLE	
15 DEPTH GROUNDWATER ENCOUNTERED	
16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
17 OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19 TOTAL NUMBER OF CORE BOXES

20 SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21 TOTAL CORE RECOVERY %
			Rad			

22 DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23 SIGNATURE OF INSPECTOR
	X		Gamma	

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.3 dk br topsoil, mc soft, dry			0-0.5		4684
		0.3-2.4 gray to black sand w/ gravel, dry to moist loose					
	1				0.5-1.5		4615
	2						

HTW DRILLING LOG

HOLE NO.	SB-24
1 COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	n/a
SHEET 1 OF SHEETS	
3. PROJECT	Staten Island Warehouse
4. LOCATION	Staten Island
5 NAME OF DRILLER	
6 MANUFACTURER'S DESIGNATION OF DRILL	n/a
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Hand Auger
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9/24/21
11. DATE COMPLETED	9/24/21
12 OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	
13 DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
			Rad			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		0-0.5 dk br ML, moist, firm Topsoil			0-0.5		4668
	1	0.5-2.5 dk gray to bl Sand w/ ML, gravel loose, moist			0.5-2		5359
	2						
		EOB at 2.5'					

APPENDIX B

QUALITY CONTROL SUMMARY REPORT

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QUALITY CONTROL SUMMARY REPORT

This Quality Control Summary Report (QCSR) contains the examination of the quality of the analytical data for samples collected at the former Staten Island Warehouse (SIW) Formerly Utilized Sites Remedial Action Program Site. The intent of this assessment is to document the usability of the data based on project measurement performance criteria, precision, accuracy, representativeness, comparability, completeness, and sensitivity.

Analytical test methods and sample volume, preservation, holding time, and quality control requirements were met, as presented in the Uniform Federal Policy-Quality Assurance Protection Policy (UFP-QAPP). Standard methodology was used for sample collection, identification, documentation, handling, packaging, shipping, and chain-of-custody. Surface soil, subsurface soil, sediment, and test pit samples collected were analyzed for Ra-226 (Pb-214, Bi-214), Th-234, Ac-228, and K-40 by gamma spectroscopy (Method DOE Ga-01-R/901.1 (21 day)), and U isotopes (U-234, U-235, U-238) by alpha spectrometry (Method D3972 U-02). Groundwater samples collected were analyzed for gross alpha/gross beta by gas proportional counting (Method EPA 900/9310), Ra-228 (Method EPA 904/9320), Total Uranium (ASTM D5174/D5174M), and Ra-226 (Method SM-7500-RA-B M). All of the analyses were performed and reported by Pace Analytical, Mt. Juliet, TN. A list of the Sample Delivery Groups (SDGs) is presented in Table 1. Radiological data packages received from the analytical laboratory were validated and qualified in accordance with the *Kansas City District Radionuclide Data Quality Evaluation Guidance (CENWK)* referenced in the UFP-QAPP and the Stage 3 and 4 guidelines provided in the U.S Department of Defense (*DoD) General Data Validation Guidelines*. Additional documentation required for data validation was obtained from the laboratory as necessary during the validation process. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use, with the exception of 3 rejected results. The overall quality of the data meets or exceeds the established project objectives. Assessment of the data for quality and usability is presented below.

PRECISION

Precision is a measure of mutual agreement among individual measurements performed under the same laboratory controls. Field precision is assessed through the evaluation of field duplicate results. Analytical precision is assessed through the evaluation of laboratory duplicate, laboratory control sample duplicate, and matrix spike (MS)/ matrix spike duplicate (MSD) results.

Precision for radiological results was evaluated by calculating the relative percent difference (RPD), and/or normalized absolute difference (NAD), which accounts for uncertainty in the laboratory results. The RPD is calculated for all sample/duplicate pairs if a detectable result is reported for both the parent and duplicate. The RPD is not calculated when the analyte in one or both of the samples is not detected. In the cases where the RPD is not calculated, the comparison is counted as acceptable in the overall number of comparisons. The calculated RPD results were compared to performance criteria of less than or equal to 25% for gamma analysis and less than or equal to 20 percent (%) for alpha, gross alpha and beta, Radium-228, Uranium, and Radium-226 analyses. Where RPD values were greater than the project criteria, precision was evaluated by calculating the NAD. NAD values of less than or equal to 3 are considered acceptable per the UFP-QAPP. RPD and NAD are calculated as follows:

$$RPD = \left[\frac{|S-D|}{\frac{S+D}{2}}\right] \times 100$$

$$NAD = \left[\frac{|S - D|}{\sqrt{\sigma_S^2 + \sigma_D^2}}\right] \times 100$$

Where:
S = Parent Sample Result
D = Duplicate Sample Result
σ_S^2 = Parent Sample Combined Standard Uncertainty (CSU)
σ_D^2 = Duplicate Sample CSU

Calculated NAD values less than or equal to 3 were considered acceptable. Using NAD performance criteria of greater than 3 provides greater than 99.9% confidence that the numbers are not in agreement. Values greater than 3 were evaluated for qualification as estimated (J) but still usable for project decisions.

Field Precision

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision that contribute to the precision for the entire system of collecting and analyzing samples. The field duplicate samples were collected from the same spatial and temporal conditions as the primary environmental sample. The field duplicate samples are submitted to the laboratory along with the original parent samples. Both samples are analyzed under the same laboratory conditions.

Eleven parent and field duplicate soil sample pairs were compared for 3 analytes for alpha spectroscopy and 6 analytes for gamma spectroscopy, for a total of 99 comparisons, which are presented in Tables 2 and 3. One comparison (shown in bold, Table 3) exceeded the factor of 4 criteria specified in the UFP-QAPP for field duplicates, representing a 1.01% exceedance rate. No groundwater field duplicates were collected. Comparisons that did not meet the criteria can indicate a lack of precision in field sampling and perhaps a lack of sampling representativeness. The affected samples were qualified as estimated (J) but still usable for project decisions.

Laboratory Precision

Laboratory precision was evaluated by calculating the RPD and NAD between results for laboratory duplicate samples and their associated parent samples, laboratory control samples/ laboratory control sample duplicates (LCS/LCSD), and MS/MSD. These Quality Control (QC) samples were analyzed at a rate of one per analytical batch. Precision was considered acceptable if the RPD was less than or equal to 25% for gamma analysis and less than or equal to 20% for alpha, gross alpha and beta, Radium-228, Uranium, and Radium-226 analyses, or if the NAD was less than 3.

Sixteen parent and laboratory duplicate sample pairs were analyzed (5 duplicates for 3 alpha analytes; 6 duplicates for 6 gamma analytes; 1 duplicate for gross alpha; 1 duplicate for gross beta; 1 duplicate for Radium-228; 1 duplicate for Uranium; 2 duplicates for Radium-226), resulting in a total of 57 comparisons, which are presented in Tables 4 through 9. One comparison (shown in bold) exceeded the criteria, representing a 1.8% exceedance rate.

Six LCS/LCSD pairs were compared for 3 analytes for gamma spectroscopy, for a total of 18 comparisons. All comparisons were within the criteria, as shown in Table 10.

Ten MS/MSD pairs were analyzed (5 pairs for 2 alpha analytes; 1 pair for gross alpha; 1 pair for gross beta; 1 pair for Radium-228; 1 pair for Uranium; 2 pairs for Radium-226), resulting in a total of 16 comparisons. All comparisons were within the criteria, as shown in Tables 11 through 15.

For comparisons that did not meet the criteria, there is an indication of the precision goal not being met, and all samples for that analyte in the batch were qualified as estimated (J) but still usable for project decisions.

Accuracy

Accuracy is defined as the degree to which the reported measurement represents the true value. Analytical accuracy is assessed through the evaluation of laboratory blanks, equipment blanks, Laboratory Control Samples (LCSs), and MS recoveries.

Laboratory Method Blanks (MB)/Equipment Blanks (EB)

Laboratory method blanks are analyzed to evaluate the potential contamination of samples due to preparation and analytical procedures. Laboratory method blanks are prepared and analyzed exactly like the field samples and are designed to represent the matrix of interest as closely as possible. Laboratory method blanks were prepared and analyzed with each analytical batch. Equipment rinsate blanks were analyzed to verify the absence of any contamination of field equipment. Two equipment rinsate blank samples were collected.

Sixteen laboratory method blanks were analyzed for a total of 57 analytes, which are presented in Tables 16 through 21. Two analytes (shown in bold) were greater than the Minimum Detectable Activity, resulting in a 3.5% exceedance rate. When the criteria were not met, there is an indication of laboratory contamination. Samples for that analyte in the batch were evaluated for qualification: samples less than 5 times the blank value were qualified as non-detect (U), and samples with results greater than 5 times but less than 10 times the blank result were qualified as estimated (J) but still usable for project decisions.

Two equipment blanks were analyzed for a total of 10 analytes, which are presented in Table 22. One analyte (shown in bold) was greater than the Minimum Detectable Activity, resulting in 3.5% exceedance. When the criteria were not met, there is an indication of field equipment contamination. All samples for that analyte in the batch were evaluated for qualification: samples less than 5 times the blank value were qualified as non-detect (U), and samples with results greater than 5 times but less than 10 times the blank result were qualified as estimated (J) but still usable for project decisions.

Laboratory Control Samples (LCS)

The LCS is a laboratory spike sample that originates from a source other than the source of the calibration standards and serves as a zero-blind check on the laboratory’s accuracy/bias. The LCSs were prepared and analyzed along with each analytical batch. Accuracy/bias is measured through a comparison of a known amount of radionuclide versus the results of the measured amount of radionuclide.

Twenty-one LCS and LCSDs were analyzed for a total of 51 analytes; the percent recoveries are presented in Tables 23 through 28. The percent recovery for 2 analytes (shown in bold) were within the laboratory control limits, but outside the project control limits, resulting in 3.9% exceedance rate. When the criteria were not met, there is an indication of laboratory accuracy not meeting the accuracy goal, and all samples for that analyte in the batch were qualified as estimated (J) but still usable for project decisions.

Matrix Spike (MS)

MS analyses are performed by the laboratory to estimate the extent of accuracy/bias in the analytical measurements of radiological constituents. The analytical laboratory performed MS/MSD analyses by adding a known quality of each analyte to representative media, and analyzing the spiked media. Accuracy/bias in the result was quantified by determining the percent recovery of the spike amount.

However, per the DoD Quality Systems Manual (QSM), MSs are not required for radiochemical analysis if an isotopic tracer or chemical carrier is used in the analysis to determine chemical recovery (yield) for the chemical separation and sample mounting procedures. MSs are not required for gross alpha, gross beta, or gamma analysis.

Twenty MS/MSDs were analyzed for a total of 32 analytes; the percent recoveries are presented in Tables 29 through 33. When the criteria were not met, there is an indication of matrix interference. The percent recovery for 2 analytes (shown in bold) exceeded the control limits, resulting in a 6.2% exceedance rate. However, because a non-project sample was used for the MS where the 2 analytes exceeded the limits, qualification for matrix interference would not necessarily be applicable to project samples.

Calibrations

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The CENWK also states that any samples counted on detectors with delta % greater than 5% should be qualified as rejected. The UFP-QAPP further states that the 95% confidence limit (CL) of fitted function over range shall be ≤ 8%. Table 34 shows gamma spectrometer detectors/geometries with radionuclides that had delta values greater than 5% and or a 95% CL (1.96 sigma) greater than 8%. It is likely that the deficiencies for both parameters are due to the calibration being performed with less than the minimum 10,000 net counts in each peak, in at least six calibration peaks that bracket the range of use, as is specified in the DoD QSM. This is evidenced by the uncertainty reported for the peaks, even though the raw counts for the calibration were not provided. This indicates that there is greater than normal uncertainty in the results due to an uncertain bias from calibration. Based on the CENWK guidance, the samples counted on these detectors/geometries were qualified as rejected during validation. However, it was recommended that the project consider these results as estimated (J) and potentially usable for the project, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than normally allowed.

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration verification standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The UFP-QAPP also sets a limit of 10% relative to the true value. Based on the CENWK, any samples counted on detectors with check source value of greater than 10% should be qualified as rejected. Table 35 shows detectors/geometries with quantified peaks outside of the 10% limit for the calibration verification check source. It is likely that the deficiencies for this parameter are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK. Indeed, the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This indicates that there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. Based on the CENWK guidance, the samples counted on these detectors/geometries were qualified as rejected during validation. However, it was recommended that the project consider these results as estimated (J) and potentially usable for the project, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

During the data quality assessment discussion, the calibration issues noted above, which affected the samples qualified as “X” (unusable) during validation, were evaluated. The project team determined that these calibration issues were not significant enough to impact the data usability, and the affected results could be used and qualified as estimated (J). The final qualifiers are reflected in the tables referenced in Section 5 of the main report. The data are acceptable for use.

REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. The representativeness criteria are best satisfied by making certain that sampling locations are properly selected; and a sufficient number of samples are collected. Representativeness is addressed by describing sampling techniques and rationale used to select sampling locations. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or isotope interferences. Sample preservation, holding times, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied.

Representativeness is also evaluated through the review of the field precision as described above. The 2021 Supplemental Site Inspection (SSI) performed at the SIW Site was designed using guidance in the U.S. Environmental Protection Agency (USEPA) Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Additionally, representativeness was achieved through adherence to sampling and analytical procedures described in the UFP-QAPP. EPA-approved and American Society for Testing and Materials (ASTM)-approved and standardized sampling procedures were used where practical to ensure the representativeness of sample data. Data collected during this SSI followed the guidance, standards and procedures discussed above and are representative of conditions found at the Site.

COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols to be used for obtaining and analyzing samples, data sets should be comparable regardless of who obtains the sample or performs the analysis. The analytical laboratory was responsible for enhancing comparability using the following controls:

- Use of current, standard EPA-approved methodology for sample preservation, holding, and analysis;
- Consistent reporting units for each parameter in similar matrices;
- EPA-traceable standards, when available; and
- Analysis of EPA QC samples, when available.

By following these controls, the data obtained during the 2021 SSI has met the objectives outlined in the UFP-QAPP.

Data Intercomparison

Results from different but comparable analytical techniques from different subsample aliquots of the same sample were compared for consistency. All Uranium-235 and Uranium-238 results from the alpha analysis and gamma analysis were compared by calculating the RPD and NAD. If the NAD was greater than 3, results were considered incomparable and qualified as estimated (J). Results that exceeded the NAD criteria are demonstrated in Tables 36 and 37. Three samples (SS-DUP-17, TS-02-0002, and TS-02-0304) were qualified with X due to incomparable results between alpha and gamma Uranium-238 which impacted both the detect decision and the action level. However, during data usability assessment, in all 3 cases, it was determined that there was a spectral interference problem with the gamma Thorium-234 background, causing a problem with the gamma data, but there was agreement between the Pa-234m equilibrium daughter of Uranium-238 and the Uranium-238 results by alpha spectroscopy. Therefore, the gamma

Uranium-238 results for those 3 samples were rejected (R), and the Uranium-238 results using alpha spectroscopy were accepted as usable and qualified accordingly.

COMPLETENESS

Completeness is a measure of the degree to which the amount of sample data collected meets the scope and a measure of the relative number of analytical data points that meet the acceptance criteria, including accuracy, precision, and any other criteria required by the specific analytical method used. Completeness is defined as a comparison of the actual numbers of valid data points and expected numbers of points expressed as a percentage. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data, i.e., data of known quality even if not perfect, are suitable for the specified project goals. A total of 822 analyses were obtained, reviewed, and integrated into the assessment. Three analyses were rejected due to incomparability, yielding completeness for this project of 99.6%, which achieved the goal of 90% as specified in the UFP-QAPP.

SENSITIVITY

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. It represents the minimum difference in concentration that can be distinguished between two samples with a high degree of confidence. The sensitivity is evaluated by determining if the required detection level (RDL) was met. The non-detect sample results were then evaluated to determine if the RDL was met by comparing to a sample specific minimum detectable activity (MDA) that was calculated by multiplying the CSU by 3.5. If the RDL is greater than 3.5×CSU, the sample result met the RDL. If not, it was noted in the validation report that the RDL was not met. For gamma spectroscopy, a total of 2 in Uranium-235 analyses, 1 in Actinium-228 analyses, and 45 in Thorium-234 analyses did not meet the RDL.

For validation purposes, the detectability was evaluated by calculating the critical level. The critical level was determined by multiplying CSU by 1.65. If the sample result was less than the critical level, it is determined to be non-detect and qualified as U. For gamma spectroscopy, a total of 24 Uranium-235, 1 Actinium-228, and 45 Thorium-234 results were qualified as non-detect. For alpha spectroscopy analyses, a total of 21 Uranium-235 results were qualified as non-detect. For ground water samples, 3 gross alpha, 2 gross beta, 3 Uranium-235, 1 Radium-226, and 3 Radium-228 results were qualified as non-detect.

DATA MANAGEMENT AND DOCUMENTATION

Management of the analytical data generated during the characterization effort was conducted in accordance with the general requirements of the Project Work Plan.

ANALYTICAL DATA

Samples collected during the characterization effort were identified by a unique number code that accompanied the sample from collection through analysis and data review. Standardized chain-of-custody procedures were followed from sample collection through sample analysis. The condition of shipping coolers and enclosed sample containers was documented upon receipt at the analytical laboratory. The laboratory transmitted the completed chain-of-custody form and cooler receipt checklist to the Project Manager (PM) to confirm each sample shipment.

Analytical data reports containing results of the requested analyses were transmitted to the GEO PM and included in Appendix C of the 2021 SSI Report. Each data package contained an electronic data deliverable spreadsheet summarizing the analytical results, as well as an electronic file containing the entire case narrative and supporting data. The electronic files were uploaded to the corporate server and backed up on a compact disc. Laboratory data reports are included in Appendix D of the 2021 SSI Report.

Table 1. Sample Delivery Groups (SDGs).

SDG #	Laboratory Sample ID	Project Sample ID	Analyses	Matrix
L1409189	L1409189-01	TS-01-0002	Gamma Spec & Iso U	Test Pit
	L1409189-02	TS-01-0204	Gamma Spec & Iso U	Test Pit
	L1409189-03	TS-02-0002	Gamma Spec & Iso U	Test Pit
	L1409189-04	TS-02-0304	Gamma Spec & Iso U	Test Pit
	L1409189-05	TS-03-0002	Gamma Spec & Iso U	Test Pit
	L1409189-06	TS-03-0204	Gamma Spec & Iso U	Test Pit
	L1409189-07	TS-04-0002	Gamma Spec & Iso U	Test Pit
	L1409189-08	TS-04-0406	Gamma Spec & Iso U	Test Pit
	L1409189-09	TS-DUP-01	Gamma Spec & Iso U	Test Pit
	L1409189-10	TS-DUP-02	Gamma Spec & Iso U	Test Pit
L1409907	L1409907-01	SS-15-1135	Gamma Spec & Iso U	Soil
	L1409907-02	SB-15-0406	Gamma Spec & Iso U	Soil
	L1409907-03	SB-15-0608	Gamma Spec & Iso U	Soil
	L1409907-04	SS-10-0750	Gamma Spec & Iso U	Soil
	L1409907-05	SB-10-0517	Gamma Spec & Iso U	Soil
	L1409907-06	SB-10-0465	Gamma Spec & Iso U	Soil
	L1409907-07	SS-09-0840	Gamma Spec & Iso U	Soil
	L1409907-08	SB-09-0117	Gamma Spec & Iso U	Soil
	L1409907-09	SB-09-0506	Gamma Spec & Iso U	Soil
L1410500	L1410500-01	SS-04-0926	Gamma Spec & Iso U	Soil
	L1410500-02	SB-04-0102	Gamma Spec & Iso U	Soil
	L1410500-03	SB-04-0406	Gamma Spec & Iso U	Soil
	L1410500-04	SS-02-0835	Gamma Spec & Iso U	Soil
	L1410500-05	SB-02-0501	Gamma Spec & Iso U	Soil
	L1410500-06	SB-02-0102	Gamma Spec & Iso U	Soil
	L1410500-07	SB-DUP-02	Gamma Spec & Iso U	Soil
L1410504	L1410504-01	SS-11-1100	Gamma Spec & Iso U	Soil
	L1410504-02	SB-11-0405	Gamma Spec & Iso U	Soil
	L1410504-03	SB-11-0506	Gamma Spec & Iso U	Soil
	L1410504-04	SS-12-1115	Gamma Spec & Iso U	Soil
	L1410504-05	SB-12-0304	Gamma Spec & Iso U	Soil
	L1410504-06	SB-12-0506	Gamma Spec & Iso U	Soil
	L1410504-07	SS-14-1205	Gamma Spec & Iso U	Soil
	L1410504-08	SB-14-2540	Gamma Spec & Iso U	Soil
	L1410504-09	SB-14-0608	Gamma Spec & Iso U	Soil
	L1410504-10	SB-DUP-11	Gamma Spec & Iso U	Soil
L1410508	L1410508-01	SS-05-0915	Gamma Spec & Iso U	Soil
	L1410508-02	SB-05-0505	Gamma Spec & Iso U	Soil
	L1410508-03	SB-05-0510	Gamma Spec & Iso U	Soil
	L1410508-04	SS-03-0810	Gamma Spec & Iso U	Soil
	L1410508-05	SB-03-0815	Gamma Spec & Iso U	Soil
	L1410508-06	SB-03-0102	Gamma Spec & Iso U	Soil
	L1410508-07	SS-01-0825	Gamma Spec & Iso U	Soil
	L1410508-08	SB-01-0501	Gamma Spec & Iso U	Soil
	L1410508-09	SB-01-0102	Gamma Spec & Iso U	Soil
	L1410508-10	SB-DUP-01	Gamma Spec & Iso U	Soil
	L1410508-11	SS-DUP-03	Gamma Spec & Iso U	Soil

Table 1. Sample Delivery Groups (SDGs).

SDG #	Laboratory Sample ID	Project Sample ID	Analyses	Matrix
L1410508	L1410508-01	SS-05-0915	Gamma Spec & Iso U	Soil
	L1410508-02	SB-05-0505	Gamma Spec & Iso U	Soil
	L1410508-03	SB-05-0510	Gamma Spec & Iso U	Soil
	L1410508-04	SS-03-0810	Gamma Spec & Iso U	Soil
	L1410508-05	SB-03-0815	Gamma Spec & Iso U	Soil
	L1410508-06	SB-03-0102	Gamma Spec & Iso U	Soil
	L1410508-07	SS-01-0825	Gamma Spec & Iso U	Soil
	L1410508-08	SB-01-0501	Gamma Spec & Iso U	Soil
	L1410508-09	SB-01-0102	Gamma Spec & Iso U	Soil
	L1410508-10	SB-DUP-01	Gamma Spec & Iso U	Soil
	L1410508-11	SS-DUP-03	Gamma Spec & Iso U	Soil
L1410531	L1410531-01	SS-16-1300	Gamma Spec & Iso U	Soil
	L1410531-02	SB-16-0235	Gamma Spec & Iso U	Soil
	L1410531-03	SS-17-1230	Gamma Spec & Iso U	Soil
	L1410531-04	SB-17-0102	Gamma Spec & Iso U	Soil
	L1410531-05	SS-18-1250	Gamma Spec & Iso U	Soil
	L1410531-06	SB-18-0102	Gamma Spec & Iso U	Soil
	L1410531-07	SS-19-1310	Gamma Spec & Iso U	Soil
	L1410531-08	SB-19-0102	Gamma Spec & Iso U	Soil
	L1410531-09	SB-19-0203	Gamma Spec & Iso U	Soil
	L1410531-10	SB-DUP-16	Gamma Spec & Iso U	Soil
	L1410531-11	SS-DUP-17	Gamma Spec & Iso U	Soil
L1410640	L1410640-01	SS-25-0940	Gamma Spec & Iso U	Soil
	L1410640-02	SS-22-0935	Gamma Spec & Iso U	Soil
	L1410640-03	SS-21-1000	Gamma Spec & Iso U	Soil
	L1410640-04	SS-20-1020	Gamma Spec & Iso U	Soil
	L1410640-05	SS-24-0941	Gamma Spec & Iso U	Soil
	L1410640-06	SB-24-0102	Gamma Spec & Iso U	Soil
	L1410640-07	SB-DUP-23	Gamma Spec & Iso U	Soil
	L1410640-08	SB-23-0102	Gamma Spec & Iso U	Soil
	L1410640-09	SS-23-1014	Gamma Spec & Iso U	Soil
	L1410640-10	SS-13-1015	Gamma Spec & Iso U	Soil
L1410673	L1410673-01	SS-08-1400	Gamma Spec & Iso U	Soil
	L1410673-02	SB-08-0102	Gamma Spec & Iso U	Soil
	L1410673-03	SS-06-0936	Gamma Spec & Iso U	Soil
	L1410673-04	SB-06-0203	Gamma Spec & Iso U	Soil
	L1410673-05	SB-06-0501	Gamma Spec & Iso U	Soil
	L1410673-06	SS-07-1220	Gamma Spec & Iso U	Soil
	L1410673-07	SB-07-0102	Gamma Spec & Iso U	Soil
	L1410673-08	SB-07-0203	Gamma Spec & Iso U	Soil
	L1410673-09	SS-DUP-06	Gamma Spec & Iso U	Soil

Table 1. Sample Delivery Groups (SDGs) Continued.

SDG #	Laboratory Sample ID	Project Sample ID	Analyses	Matrix
L1410682	L1410682-01	SD-01-0813	Gamma Spec & Iso U	Sediment
	L1410682-02	SD-02-0810	Gamma Spec & Iso U	Sediment
	L1410682-03	SD-03-0815	Gamma Spec & Iso U	Sediment
	L1410682-04	SD-04-0910	Gamma Spec & Iso U	Sediment
	L1410682-05	SD-05-0800	Gamma Spec & Iso U	Sediment
	L1410682-06	SD-06-0754	Gamma Spec & Iso U	Sediment
	L1410682-07	SD-07-0758	Gamma Spec & Iso U	Sediment
	L1410682-08	SD-08-0805	Gamma Spec & Iso U	Sediment
	L1410682-09	SD-09-0750	Gamma Spec & Iso U	Sediment
	L1410682-10	SD-10-0816	Gamma Spec & Iso U	Sediment
	L1410682-11	SD-DUP-02	Gamma Spec & Iso U	Sediment
L1411184	L1411184-01	GW-06-1205	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water
	L1411184-02	GW-09-1210	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water
	L1411184-03	GW-07-1215	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water
	L1411184-04	GW-10-1220	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water
L1411187	L1411187-01	EQ-SD-1410	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water
	L1411187-02	EQ-SB-1520	Gross alpha/gross beta, Ra-228, Total U, & Ra-226	Ground Water

Table 2. Field Duplicate Results by Alpha Spectroscopy

	U-234			U-235			U-238		
Sample ID	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**
SD-DUP-02	0.618	2.47	0.881	0.0291	0.116	0.0275	0.686	2.74	0.913
TS-DUP-01	9	36	9.93	0.384	1.54	0.357	9.07	36.3	9.77
TS-DUP-02	9.29	37.2	9.85	0.476	1.90	0.572	9.69	38.8	10.1
SB-DUP-02	0.809	3.24	0.787	0.00939	0.0376	-0.00463	0.752	3.01	0.795
SB-DUP-23	2.94	11.8	2.05	0.272	1.09	0.0447	2.9	11.6	2.54
SB-DUP-01	0.597	2.39	1.24	0.041	0.164	0.0837	0.634	2.54	1.35
SS-DUP-03	3.43	13.7	3.86	0.14	0.56	0.169	3.96	15.8	3.63
SB-DUP-16	1.04	4.16	0.928	0.0321	0.128	0.0315	1.16	4.64	0.874
SS-DUP-17	22	88	14.3	0.97	3.88	0.526	22.1	88.4	14.6
SB-DUP-11	1.46	5.84	2.01	0.0359	0.144	0.128	1.8	7.2	2.09
SS-DUP-06	1.45	5.8	2.77	0.0943	0.377	0.0417	1.2	4.8	3.02

DUP: duplicate; ID: identification number; pCi/g: picocuries per gram; SB: soil boring; SD: sediment; SS: surface sample; TS: test pit; U-234: Uranium-234;U-235: Uranium-235; U-238: Uranium-238

Table 3. Field Duplicate Results by Gamma Spectroscopy

	Ac-228			Bi-214 (Ra-226)			Pb-214		
Sample ID	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**
SD-DUP-02	1.09	4.36	0.902	0.972	3.89	1.01	1.01	4.04	1.19
TS-DUP-01	1.9	7.6	1.29	35.1	140	32	35.8	143	34.8
TS-DUP-02	1.27	5.08	1.57	11.9	47.6	12.7	13.3	53.2	13.7
SB-DUP-02	1.27	5.08	1.13	1.1	4.4	1.13	1.36	5.44	1.22
SB-DUP-23	1.07	4.28	0.864	3.85	15.4	2.76	3.54	14.2	4.97
SB-DUP-01	1.45	5.8	1.51	1.14	4.56	1.13	1.07	4.28	1.02
SS-DUP-03	2.51	10.04	0.632	2.23	8.92	0.543	2.62	10.5	0.795
SB-DUP-16	1.43	5.72	1.25	1.34	5.36	1.07	1.3	5.2	1.14
SS-DUP-17	2.21	8.84	1.72	19.8	79.2	9.7	21.8	87.2	11.8
SB-DUP-11	2.02	8.08	5.04	1.9	7.6	3.8	1.91	7.64	4.31
SS-DUP-06	1.01	4.04	0.986	1.31	5.24	2.08	1.3	5.2	2.41

Ac-228: actinium-228; Bi-214: Bismuth-214; DUP: duplicate; ID: identification number; Pb—214: Lead-214; pCi/g: picocuries per gram; Ra-226: Radium-226; SB: soil boring; SD: sediment; SS: surface sample; TS: test pit

Table 3. Field Duplicate Results by Gamma Spectroscopy (continued)

	K-40			U-235			Th-234		
Sample ID	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**	**Parent Result (pCi/g)**	**Factor of 4 of Parent Result (pCi/g)**	**Duplicate Result (pCi/g)**
SD-DUP-02	17.1	68.4	16	0.151	0.604	0.159	1.48	5.92	0.805
TS-DUP-01	13	52	14.1	2.74	11.0	0.498	-4.94	-19.8	1.86
TS-DUP-02	5.4	21.6	5.81	0.361	1.44	**1.48**	3.21	12.8	6.53
SB-DUP-02	15.1	60.4	13.9	0.174	0.696	0.1	1.02	4.08	0.463
SB-DUP-23	8.34	33.36	7.54	0.54	2.16	0.391	1.49	5.96	-2.13
SB-DUP-01	6.56	26.24	8.19	0.131	0.524	0.181	-3.88	-15.5	-2.31
SS-DUP-03	11	44	1.94	0.37	1.48	0.0184	3.45	13.8	3.17
SB-DUP-16	13.4	53.6	15.8	0.103	0.412	0.131	1.16	4.64	0.874
SS-DUP-17	9.98	39.92	8.94	1.28	5.12	0.0293	18.5	74	-5.2
SB-DUP-11	10.6	42.4	19.7	0.187	0.748	0.608	-1.46	-5.84	2.29
SS-DUP-06	14.3	57.2	7.9	1.5	6	0.263	1.4	5.6	-2.35

DUP: duplicate; K-40: Potassium-40; ID: identification number; pCi/g: picocuries per gram; SB: soil boring; SD: sediment; SS: surface sample; Th-234: Thorium-234;
TS: test pit; U-235: Uranium-235;

Table 4. Laboratory Duplicate Results by Alpha Spectroscopy

	U-234		U-235		U-238	
Lab Sample ID	**RPD (%)**	**NAD(%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**
R3715413-5	15.8	2.2	46.9	1.5	19.5	2.7
R3720206-5	17.0	1.4	129	2.5	6.76	0.56
R3724488-5	0.85	0.076	59.6	1.1	19.2	1.8
R3725650-5	2.78	0.27	62.6	0.96	2.48	0.26
R3726763-5	7.19	0.81	282	1.3	17.8	1.91

ID: identification number; NAD: normalized absolute difference; %: percent; RPD: relative percent difference; U-234: Uranium-234; U-235: Uranium-235; U-238: Uranium-238

Table 5. Laboratory Duplicate Results by Gamma Spectroscopy

	Ac-228		Bi-214 (Ra-226)		Pb-214		K-40		U-235		Th-234	
Lab Sample ID	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**
R3722645-3	38.1	1.1	2.36	0.28	14.4	1.7	25.3	1.7	0.43	0.02	97.8	1.1
R3723176-2	2.26	0.14	3.95	0.39	2.38	0.23	22.6	1.5	44.9	1.4	19.2	0.25
R3724570-4	5.71	0.31	9.09	0.73	6.69	0.62	0.94	0.073	15.3	0.53	**434**	**3.7**
R3725159-4	77.4	0.81	0.66	0.023	18.7	0.73	84.3	1.5	768	2.4	114	0.92
R3725157-4	18.9	0.92	22.2	1.5	11.4	1.01	6.16	0.47	45.2	0.15	259	2.8
R3725727-2	27.3	1.59	1.39	0.094	30.6	2.6	12.7	1.09	22.2	0.48	53.6	0.90

Ac-228: Actinium-228; Bi-214: Bismuth-214; K-40: Potassium-40; ID: identification number; NAD: normalized absolute difference; Pb-40: Lead-40; Ra-226: Radium-226; RPD: relative percent difference; Th-234: Thorium-234; U-235: Uranium-235

Table 6. Laboratory Duplicate Results for Gross Alpha/Beta Measurements

	Gross Alpha		Gross Beta	
Lab Sample ID	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD(%)**
R3719591-5	15.7	0.13	66.8	1.95

ID: identification number; NAD: normalized absolute difference; %: percent; RPD: relative percent difference

Table 7. Laboratory Duplicate Results for Ra-228

	Ra-228	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3723073-5	240	0.43

ID: identification number; NAD: normalized absolute difference; %: percent; RA-228: Radium-228; RPD: relative percent difference

Table 8. Laboratory Duplicate Results for Uranium

	Uranium	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3719923-5	0	0

ID: identification number; NAD: normalized absolute difference; %: percent;
RPD: relative percent difference

Table 9. Laboratory Duplicate Results for Ra-226

	Ra-226	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3714970-5	83.2	0.077
R3722405-5	2227	0.49

ID: identification number; NAD: normalized absolute difference; %: percent;
Ra-226: Radium-226; RPD: relative percent difference

Table 10. LCS Duplicate Results by Gamma Spectroscopy

	Am-241		Cs-137		Co-60	
Lab Sample ID	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**
R3722645-4	5.06	0.99	17.1	4.0	0.14	0.034
R3723176-4	4.22	0.83	0.92	0.20	0.04	0.009
R3724570-2	3.18	0.44	4.84	0.82	0.79	0.16
R3725159-3	6.63	1.00	6.49	1.26	8.09	1.8
R3725157-2	7.33	0.99	0.43	0.074	1.07	0.22
R3725727-4	8.26	1.09	5.45	1.12	3.16	0.73

Am-241: Americium-241; Co-60: Cobalt-60; Cs-137: Cesium-137; ID: identification number;
NAD: normalized absolute difference; %: percent; Ra-226: Radium-226; RPD: relative percent difference

Table 11. Matrix Spike Duplicate Results by Alpha Spectroscopy

	U-234		U-238	
Lab Sample ID	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**
R3715413-4	1.53	0.39	3.75	0.95
R3720206-4	0.34	0.074	7.56	1.66
R3724488-4	5.74	1.62	5.32	1.50
R3725650-4	2.49	0.49	2.49	0.49
R3726763-4	4.29	0.86	5.22	1.04

ID: identification number; NAD: normalized absolute difference; %: percent;
RPD: relative percent difference U-234: Uranium-234; U-238: Uranium-238

Table 12. Matrix Spike Duplicate Results for Gross Alpha/Beta Measurements

	Gross Alpha		Gross Beta	
Lab Sample ID	**RPD (%)**	**NAD (%)**	**RPD (%)**	**NAD (%)**
R3719591-4	5.26	0.48	1.56	0.38

ID: identification number; NAD: normalized absolute difference; %: percent; RPD: relative percent difference

Table 13. Matrix Spike Duplicate Results for Ra-228

	Ra-228	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3723073-4	6.28	1.46

ID: identification number; NAD: normalized absolute difference; %: percent; Ra-228: Radium-228;RPD: relative percent difference

Table 14. Matrix Spike Duplicate Results for Uranium

	Uranium	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3719923-4	1.01	0.301

ID: identification number; NAD: normalized absolute difference; %: percent; RPD: relative percent difference

Table 15. Matrix Spike Duplicate Results for Radium-226

	Ra-226	
Lab Sample ID	**RPD (%)**	**NAD (%)**
R3714970-4	5.74	0.69
R3722405-4	2.01	0.26

ID: identification number; NAD: normalized absolute difference; %: percent; Ra-226: Radium-226; RPD: relative percent difference

Table 16. Alpha Spectroscopy Method Blank Results

	U-234		U-235		U-238	
Lab Sample ID	**Result (pCi/g)**	**VQ**	**Result (pCi/g)**	**VQ**	**Result (pCi/g)**	**VQ**
R3715413-1	0.0526	U	0.00566	U	0.147	J
R3720206-1	0.0345	U	-0.0164	U	0.0806	J
R3724488-1	-0.031	U	-0.0049	U	0.103	J
R3725650-1	-0.0275	U	-0.0232	U	0.0641	J
R3726763-1	0.106	J	-0.0049	U	0.0867	J

ID: identification number; J: estimated value; pCi/g: picocuries per gram; U: non-detect; U-234: Uranium-234; U-235: Uranium-235; U-238: Uranium-238; VQ: validation qualifier

Table 17. Gamma Spectroscopy Method Blank Results

	Ac-228		Bi-214 (Ra-226)		Pb-214		K-40		U-235		Th-234	
Lab Sample ID	**Result (%)**	**VQ**	**Result (%)**	**VQ**	**Result (%)**	**VQ**	**Result (%)**	**VQ**	**Result (%)**	**VQ**	**Result (%)**	**VQ**
R3722645-1	0.168	U	-0.0053	U	-0.0063	U	-0.379	U	0.0456	U	1.01	J
R3723176-3	0.118	U	0.138	J	0.106	J	-0.303	U	-0.0158	U	0.275	U
R3724570-3	-0.0742	U	0.0623	U	-0.0131	U	-0.123	U	0.0659	J	**0.975**	
R3725159-2	-0.0422	U	-0.0035	U	0.0248	U	0.219	U	0.0374	U	1.12	J
R3725157-3	0.105	U	0.0117	U	0.00454	U	0.221	U	0.119	J	**1.85**	
R3725727-3	-0.0081	U	0.0976	J	-0.0277	U	-0.186	U	0.0353	J	0.756	U

Ac-228: actinium-228; Bi-214: Bismuth-214; K-40: Potassium-40; ID: identification number; J: estimated value; NAD: normalized absolute difference; Pb-40: Lead-40; pCi/g: picocuries per gram Ra-226: Radium-226; RPD: relative percent difference; Th-234: Thorium-234; U: non-detect; U-235: Uranium-235; VQ: validation qualifier

Table 18. Gross Alpha/Beta Method Blank Results

	Gross Alpha		Gross Beta	
Lab Sample ID	**Result (pCi/L)**	**VQ**	**Result (pCi/L)**	**VQ**
R3719591-1	0.165	U	-0.314	U

ID: identification number pCi/L: picocuries per liter; U: non-detect; VQ: validation qualifier

Table 19. Ra-228 Method Blank Result

	Ra-228	
Lab Sample ID	**Result (pCi/L)**	**VQ**
R3723073-1	-0.151	U

ID: identification number; pCi/L: picocuries per liter; Ra-28: Radium-228;
U: non-detect; VQ: validation qualifier

Table 20. Uranium Method Blank Result

	Uranium	
Lab Sample ID	**Result (%)**	**VQ**
R3719923-1	U	U

ID: identification number; U: non-detect; VQ: validation qualifier

Table 21. Ra-226 Method Blank Result

	Ra-226	
Lab Sample ID	**Result (PCi/L)**	**VQ**
R3714970-1	0.00799	U
R3722405-1	-0.000464	U

ID: identification number; pCi/L: picocuries per liter;
Ra-226: Radium-226; U: non-detect; VQ: validation qualifier

Table 22. Equipment Blanks

	Gross Alpha		Gross Beta		Ra-228		Uranium		Ra-226	
Lab Sample ID	**Result (pCi/L)**	**VQ**	**Result (pCi/L)**	**VQ**	**Result (pCi/L)**	**VQ**	**Result (pCi/L)**	**VQ**	**Result (pCi/L)**	**VQ**
EQ-SD-1410	-0.0607	U	0.125	U	-0.256	U	ND	U	0.0348	U
EQ-SB-1520	0.11	U	-1.54	U	-0.575	U	ND	U	**0.468**	

EQ: equipment blank; ID: identification number; ND: not detected at the associated level; pCi/L: picocuries per liter; Ra-226: Radium-226; Ra-228: Radium-228; U: non-detect; VQ: validation qualifier

Table 23. LCS Results for Alpha Spectroscopy

	U-234	U-238
Lab Sample ID	Recovery (%)	Recovery (%)
R3715413-2	98.1	96.5
R3720206-2	**72.7***	81.3
R3724488-2	96.1	105
R3725650-2	75.5	**72.9***
R3726763-2	90.1	90.2
Control Limits	75-125	75-125
*Laboratory limits	60.9-117	68.1-121

ID: identification number; LCS: laboratory control sample; %: percent;
U-234: Uranium-234; U-238: Uranium-238

Table 24. LCS Results for Gamma Spectroscopy

	Am-241	Cs-137	Co-60
Lab Sample ID	Recovery (%)	Recovery (%)	Recovery (%)
R3722645-2	104	102	95.5
R3722645-4	98.7	100	95.4
R3723176-1	103	102	95.1
R3723176-4	98.5	101	95.1
R3724570-1	99.6	100	95.5
R3724570-2	96.4	95.4	94.8
R3725159-1	98.7	106	99.2
R3725159-3	106	98.8	91.4
R3725157-1	97.7	98.4	96.9
R3725157-2	105	98	95.8
R3725727-1	108	105	99.2
R3725727-4	99.3	99.5	96.1
Control Limits	80-120	80-120	80-120

Am-241:Americium-241; Co-60: Cobalt-60; Cs-137: Cesium-137; ID: identification number;
LCS: laboratory control sample; %: percent

Table 25. LCS Results for Gross Alpha/Beta

	Gross Alpha	Gross Beta
Lab Sample ID	Recovery (%)	Recovery (%)
R3719591-2	93.2	120
Control Limits	80-120	80-120

ID: identification number; LCS: laboratory control sample; %: percent

Table 26. LCS Results for Ra-228

	Ra-228
Lab Sample ID	**Recovery (%)**
R3723073-2	103
Control Limits	80-120

ID: identification number; LCS: laboratory control sample; %: percent; Ra-228: Radium-228

Table 27. LCS Results for Uranium

	Uranium
Lab Sample ID	**Recovery (%)**
R3719923-2	112
Control Limits	80-120

ID: identification number; LCS: laboratory control samples; %: percent

Table 28. LCS Results for Ra-226

	Ra-226
Lab Sample ID	**Recovery (%)**
R3714970-2	102
R3722405-2	105
Control Limits	80-120

ID: identification number; LCS: laboratory control sample; %: percent; Ra-226: Radium-226

Table 29. Matrix Spike Results for Alpha Spectroscopy

	U-234	U-238
Lab Sample ID	**Recovery (%)**	**Recovery (%)**
R3715413-3	104	112
R3715413-4	106	106
R3720206-3	98.9	103
R3720206-4	98.5	113
R3724488-3	102	118
R3724488-4	109	113
R3725650-3	97.9	98.6
R3725650-4	101	101
R3726763-3	105	105
R3726763-4	110	112
Control Limits	60-140	60-140

ID: identification number; LCS: laboratory control sample; %: percent; U-234: Uranium-234; U-238: Uranium-238

Table 30. Matrix Spike Results for Gross Alpha/Beta

	Gross Alpha	Gross Beta
Lab Sample ID	**Recovery (%)**	**Recovery (%)**
R3719591-3	**129**	**125**
R3719591-4	122	123
Control Limits	75-125	75-125

ID: identification number; %: percent

Table 31. Matrix Spike Results for Ra-228

	Ra-228
Lab Sample ID	**Recovery (%)**
R3723073-3	114
R3723073-4	107
Control Limits	75-125

ID: identification number; %: percent; Ra-228: Radium-228

Table 32. Matrix Spike Results for Uranium

	Uranium
Lab Sample ID	**Recovery (%)**
R3719923-3	110
R3719923-4	112
Control Limits	75-125

ID: identification number; %: percent

Table 33. Matrix Spike Results for Ra-226

	Ra-226
Lab Sample ID	**Recovery (%)**
R3714970-3	92.1
R3714970-4	97.7
R3722405-3	75.4
R3722405-4	77.1
Control Limits	75-125

ID: identification number; %: percent; Ra-226: Radium-226

Table 34. Gamma Detector Calibrations Outside of Acceptance Criteria

Detector	Geometry	Energy Peaks (#)	Delta (%)	Energy Peaks (#)	95% CL
1	C6	1	6.3		
2	C1	1	8.2	5	8.9 – 11.9
2	C6	3	-9.4 – 7.9		
2	P3	1	5.3		
3	C6	1	18.8	8	8.4 – 10.6
4	C6	1	-6.5		
4	P3	1	18.3	1	8.8
5	C6	2	-16.4 – 6.5	9	8.8 – 14.7
9	C1	1	-12.9		
9	P3	1	12.7		
10	P3	1	22.4	2	8.2 – 8.3
11	C6	1	-5.3	2	8.2 – 12.7
12	P3	1	24.5	1	9.6

#: number; %: percent; CL: confidence limit

Table 35. Gamma Detector Calibration Verifications Outside of Acceptance Criteria

Detector	Geometry	Energy Peaks	Difference (%)
1	C6	1	10.8
1	C6	1	12.2
1	C6	1	-10.6
2	P3	1	10.2
3	C6	1	14.34
3	C6	1	25.5

%: percent

Table 36. U-235 Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD (%)	NAD	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SD-02-0810	U-235	0.0291	0.019	0.151	0.03225	135	3.2	J
SD-03-0815	U-235	0.0455	0.029	0.218	0.04335	131	3.3	J
SD-06-0754	U-235	0.0877	0.031	0.25	0.03175	96.1	3.6	J
SD-07-0758	U-235	0.104	0.031	0.308	0.0439	99.0	3.8	J
SB-15-0406	U-235	0.0477	0.021	0.344	0.0458	151	5.9	J
SB-15-0608	U-235	0.0168	0.021	0.176	0.036	165	3.8	J
SB-09-0117	U-235	0.0304	0.024	0.238	0.056	155	3.4	J
TS-01-0002	U-235	0.106	0.026	0.356	0.04475	108	4.8	J
TS-01-0204	U-235	0.0888	0.028	0.359	0.063	121	3.9	J
TS-02-0002	U-235	3.8	0.138	13.5	1.965	112	4.9	J
TS-02-0304	U-235	0.384	0.054	2.74	0.2095	151	10.8	J
TS-03-0002	U-235	0.159	0.038	0.55	0.0525	110	6.0	J
TS-04-0406	U-235	0.11	0.029	0.475	0.051	125	6.2	J
TS-DUP-02	U-235	0.572	0.056	1.48	0.088	88.5	8.7	J
SS-04-0926	U-235	0.248	0.038	0.466	0.0585	61.1	3.1	J
SB-02-0501	U-235	0.00939	0.02	0.174	0.03525	179	4.1	J
SS-24-0941	U-235	0.0692	0.022	0.377	0.0515	138	5.5	J
SB-24-0102	U-235	0.105	0.031	0.319	0.0442	101	4.0	J
SB-DUP-23	U-235	0.0447	0.022	0.391	0.0715	159	4.6	J
SS-03-0810	U-235	0.14	0.04315	0.37	0.052	90.2	3.4	J
SS-16-1300	U-235	0.101	0.027	0.385	0.077	116	3.5	J
SS-17-1230	U-235	1.19	0.088	2.17	0.115	58.3	6.8	J
SS-18-1250	U-235	0.0309	0.017	0.228	0.04285	152	4.3	J
SB-11-0405	U-235	0.0359	0.022	0.187	0.0381	136	3.4	J
SB-11-0506	U-235	0.0294	0.025	0.241	0.0447	157	4.1	J
SS-12-1115	U-235	0.00489	0.019	0.223	0.03345	191	5.7	J
SB-14-0608	U-235	0.114	0.033	0.322	0.0467	95.4	3.6	J
SB-DUP-11	U-235	0.128	0.034	0.608	0.0785	130	5.6	J
SS-08-1400	U-235	0.0317	0.018	1.92	0.0497	193	36	J
SB-08-0102	U-235	0.0518	0.02	0.204	0.0442	119	3.1	J
SB-06-0203	U-235	0.00867	0.022	0.358	0.0575	191	5.7	J
SB-06-0501	U-235	0.197	0.032	0.62	0.053	103	6.8	J
SB-07-0102	U-235	0.145	0.027	0.296	0.03726	68.5	3.3	J
SS-DUP-06	U-235	0.0417	0.025	0.263	0.0583	145	3.5	J

CSU: combined standard uncertainty: DUP: duplicate; J:estimated value; ID: identification number; NAD: normalized absolute difference %: percent; pCi/g: picocuries per gram; RPD: relative percent difference; SB: soil boring; SD: sediment; SS: surface sample; TS: test pit; U-235: Uranium-235

Table 37. U-238 Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD (%)	NAD	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SD-01-0813	U-238	3.09	0.1805	0.819	0.52	116	4.1	J
SD-07-0758	U-238	2.39	0.146	-0.71	0.63	369	4.8	J
SD-10-0816	U-238	1.57	0.1295	-2.52	0.8	861	5.0	J
TS-04-0406	U-235	0.11	0.029	0.475	0.051	125	6.2	J
TS-01-0002	U-238	3.27	0.171	1.16	0.665	95.3	3.1	J
TS-02-0002	U-238	73.3	1.05	-7.05	5.2	242	15.1	**X**
TS-02-0304	U-238	9.07	0.2745	-4.94	2.415	678	5.8	**X**
TS-04-0002	U-238	9.69	0.3055	3.21	1.07	100	5.8	J
TS-DUP-01	U-238	9.77	0.343	1.86	1.53	136	5.0	J
SS-20-1020	U-238	0.995	0.102	-0.599	0.4915	805	3.2	J
SB-DUP-23	U-238	2.54	0.176	-2.13	1.095	2278	4.2	J
SS-05-0915	U-238	2.8	0.178	-6.81	1.59	479	6.0	J
SB-05-0510	U-238	1.43	0.1285	-1.29	0.705	3885	3.8	J
SB-03-0815	U-238	3.07	0.176	0.79	0.64	118	4.9	J
SB-01-0501	U-238	0.634	.079	-3.88	1.11	278	4.1	J
SB-DUP-01	U-238	1.35	0.115	-2.31	1.07	762	3.4	J
SS-17-1230	U-238	24.9	0.51	12.3	2.255	68	5.5	J
SS-DUP-17	U-238	14.6	0.3905	-5.2	1.695	421	11.4	**X**
SB-11-0405	U-238	1.8	0.135	-1.46	0.735	1917	4.4	J
SB-14-2540	U-238	3.1	0.207	1.57	0.406	65.5	3.4	J
SB-14-0608	U-238	2.27	0.1515	-3.93	1.12	747	5.5	J
SS-08-1400	U-238	1.59	0.119	-2.27	0.86	1135	4.4	J

CSU: combined standard uncertainty; DUP: duplicate; ID: identification number; J: estimated value; NAD: normalized absolute difference; %: percent; pCi/g: picocuries per gram; RPD: relative percent difference; SB: soil boring; SD: sediment; SS: surface sample; TS: test pit; U-235: Uranium-235; U-238: Uranium-238; X: incomparable results between alpha and gamma Uranium-238

Company Name/Address:	Billing Information:	Pres Chk
Geo Consultants - Kevil, KY 325 Kentucky Ave Kevil, KY 42053	Accounts Payable 325 Kentucky Ave Kevil, KY 42053	

Report to: **David Lindsey**

Email To: lindseyd@geoconsultantscorp.com

Project Description: **Staten Isl Warehouse, Port Richmond**

City/State Collected:

Please Circle: PT MT CT ET

Phone: **270-462-3882**

Client Project # **FUSRAP**

Lab Project #

Collected by (print): B. Hooks

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

SDG # L1409189

B168

Acctnum: **GEOCONKKY**
Template: **T195295**
Prelogin: **P873895**
PM: **732 - Donna Eidson**
PB:
Shipped Via: **FedEX Ground**

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres	Remarks	Sample # (lab only)
TS-01-0002	grab	SCM	0-2	9/24/21	1015	1	X		-01
TS-01-0204	grab	SCM	2-4		1020	1	X		-02
TS-02-0002	grab	SCM	0-2		1055	1	X		-03
TS-02-03-04	grab	SCM	3-4		1105	1	X		-04
TS-03-0002	grab	SCM	0-2		1215	1	X		-05
TS-03-0204	grab	SCM	2-4		1230	1	X		-06
TS-04-0002	grab	SCM	0-2		1500	1	X		-07
TS-04-0406	grab	SCM	4-6		1430	1	X		-08
TS-DUP-01	grab	SCM			1900	1	X		-09
TS-DUP-02	grab	SCM			1900	1	X		-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks: no ice required

<500 cpm

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking # 531899451528

Sample Receipt Checklist
COC Seal Present/Intact: _NP _Y _N
COC Signed/Accurate: Y _N
Bottles arrive intact: Y _N
Correct bottles used: Y _N
Sufficient volume sent: Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: _Y _N
RAD Screen <0.5 mR/hr: Y _N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
	9/24/21	1715			
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: AGO+ °C 15.2+1=15.3	Bottles Received: 10
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/25/21	Time: 0945

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.21		0.346	0.128	10/12/2021 09:23	WG1753087
URANIUM-235	0.106	J	0.0677	0.061	10/12/2021 09:23	WG1753087
URANIUM-238	3.27	J	0.342	0.061	10/12/2021 09:23	WG1753087
(T) URANIUM-232	*78.1*			*30.0-110*	*10/12/2021 09:23*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.74	X	0.298	0.417	10/26/2021 13:03	WG1756346
Bismuth-212	2.11	X	0.887	1.42	10/26/2021 13:03	WG1756346
Bismuth-214 (Ra-226)	2.90	X	0.310	0.215	10/26/2021 13:03	WG1756346
Lead-212	1.41	X	0.214	0.29	10/26/2021 13:03	WG1756346
Lead-214	3.39	X	0.330	0.227	10/26/2021 13:03	WG1756346
Potassium-40	5.83	X	1.41	2.02	10/26/2021 13:03	WG1756346
Thallium-208	0.560	X	0.101	0.125	10/26/2021 13:03	WG1756346
Uranium-235	0.356	~~U~~ X(J)	0.0895	0.675	10/26/2021 13:03	WG1756346
Thorium-234 (U-238)	1.16	~~U~~ X(J)	1.33	2.65	10/26/2021 13:03	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.54		0.311	0.123	10/12/2021 09:23	WG1753087
URANIUM-235	0.0888	J	0.0778	0.0955	10/12/2021 09:23	WG1753087
URANIUM-238	2.63		0.310	0.0757	10/12/2021 09:23	WG1753087
(T) URANIUM-232	*77.1*			*30.0-110*	*10/12/2021 09:23*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.67	X	0.578	0.888	10/26/2021 13:05	WG1756346
Bismuth-212	3.19	X	1.74	2.93	10/26/2021 13:05	WG1756346
Bismuth-214 (Ra-226)	4.02	X	0.515	0.422	10/26/2021 13:05	WG1756346
Lead-212	2.19	X	0.352	0.431	10/26/2021 13:05	WG1756346
Lead-214	4.65	X	0.532	0.458	10/26/2021 13:05	WG1756346
Potassium-40	12.6	X	2.69	2.14	10/26/2021 13:05	WG1756346
Thallium-208	1.01	X	0.203	0.223	10/26/2021 13:05	WG1756346
Uranium-235	0.359	(U)X,J	0.126	0.886	10/26/2021 13:05	WG1756346
Thorium-234 (U-238)	2.95	X	1.51	2.53	10/26/2021 13:05	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

7

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	73.6		2.11	0.279	10/11/2021 17:29	WG1753087
URANIUM-235	3.80	J	0.480	0.103	10/11/2021 17:29	WG1753087
URANIUM-238	73.3	(X)	2.10	0.159	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*50.7*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.36	(U) X	1.49	3.34	10/26/2021 13:20	WG1756346
Bismuth-212	2.56	~~U~~ X	6.28	11.5	10/26/2021 13:20	WG1756346
Bismuth-214 (Ra-226)	347	X	30.0	1.72	10/26/2021 13:20	WG1756346
Lead-212	-63.7	~~U~~ X	6.44	3.08	10/26/2021 13:20	WG1756346
Lead-214	377	X	38.7	2.12	10/26/2021 13:20	WG1756346
Potassium-40	8.07	~~J~~ X	5.53	9.8	10/26/2021 13:20	WG1756346
Thallium-208	0.751	~~J~~ X	0.514	0.874	10/26/2021 13:20	WG1756346
Uranium-235	13.5	X(J)	3.93	6.18	10/26/2021 13:20	WG1756346
Thorium-234 (U-238)	-7.05	~~U~~ (X)	10.4	19.7	10/26/2021 13:20	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	9.00		0.551	0.119	10/11/2021 17:29	WG1753087
URANIUM-235	0.384	J	0.121	0.0799	10/11/2021 17:29	WG1753087
URANIUM-238	9.07	(X)	0.549	0.0571	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*88.2*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.90	X	0.715	1.48	10/26/2021 13:50	WG1756346
Bismuth-212	-14.4	U X	13.1	5.4	10/26/2021 13:50	WG1756346
Bismuth-214 (Ra-226)	35.1	X	3.31	0.771	10/26/2021 13:50	WG1756346
Lead-212	4.42	X	0.684	0.789	10/26/2021 13:50	WG1756346
Lead-214	35.8	X	4.05	0.842	10/26/2021 13:50	WG1756346
Potassium-40	13.0	X	2.98	3.96	10/26/2021 13:50	WG1756346
Thallium-208	0.799	X	0.260	0.422	10/26/2021 13:50	WG1756346
Uranium-235	2.74	X(J)	0.419	2.7	10/26/2021 13:50	WG1756346
Thorium-234 (U-238)	-4.94	U (X)	4.83	10.1	10/26/2021 13:50	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	4.20		0.427	0.137	10/11/2021 17:29	WG1753087
URANIUM-235	0.159	J	0.0931	0.0882	10/11/2021 17:29	WG1753087
URANIUM-238	4.67		0.445	0.101	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*84.0*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.61	X	0.305	0.463	10/26/2021 14:13	WG1756346
Bismuth-212	2.35	X	0.896	1.36	10/26/2021 14:13	WG1756346
Bismuth-214 (Ra-226)	3.51	X	0.349	0.226	10/26/2021 14:13	WG1756346
Lead-212	1.49	X	0.229	0.31	10/26/2021 14:13	WG1756346
Lead-214	4.06	X	0.388	0.256	10/26/2021 14:13	WG1756346
Potassium-40	6.51	X	1.56	2.21	10/26/2021 14:13	WG1756346
Thallium-208	0.634	X	0.110	0.128	10/26/2021 14:13	WG1756346
Uranium-235	0.550	~~U~~ X(J)	0.105	0.788	10/26/2021 14:13	WG1756346
Thorium-234 (U-238)	3.16	X	1.77	2.73	10/26/2021 14:13	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

10

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.22		0.351	0.131	10/11/2021 17:29	WG1753087
URANIUM-235	0.118		0.0765	0.0766	10/11/2021 17:29	WG1753087
URANIUM-238	3.10		0.342	0.112	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*81.6*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.83	X	0.570	0.742	10/26/2021 15:07	WG1756346
Bismuth-212	3.86	X	1.92	3.55	10/26/2021 15:07	WG1756346
Bismuth-214 (Ra-226)	3.26	X	0.476	0.456	10/26/2021 15:07	WG1756346
Lead-212	3.11	X	0.446	0.376	10/26/2021 15:07	WG1756346
Lead-214	3.38	X	0.496	0.457	10/26/2021 15:07	WG1756346
Potassium-40	7.14	X	2.00	2.26	10/26/2021 15:07	WG1756346
Thallium-208	0.798	X	0.190	0.245	10/26/2021 15:07	WG1756346
Uranium-235	0.292	(U) X	0.146	1.33	10/26/2021 15:07	WG1756346
Thorium-234 (U-238)	3.90	J X	2.82	5.15	10/26/2021 15:07	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	9.29		0.604	0.191	10/11/2021 17:29	WG1753087
URANIUM-235	0.476		0.137	0.0647	10/11/2021 17:29	WG1753087
URANIUM-238	9.69	J	0.611	0.147	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*80.4*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.27	X	0.303	0.583	10/26/2021 15:25	WG1756346
Bismuth-212	2.29	X	0.992	1.57	10/26/2021 15:25	WG1756346
Bismuth-214 (Ra-226)	11.9	X	0.919	0.289	10/26/2021 15:25	WG1756346
Lead-212	-0.0401	~~U~~ X	0.231	0.437	10/26/2021 15:25	WG1756346
Lead-214	13.3	X	1.07	0.334	10/26/2021 15:25	WG1756346
Potassium-40	5.40	X	1.44	2.16	10/26/2021 15:25	WG1756346
Thallium-208	0.537	X	0.108	0.148	10/26/2021 15:25	WG1756346
Uranium-235	0.361	(U) X	0.570	1.01	10/26/2021 15:25	WG1756346
Thorium-234 (U-238)	3.21	(J) X	2.14	3.67	10/26/2021 15:25	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.43		0.308	0.169	10/11/2021 17:29	WG1753087
URANIUM-235	0.110	J	0.0672	0.0585	10/11/2021 17:29	WG1753087
URANIUM-238	2.32		0.292	0.132	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*85.1*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.45	X	0.382	0.462	10/26/2021 16:28	WG1756346
Bismuth-212	2.79	X	1.07	1.69	10/26/2021 16:28	WG1756346
Bismuth-214 (Ra-226)	2.74	X	0.313	0.265	10/26/2021 16:28	WG1756346
Lead-212	2.38	X	0.290	0.329	10/26/2021 16:28	WG1756346
Lead-214	3.20	X	0.331	0.257	10/26/2021 16:28	WG1756346
Potassium-40	5.68	X	1.48	2.07	10/26/2021 16:28	WG1756346
Thallium-208	0.863	X	0.137	0.154	10/26/2021 16:28	WG1756346
Uranium-235	0.475	~~U~~ X(J)	0.102	0.784	10/26/2021 16:28	WG1756346
Thorium-234 (U-238)	2.35	~~J~~ X	1.80	3.06	10/26/2021 16:28	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	9.93		0.693	0.127	10/11/2021 17:29	WG1753087
URANIUM-235	0.357		0.136	0.0824	10/11/2021 17:29	WG1753087
URANIUM-238	9.77	J	0.686	0.101	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*65.7*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.29	X	0.508	1.05	10/26/2021 16:35	WG1756346
Bismuth-212	-2.59	~~U~~ X	8.79	3.77	10/26/2021 16:35	WG1756346
Bismuth-214 (Ra-226)	32.0	X	2.92	0.539	10/26/2021 16:35	WG1756346
Lead-212	-4.48	~~U~~ X	0.635	0.924	10/26/2021 16:35	WG1756346
Lead-214	34.8	X	3.65	0.603	10/26/2021 16:35	WG1756346
Potassium-40	14.1	X	2.59	3.02	10/26/2021 16:35	WG1756346
Thallium-208	0.596	X	0.182	0.272	10/26/2021 16:35	WG1756346
Uranium-235	0.498	(U) X	1.12	1.91	10/26/2021 16:35	WG1756346
Thorium-234 (U-238)	1.86	(U) X,J	3.06	6.08	10/26/2021 16:35	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	9.85		0.562	0.141	10/11/2021 17:29	WG1753087
URANIUM-235	0.572	J	0.138	0.0657	10/11/2021 17:29	WG1753087
URANIUM-238	10.1		0.563	0.0829	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*77.7*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.57	X	0.338	0.592	10/26/2021 17:35	WG1756346
Bismuth-212	1.06	~~J~~ X	1.16	2.13	10/26/2021 17:35	WG1756346
Bismuth-214 (Ra-226)	12.7	X	0.986	0.315	10/26/2021 17:35	WG1756346
Lead-212	-0.110	~~U~~ X	0.242	0.465	10/26/2021 17:35	WG1756346
Lead-214	13.7	X	1.10	0.32	10/26/2021 17:35	WG1756346
Potassium-40	5.81	X	1.52	2.25	10/26/2021 17:35	WG1756346
Thallium-208	0.498	X	0.116	0.171	10/26/2021 17:35	WG1756346
Uranium-235	1.48	X(J)	0.176	0.989	10/26/2021 17:35	WG1756346
Thorium-234 (U-238)	6.53	X	3.08	3.85	10/26/2021 17:35	WG1756346

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1409189
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}$U by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.
"J" - Indicates an unusually uncertain or estimated result.
"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
TS-01-0002	Test Pit	L1409189-01
TS-01-0204	Test Pit	L1409189-02
TS-02-0002	Test Pit	L1409189-03
TS-02-0304	Test Pit	L1409189-04
TS-03-0002	Test Pit	L1409189-05
TS-03-0204	Test Pit	L1409189-06
TS-04-0002	Test Pit	L1409189-07
TS-04-0406	Test Pit	L1409189-08
TS-DUP-01	Test Pit	L1409189-09
TS-DUP-02	Test Pit	L1409189-10

Validation Report By: **Amanda Leigh Dick** **03/07/2022**

(print) **Date**

Amanda Leigh Dick

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/11/2022**

(print) **Date**

TLRucker

(sign)

1.0 GAMMA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			TS-01-0204	X
3	C6	1	18.8	8	8.4 – 10.6	TS-02-0304, TS-03-0204	X
4	C6	1	-6.5			TS-01-0002, TS-03-0002, TS-04-0002, TS-04-0406, TS-DUP-02	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	TS-02-0002, TS-DUP-01	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detectors/geometries have one or more quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	12.2	TS-01-0204	X
3	C6	1	14.3	TS-02-0304, TS-03-0204	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples results did not meet the RDL project goal:

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
TS-02-0002	Ac-228	0.7435	2.60225	1
TS-02-0002	Th-234	5.2	18.2	1
TS-02-0304	Th-234	2.414	8.449	1
TS-DUP-01	U-235	0.5585	1.95475	0.5
TS-DUP-01	Th-234	1.528	5.348	1

The following samples have results greater than the project action limits: TS-01-0002: Ra- 226 (2.294 pCi/g), TS-01-0204: Ra-226 (4.02 pCi/g), TS-02-0002: Ra-226 (347 pCi/g), TS-02-0304: Ra-226 (35.1 pCi/g), TS-03-0002: Ra- 226 (3.51 pCi/g), TS-03-0204: Ra-226 (3.26 pCi/g), TS-04-0002: Ra-226 (11.9 pCi/g), TS-04-0406: Ra-226 (2.74 pCi/g), TS-DUP-01: Ra-226 (32.0 pCi/g), TS-DUP-02: Ra-226 (12.7 pCi/g).

No samples exhibited excess uncertainty.

The following sample had a negative result with an uncertainty smaller than its absolute value. The CENWK states this result needs to be rejected. However, since this result is likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify the result. TS-02-0304: Th-234.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows: TS-01-0204: U-235; TS-02-0002: Ac-228 and Th-234; TS-02-0304: Th-234; TS-03-0204: U-235; TS-04-0002: U-235; and TS-DUP-01: U-235 and Th-234.

Method Blank

There was no indication of blank contamination for the gamma spectrometry analysis.

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The laboratory duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, <3).

All analyte results for field duplicate TS-DUP-01 were within a factor of 4 from the original result. All analyte results for field duplicate TS-DUP-02 were within a factor of 4 from the original result except for U-235. The U-235 result for field duplicate TS-DUP-02 was outside the upper limit of a factor of 4 from the original result but less than a factor of 5**. It is recommended that the Uranium-235 result from TS-DUP-02 be qualified as estimated (J)**. Please see table below.

Staten Island Field Duplicate

Field Duplicate IDs	Analyte	Original Result (pCi/g)	Factor of 4 of Original Result (pCi/g)	Factor of 5 of Original Result (pCi/g)	Original-(Factor 4 - Original) (pCi/g)	Duplicate Result (pCi/g)	Qualifier
TS-DUP-02	U-235	0.361	1.444	1.805	-0.722	1.48	J

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the alpha spectrometry analyses.

Initial Calibration

The initial calibration met project acceptance criteria for all reported analytes.

Continuing Calibration

The continuing calibration met project acceptance criteria for all reported analytes.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The RDL project goal of <0.5 pCi/g was met for all samples.

The following samples had results greater than the project action limit: TS-02-0002: U-234 α (73.6 pCi/g), U-235 α (3.80 pCi/g), U-238 α (73.3 pCi/g), TS-02-0304: U-234 α (9.00 pCi/g), U-235 α (0.384 pCi/g), U-238 α (9.07 pCi/g), TS-03-0002: U-234 α (4.20 pCi/g), U-238 α (4.67 pCi/g), TS-04-0002: U-234 α (9.29 pCi/g), U-235 α (0.476 pCi/g), U-238 α (9.69 pCi/g), TS-DUP-01: U- 234 α (9.93 pCi/g), U-235 α (0.357 pCi/g), U-238 α (9.77 pCi/g), and TS-DUP-02: U- 234 α (9.85 pCi/g), U-235 α (0.572 pCi/g), U-238 α (10.1 pCi/g).

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty. No sample results were qualified.

Matrix Spike

A non-SDG sample was used as a matrix spike. The percent recoveries were within acceptable limits.

Method Blank

There was no indication of blank contamination for the alpha spectrometry analysis.

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The RPDs and the NADs (DERs) are within acceptable limits (<20% and <3) for the laboratory duplicate analyses for all alpha spectrometry analyses.

All field duplicate results were within a factor of 4 from the original result.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

Significant tailing was observed in the Uranium-234 and Uranium-238 peaks in sample TS-02-0002. Minor tailing was observed in the Uranium-238 peak in sample TS-DUP-02. However, there was no peak interference. Therefore, no qualification is required.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, the following samples were outside the project requirements of <25% RPD and/or NAD < 3 indicating subsampling representativeness problems. **Both the alpha and the gamma results in the following samples are recommended to be qualified as either estimated (J) or unusable (X), depending on the magnitude of the difference, due to incomparable results:**

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
TS-01-0002	U-235	0.106	0.026	0.356	0.04475	108.23%	4.830	J
TS-01-0204	U-235	0.0888	0.028	0.359	0.063	120.68%	3.919	J
TS-02-0002	U-235	3.8	0.138	13.5	1.965	112.14%	4.924	J
TS-02-0304	U-235	0.384	0.054	2.74	0.2095	150.83%	10.890	J
TS-03-0002	U-235	0.159	0.038	0.55	0.0525	110.30%	6.033	J
TS-04-0406	U-235	0.11	0.029	0.475	0.051	124.79%	6.221	J
TS-DUP-02	U-235	0.572	0.056	1.48	0.088	88.50%	8.705	J
TS-01-0002	U-238	3.27	0.171	1.16	0.665	95.26%	3.073	J
TS-02-0002	U-238	73.3	1.05	-7.05	5.2	242.57%	15.146	X
TS-02-0304	U-238	9.07	0.2745	-4.94	2.415	678.45%	5.764	X
TS-04-0002	U-238	9.69	0.3055	3.21	1.07	100.47%	5.823	J
TS-DUP-01	U-238	9.77	0.343	1.86	1.53	136.03%	5.045	J

[1]The U-238 results for gamma were taken from the Th-234 daughter measurement

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1409189

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Test Pit
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ Tracer recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other:	initial calibration data	Y
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

The calibration documentation are missing for both alpha and gamma analyses. .
Calibration standard COAs are not found in the package.
A revision was issued from the laboratory containing the some of the missing information.

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR # Item

Reviewed By: Amanda Leigh Dick Date: 03/07/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1409189

Analyte Group: Gamma Spec. & Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
TS-01-0002	L1409189-01	TP	Gamma Spec & Iso U	
TS-01-0204	L1409189-02	TP	Gamma Spec & Iso U	
TS-02-0002	L1409189-03	TP	Gamma Spec & Iso U	
TS-02-0304	L1409189-04	TP	Gamma Spec & Iso U	
TS-03-0002	L1409189-05	TP	Gamma Spec & Iso U	
TS-03-0204	L1409189-06	TP	Gamma Spec & Iso U	
TS-04-0002	L1409189-07	TP	Gamma Spec & Iso U	
TS-04-0406	L1409189-08	TP	Gamma Spec & Iso U	
TS-DUP-01	L1409189-09	TP	Gamma Spec & Iso U	
TS-DUP-02	L1409189-10	TP	Gamma Spec & Iso U	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1409189

Analysis: Gamma Spectroscopy & Iso Uranium

Method: DOE Ga-01-R/901.1 & D3972 U-02

Laboratory: Pace Analytical

Matrix: Test Pit

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Results qualified as indicated due to detection limits, field duplicates, and incomparable results.

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick   Date: 03/07/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: The Uranium-235 gamma result from field duplicate TS-DUP-02 was greater than a factor of four of the parent sample. DVQ: "J".

K-40, Ra-226, and Th-234 exceeded the project MDA goal for several samples. Additionally, several sample results were greater than the project action limit.

Sample TS-02-0304 had a negative result with an uncertainty greater than its absolute value.

Samples counted on gamma detectors with a delta value greater than 5% were qualified as "X".

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No samples were re-analyzed or diluted.

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
K-40	< 1 pCi/g	2.02 pCi/g	TS-01-0002
Th-234	< 1 pCi/g	2.65 pCi/g	TS-01-0002
K-40	< 1 pCi/g	2.14 pCi/g	TS-01-0204
Th-234	< 1 pCi/g	2.53 pCi/g	TS-01-0204
Ac-228	< 1 pCi/g	3.34 pCi/g	TS-02-0002
Ra-226	< 1 pCi/g	1.72 pCi/g	TS-02-0002
K-40	< 1 pCi/g	9.80 pCi/g	TS-02-0002
U-235 γ	< 1 pCi/g	6.18 pCi/g	TS-02-0002
Th-234	< 1 pCi/g	19.7 pCi/g	TS-02-0002
Ac-228	< 1 pCi/g	1.48 pCi/g	TS-02-0304
K-40	< 1 pCi/g	3.96 pCi/g	TS-02-0304
U-235 γ	< 1 pCi/g	2.70 pCi/g	TS-02-0304
Th-234	< 1 pCi/g	10.1 pCi/g	TS-02-0304
K-40	< 1 pCi/g	2.21 pCi/g	TS-03-0002
Th-234	< 1 pCi/g	2.73 pCi/g	TS-03-0002
K-40	< 1 pCi/g	2.26 pCi/g	TS-03-0204

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The following samples had results above the project action limit: TS-01-0002: Ra-226 (2.294 pCi/g), TS-01-0204: Ra-226 (4.02 pCi/g), TS-02-0002: U-234 α (73.6 pCi/g), U-235 α (3.80 pCi/g), U-238 α (73.3 pCi/g), Ra-226 (347 pCi/g), TS-02-0304: U-234 α (9.00 pCi/g), U-235 α (0.384 pCi/g), U-238 α (9.07 pCi/g), Ra-226 (35.1 pCi/g), TS-03-0002: U-234 α (4.20 pCi/g), U-238 α (4.67 pCi/g), Ra-226 (3.51 pCi/g), TS-03-0204: Ra-226 (3.26 pCi/g), TS-04-0002: U-234 α (9.29 pCi/g), U-235 α (0.476 pCi/g), U-238 α (9.69 pCi/g), Ra-226 (11.9 pCi/g), TS-04-0406: Ra-226 (2.74 pCi/g), TS-DUP-01: U-234 α (9.93 pCi/g), U-235 α (0.357 pCi/g), U-238 α (9.77 pCi/g), Ra-226 (32.0 pCi/g), TS-DUP-02: U-234 α (9.85 pCi/g), U-235 α (0.572 pCi/g), U-238 α (10.1 pCi/g), Ra-226 (12.7 pCi/g).

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
U-235 γ	< 1 pCi/g	1.33 pCi/g	TS-03-0204
Th-234	< 1 pCi/g	5.15 pCi/g	TS-03-0204
K-40	< 1 pCi/g	2.16 pCi/g	TS-04-0002
U-235 γ	< 1 pCi/g	1.01 pCi/g	TS-04-0002
Th-234	< 1 pCi/g	3.67 pCi/g	TS-04-0002
K-40	< 1 pCi/g	2.07 pCi/g	TS-04-0406
Th-234	< 1 pCi/g	3.06 pCi/g	TS-04-0406
Ac-228	< 1 pCi/g	1.05 pCi/g	TS-DUP-01
K-40	< 1 pCi/g	3.02 pCi/g	TS-DUP-01
U-235 γ	< 1 pCi/g	1.91 pCi/g	TS-DUP-01
Th-234	< 1 pCi/g	6.08 pCi/g	TS-DUP-01
K-40	< 1 pCi/g	2.25 pCi/g	TS-DUP-02
Th-234	< 1 pCi/g	3.85 pCi/g	TS-DUP-02
U-235 γ		Result > LC	TS-01-0002
Th-234		Result > LC	TS-01-0002
U-235 α		Result > LC	TS-01-0204

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: For concentrations greater than ten times the MDC, the calculation CSU > 0.25*Rs was used to indentify excess reported uncertainty. No samples exhibited excess uncertainty.

The following sample had a negative results with an uncertainty smaller than its absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results.

TS-02-0304

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
U-235 γ		Result < LC	TS-01-0204
Ac-228		Result < LC	TS-02-0002
K-40		Result > LC	TS-02-0002
Th-234		Result < LC	TS-02-0002
Th-234		Result < LC	TS-02-0304
U-235 γ		Result > LC	TS-03-0002
U-235 γ		Result < LC	TS-03-0204
Th-234		Result > LC	TS-03-0204
U-235 γ		Result < LC	TS-04-0002
Th-234		Result > LC	TS-04-0002
U-235 γ		Result > LC	TS-04-0406
Th-234		Result > LC	TS-04-0406
U-235 γ		Result < LC	TS-DUP-01
Th-234		Result < LC	TS-DUP-01

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: The sample-specific detection limit (LC) was calculated for sample results less than the critical level. Sample concentrations less than the LC were qualified "U". Please see calculation sheet.

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. The following samples had results that did not meet the RDL: TS-02-0002, TS-02-0304, TS-04-0002, and TS-DUP-01.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: All initial and continuing calibration project acceptance criteria was met.
A monthly background was performed without any discrepancies.

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V.B1. Calibration Gamma Spectroscopy

see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy

see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.247%	898.04 keV	1	< 5%		
5.283%	159.00 keV	2	< 5%		
7.914%	898.04 keV	2	< 5%		
18.765%	136.47 keV	3	< 5%		
6.524%	159.00 keV	5	< 5%		
5.272%	513.99 keV	2	< 5%		

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: A long monthly background was performed. No high results were noted.

Samples counted on detectors with delta values greater than 5% and /or 95% CL (1.96 σ) greater than 8%: were qualified as X

No documentation of an energy calibration was given. Additionally, there was no indication that a Peak-to-Compton ratio calibration was performed.

Daily source checks were performed for each detector. The FWHM was less than 3 keV for confirmed isotopes with the exception of Detector 1 at the 897.74 energy.

Detector 4 had Co-60 energy difference from the true energy greater than 1.0 keV.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations: Samples not selected for Analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations: Samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: ______________________________

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: MB R3715413-1 & MB R3722645-1

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
10/11/2021	MB R3715413-1	U-238	0.147 pCi/g & 0.124 pCi/g	0.157 pCi/g & 0.124 pCi/g
The Blank result subtracted from its uncertainty was less than the MDA. No DVQ per QAPP.				
10/26/2021	MB R3722645-1	Ac-228	0.168 pCi/g & 0.151 pCi/g	0.376 pCi/g & 0.151 pCi/g
The Blank result subtracted from its uncertainty was less than the MDA. No DVQ per QAPP.				
10/26/2021	MB R3722645-1	Th-234	1.01 pCi/g & 0.582 pCi/g	1.06 pCi/g & 0.582 pCi/g
The Blank result subtracted from its uncertainty was less than the MDA. No DVQ per QAPP.				

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks: All blank results were less than the MDA. No qualification needed per QAPP. There were no project blanks associated with this SDG. Additionally, the |Zblank| value was less than 3.

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations: Please see previous page.

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

Radiochemical Data Review Checklist

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations: None

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: All tracer recoveries were within project acceptance limits.

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

	Alpha aqueous	solid
	aqueous	solid
%R	80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: LCS R3715413-2
LCS R3722645-2 & LCSD R3722645-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: All LCS percent recoveries were within project limits.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: Non-SDG sample was spiked (L1410500-01)
MS R3715413-3 10/11/21 17:29 & MSD R3715413-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch

see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All matrix spike recovery results were within project QC limits.

Radiochemical Data Review Checklist

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: DUP R3715413-5 & MSD R3715413-4
DUP R3722645-3 & LCSD R3722645-4

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
U-235 γ				TS-DUP-02. Result > Parent result *4. DVQ: "J".
U-235 α		46.93%	1.464	DUP R3715413-5. NAD less than 3. No DVQ.
Ac-228 γ		38.06%	1.090	DUP R3722645-3. NAD less than 3. No DVQ.
Th-234 γ		97.83%	1.131	DUP R3722645-3. NAD less than 3. No DVQ.
K-40 γ		25.30%	1.682	DUP R3722645-3. NAD less than 3. No DVQ.

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: All laboratory duplicates met project acceptance criteria. Field DUP TS-DUP-02 had a U-235 result outside of the upper limits. Field DUP TS-DUP-01 sample results met project acceptance critieria.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected
Uranium-234	A little tailing	LCS R3715413-2
Uranium-234	A little tailing	MSD R3715413-4
Uranium-238	A little tailing	MSD R3715413-4
Uranium-234	Significant tailing.	TS-02-0002
Uranium-238	Significant tailing.	TS-02-0002
Uranium-238	A little tailing.	TS-DUP-02

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: There were no overlapping or interefent peaks. All identified peaks were within 40 keV from their theoretical energies. Major tailing was observed in TS-02-0002. With minor tailing occurring in TS-DUP-02, LCS, and MSD.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: None

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: The peak search algorithm was set at 3.0, not the required 2 keV for all SDG samples

All identified radionuclide energies were less than 2 keV from the theoretical energy.

All project radionuclides of interest met identification criteria.

The energy spectra did not contain overlapping or interferent peaks.

XIII. ~~Tentatively Identified Radionuclides (gamma spectroscopy)~~ Data Intercomparison

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and Gamma results not comparable.	TS-01-0002. DVQ: "J"
U-235	Alpha and Gamma results not comparable.	TS-01-0204. DVQ: "J"
U-235	Alpha and Gamma results not comparable	TS-02-0002. DVQ : "J"
U-235	Alpha and Gamma results not comparable	TS-02-0304. DVQ: "J"
U-235	Alpha and Gamma results not comparable	TS-03-0002: DVQ: "J"
U-235	Alpha and Gamma results not comparable	TS-04-0406. DVQ: "J"
U-235	Alpha and Gamma results not comparable	TS-DUP-02. DVQ: "J"
U-238	Alpha and Gamma results not comparable	TS-01-0002. DVQ: "J"
U-238	Alpha and Gamma results not comparable	TS-02-0002. DVQ: "X"
U-238	Alpha and Gamma results not comparable	TS-02-0304. DVQ: "X"
U-238	Alpha and Gamma results not comparable	TS-04-0002. DVQ: "J"
U-238	Alpha and Gamma results not comparable	TS-DUP-01: DVQ: "J"

Actions:
~~1. Qualify all tentatively identified radionuclides as estimated (J).~~
~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~ If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks: The samples not listed above had comparable alpha and gamma U-235 results.
Please see calculation sheets.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected
U-234	Tailing	TS-02-0002
U-238	Tailing	TS-02-0002
U-238	Tailing	TS-DUP-02

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: Tailing was observed in the samples listed above. No sample results were qualified.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculatiom sheets.

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: Samples qualified as indicated based on the CENWK & the QAPP.

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Report to: David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description:

City/State Collected:

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project #

Lab Project #

SDG # L1409499

E151

Table #

Collected by (print): B. Hooks

Site/Facility ID #

P.O. #

Acctnum: GEOCONKKY
Template: T195321
Prelogin: P873893
PM: 732 - Donna Eidson
PB: BF 9/17/21
Shipped Via: FedEX Ground

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ___ Y X

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	DODSV8270 4ozClr-NoPres	DODV8260 40mlAmb/MeOH10ml/Syr	Metals 2ozClr-NoPres	TCLP 1L-Clr-NoPres						Remarks	Sample # (lab only)
WC-01-0002	Comp	SS	0-2	9/24/21	1100	4	X	X	X	X							-01
WC-02-0001	Comp	SS	0-2	9/24/21	1400	4	X	X	X	X							-02

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ___

Remarks:

pH ___ Temp ___
Flow ___ Other ___

Samples returned via:
__ UPS __ FedEx __ Courier ___

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP _Y _N
COC Signed/Accurate: _Y _N
Bottles arrive intact: _Y _N
Correct bottles used: _Y _N
Sufficient volume sent: _Y _N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: _Y _N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
	9/24/21	1630			
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: A3 °C 4.6±0=4.6	Bottles Received: 8
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/25/21	Time: 9:45

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

ANALYTICAL REPORT

October 19, 2021

Geo Consultants - Kevil, KY

Sample Delivery Group:	L1409499
Samples Received:	09/25/2021
Project Number:	
Description:	
Report To:	David Lindsey 325 Kentucky Ave Kevil, KY 42053

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Entire Report Reviewed By:

Donna Eidson
Project Manager

Pace Analytical National
12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

TABLE OF CONTENTS

WC-01-0002 L1409499-01 Solid

Collected by: B. Hooks | Collected date/time: 09/24/21 11:00 | Received date/time: 09/25/21 09:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1753288	1	10/07/21 13:48	10/08/21 12:19	ABL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1755398	5	10/13/21 03:21	10/13/21 20:12	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1753015	1.39	09/24/21 11:00	10/07/21 17:18	ACG	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1756712	1.39	09/24/21 11:00	10/14/21 13:02	BMB	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1753791	10	10/07/21 17:45	10/08/21 13:57	AMG	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1753791	100	10/07/21 17:45	10/11/21 14:56	AMG	Mt. Juliet, TN

WC-01-0002 L1409499-02 Waste

Collected by: B. Hooks | Collected date/time: 09/24/21 11:00 | Received date/time: 09/25/21 09:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Preparation by Method 1311	WG1752313	1	10/06/21 16:45	10/06/21 16:45	TDW	Mt. Juliet, TN
Preparation by Method 1311	WG1753668	1	10/08/21 17:39	10/08/21 17:39	CJW	Mt. Juliet, TN
Mercury by Method 7470A	WG1754241	1	10/09/21 12:57	10/11/21 08:21	BMF	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1754232	1	10/11/21 01:43	10/13/21 20:03	CCE	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1753430	1	10/08/21 03:41	10/08/21 03:41	ADM	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1758658	1	10/18/21 06:05	10/18/21 14:53	JNJ	Mt. Juliet, TN

WC-02-0001 L1409499-03 Solid

Collected by: B. Hooks | Collected date/time: 09/24/21 14:00 | Received date/time: 09/25/21 09:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1753288	1	10/07/21 13:48	10/08/21 12:06	ABL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1755398	5	10/13/21 03:21	10/13/21 19:56	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1753015	1.63	09/24/21 14:00	10/07/21 17:37	ACG	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1756712	1.63	09/24/21 14:00	10/14/21 13:21	BMB	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1753791	10	10/07/21 17:45	10/08/21 15:01	AMG	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1753791	100	10/07/21 17:45	10/11/21 15:17	AMG	Mt. Juliet, TN

WC-02-0001 L1409499-04 Waste

Collected by: B. Hooks | Collected date/time: 09/24/21 14:00 | Received date/time: 09/25/21 09:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Preparation by Method 1311	WG1752313	1	10/06/21 16:45	10/06/21 16:45	TDW	Mt. Juliet, TN
Preparation by Method 1311	WG1753668	1	10/08/21 17:39	10/08/21 17:39	CJW	Mt. Juliet, TN
Mercury by Method 7470A	WG1754241	1	10/09/21 12:57	10/11/21 08:23	BMF	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1754232	1	10/11/21 01:43	10/13/21 20:06	CCE	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1753430	1	10/08/21 04:01	10/08/21 04:01	ADM	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1758658	1	10/18/21 06:05	10/18/21 15:57	JNJ	Mt. Juliet, TN

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Donna Eidson
Project Manager

Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.710		0.0400	1	10/08/2021 12:19	WG1753288

Metals (ICPMS) by Method 6020

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Arsenic	9.32		1.00	5	10/13/2021 20:12	WG1755398
Barium	313		2.50	5	10/13/2021 20:12	WG1755398
Cadmium	1.58		1.00	5	10/13/2021 20:12	WG1755398
Chromium	32.9		5.00	5	10/13/2021 20:12	WG1755398
Lead	942		2.00	5	10/13/2021 20:12	WG1755398
Selenium	ND		2.50	5	10/13/2021 20:12	WG1755398
Silver	ND		0.500	5	10/13/2021 20:12	WG1755398

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acetone	ND		0.0695	1.39	10/07/2021 17:18	WG1753015
Acrylonitrile	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
Benzene	0.00806		0.00139	1.39	10/07/2021 17:18	WG1753015
Bromobenzene	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
Bromodichloromethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Bromoform	ND		0.0348	1.39	10/07/2021 17:18	WG1753015
Bromomethane	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
n-Butylbenzene	ND		0.0174	1.39	10/14/2021 13:02	WG1756712
sec-Butylbenzene	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
tert-Butylbenzene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
Carbon tetrachloride	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
Chlorobenzene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Chlorodibromomethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Chloroethane	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
Chloroform	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Chloromethane	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
2-Chlorotoluene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
4-Chlorotoluene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,2-Dibromoethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,2-Dibromo-3-Chloropropane	ND		0.0348	1.39	10/07/2021 17:18	WG1753015
Dibromomethane	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,2-Dichlorobenzene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,3-Dichlorobenzene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,4-Dichlorobenzene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
Dichlorodifluoromethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1-Dichloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,2-Dichloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1-Dichloroethene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
cis-1,2-Dichloroethene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
trans-1,2-Dichloroethene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,2-Dichloropropane	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
1,3-Dichloropropane	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
2,2-Dichloropropane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1-Dichloropropene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
cis-1,3-Dichloropropene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
trans-1,3-Dichloropropene	ND		0.00695	1.39	10/07/2021 17:18	WG1753015
Di-isopropyl ether	ND		0.00139	1.39	10/07/2021 17:18	WG1753015
Ethylbenzene	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Hexachloro-1,3-butadiene	ND		0.0348	1.39	10/07/2021 17:18	WG1753015

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Isopropylbenzene	0.00462		0.00348	1.39	10/07/2021 17:18	WG1753015
p-Isopropyltoluene	0.0120		0.00695	1.39	10/07/2021 17:18	WG1753015
2-Butanone (MEK)	ND		0.139	1.39	10/07/2021 17:18	WG1753015
Methylene Chloride	ND		0.0348	1.39	10/07/2021 17:18	WG1753015
4-Methyl-2-pentanone (MIBK)	ND		0.0348	1.39	10/07/2021 17:18	WG1753015
Methyl tert-butyl ether	ND		0.00139	1.39	10/07/2021 17:18	WG1753015
Naphthalene	0.0379		0.0174	1.39	10/07/2021 17:18	WG1753015
n-Propylbenzene	0.0347		0.00695	1.39	10/07/2021 17:18	WG1753015
Styrene	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
1,1,1,2-Tetrachloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1,2,2-Tetrachloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Tetrachloroethene	0.0181		0.00348	1.39	10/07/2021 17:18	WG1753015
Toluene	0.0117		0.00695	1.39	10/07/2021 17:18	WG1753015
1,2,3-Trichlorobenzene	ND		0.0174	1.39	10/14/2021 13:02	WG1756712
1,2,4-Trichlorobenzene	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
1,2,3-Trimethylbenzene	0.0511		0.00695	1.39	10/07/2021 17:18	WG1753015
1,2,4-Trimethylbenzene	0.133		0.00695	1.39	10/07/2021 17:18	WG1753015
1,3,5-Trimethylbenzene	0.0565		0.00695	1.39	10/07/2021 17:18	WG1753015
1,1,1-Trichloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1,2-Trichloroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Trichloroethene	0.00393	J4	0.00139	1.39	10/07/2021 17:18	WG1753015
Trichlorofluoromethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,1,2-Trichlorotrifluoroethane	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
1,2,3-Trichloropropane	ND		0.0174	1.39	10/07/2021 17:18	WG1753015
Vinyl chloride	ND		0.00348	1.39	10/07/2021 17:18	WG1753015
Xylenes, Total	0.0462		0.00904	1.39	10/07/2021 17:18	WG1753015
(S) Toluene-d8	*101*		*85.0-116*		*10/07/2021 17:18*	WG1753015
(S) Toluene-d8	*101*		*85.0-116*		*10/14/2021 13:02*	WG1756712
(S) 4-Bromofluorobenzene	*95.2*		*79.0-119*		*10/07/2021 17:18*	WG1753015
(S) 4-Bromofluorobenzene	*97.1*		*79.0-119*		*10/14/2021 13:02*	WG1756712
(S) 1,2-Dichloroethane-d4	*95.4*		*71.0-136*		*10/07/2021 17:18*	WG1753015
(S) 1,2-Dichloroethane-d4	*114*		*71.0-136*		*10/14/2021 13:02*	WG1756712

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND	J3	0.333	10	10/08/2021 13:57	WG1753791
Acenaphthylene	0.374	J3	0.333	10	10/08/2021 13:57	WG1753791
Anthracene	0.371	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Benzidine	ND	J6	16.7	10	10/08/2021 13:57	WG1753791
Benzo(a)anthracene	1.46	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Benzo(b)fluoranthene	2.09	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Benzo(k)fluoranthene	0.693	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Benzo(g,h,i)perylene	1.45	J6	0.333	10	10/08/2021 13:57	WG1753791
Benzo(a)pyrene	1.52	J6	0.333	10	10/08/2021 13:57	WG1753791
Bis(2-chlorethoxy)methane	ND		3.33	10	10/08/2021 13:57	WG1753791
Bis(2-chloroethyl)ether	ND		3.33	10	10/08/2021 13:57	WG1753791
2,2-Oxybis(1-Chloropropane)	ND		3.33	10	10/08/2021 13:57	WG1753791
4-Bromophenyl-phenylether	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
2-Chloronaphthalene	ND	J3	0.333	10	10/08/2021 13:57	WG1753791
4-Chlorophenyl-phenylether	ND		3.33	10	10/08/2021 13:57	WG1753791
Chrysene	1.42	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Dibenz(a,h)anthracene	ND	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
3,3-Dichlorobenzidine	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
2,4-Dinitrotoluene	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
2,6-Dinitrotoluene	ND	J3	3.33	10	10/08/2021 13:57	WG1753791

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Fluoranthene	2.83	J3 V	0.333	10	10/08/2021 13:57	WG1753791
Fluorene	ND	J3	0.333	10	10/08/2021 13:57	WG1753791
Hexachlorobenzene	ND		3.33	10	10/08/2021 13:57	WG1753791
Hexachloro-1,3-butadiene	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Hexachlorocyclopentadiene	ND	J6	3.33	10	10/08/2021 13:57	WG1753791
Hexachloroethane	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Indeno(1,2,3-cd)pyrene	1.41	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Isophorone	ND		3.33	10	10/08/2021 13:57	WG1753791
Naphthalene	ND		0.333	10	10/08/2021 13:57	WG1753791
Nitrobenzene	ND		3.33	10	10/08/2021 13:57	WG1753791
n-Nitrosodimethylamine	ND	J6	3.33	10	10/08/2021 13:57	WG1753791
n-Nitrosodiphenylamine	ND		3.33	10	10/08/2021 13:57	WG1753791
n-Nitrosodi-n-propylamine	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Phenanthrene	1.78	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
Benzylbutyl phthalate	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Bis(2-ethylhexyl)phthalate	ND		3.33	10	10/08/2021 13:57	WG1753791
Di-n-butyl phthalate	ND		3.33	10	10/08/2021 13:57	WG1753791
Diethyl phthalate	ND		3.33	10	10/08/2021 13:57	WG1753791
Dimethyl phthalate	ND	J6	3.33	10	10/08/2021 13:57	WG1753791
Di-n-octyl phthalate	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Pyrene	2.34	J3 J6	0.333	10	10/08/2021 13:57	WG1753791
1,2,4-Trichlorobenzene	ND		3.33	10	10/08/2021 13:57	WG1753791
4-Chloro-3-methylphenol	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
2-Chlorophenol	ND		3.33	10	10/08/2021 13:57	WG1753791
2,4-Dichlorophenol	ND		3.33	10	10/08/2021 13:57	WG1753791
2,4-Dimethylphenol	ND		3.33	10	10/08/2021 13:57	WG1753791
4,6-Dinitro-2-methylphenol	ND		33.3	100	10/11/2021 14:56	WG1753791
2,4-Dinitrophenol	ND		33.3	100	10/11/2021 14:56	WG1753791
2-Nitrophenol	ND		3.33	10	10/08/2021 13:57	WG1753791
4-Nitrophenol	ND		3.33	10	10/08/2021 13:57	WG1753791
Pentachlorophenol	ND	J3	3.33	10	10/08/2021 13:57	WG1753791
Phenol	ND		3.33	10	10/08/2021 13:57	WG1753791
2,4,6-Trichlorophenol	ND		3.33	10	10/08/2021 13:57	WG1753791
(S) 2-Fluorophenol	*78.3*		*35.0-115*		*10/08/2021 13:57*	WG1753791
(S) 2-Fluorophenol	*0.000*	J7	*35.0-115*		*10/11/2021 14:56*	WG1753791
(S) Phenol-d5	*74.7*		*33.0-122*		*10/08/2021 13:57*	WG1753791
(S) Phenol-d5	*0.000*	J7	*33.0-122*		*10/11/2021 14:56*	WG1753791
(S) Nitrobenzene-d5	*0.000*	J7	*37.0-122*		*10/11/2021 14:56*	WG1753791
(S) Nitrobenzene-d5	*69.6*		*37.0-122*		*10/08/2021 13:57*	WG1753791
(S) 2-Fluorobiphenyl	*82.0*		*44.0-115*		*10/08/2021 13:57*	WG1753791
(S) 2-Fluorobiphenyl	*0.000*	J7	*44.0-115*		*10/11/2021 14:56*	WG1753791
(S) 2,4,6-Tribromophenol	*85.9*		*39.0-132*		*10/08/2021 13:57*	WG1753791
(S) 2,4,6-Tribromophenol	*0.000*	J7	*39.0-132*		*10/11/2021 14:56*	WG1753791
(S) p-Terphenyl-d14	*75.5*		*54.0-127*		*10/08/2021 13:57*	WG1753791
(S) p-Terphenyl-d14	*0.000*	J7	*54.0-127*		*10/11/2021 14:56*	WG1753791

Sample Narrative:

L1409499-01 WG1753791: Dilution due to matrix impact on instrumentation at lower dilution

Preparation by Method 1311

Analyte	Result	Qualifier	Prep date / time	Batch
TCLP Extraction	-		10/8/2021 5:39:13 PM	WG1753668
TCLP ZHE Extraction	-		10/6/2021 4:45:24 PM	WG1752313
Fluid	1		10/8/2021 5:39:13 PM	WG1753668
Initial pH	8.32		10/8/2021 5:39:13 PM	WG1753668
Final pH	5.70		10/8/2021 5:39:13 PM	WG1753668

Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Mercury	ND		0.0100	0.20	1	10/11/2021 08:21	WG1754241

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Arsenic	ND		0.100		1	10/13/2021 20:03	WG1754232
Barium	1.78		0.100		1	10/13/2021 20:03	WG1754232
Cadmium	ND		0.100		1	10/13/2021 20:03	WG1754232
Chromium	ND		0.100		1	10/13/2021 20:03	WG1754232
Lead	4.92		0.100		1	10/13/2021 20:03	WG1754232
Selenium	ND		0.100		1	10/13/2021 20:03	WG1754232
Silver	ND		0.100		1	10/13/2021 20:03	WG1754232

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Benzene	ND		0.0500	0.50	1	10/08/2021 03:41	WG1753430
Carbon tetrachloride	ND		0.0500	0.50	1	10/08/2021 03:41	WG1753430
Chlorobenzene	ND		0.0500	100	1	10/08/2021 03:41	WG1753430
Chloroform	ND		0.250	6	1	10/08/2021 03:41	WG1753430
1,2-Dichloroethane	ND	J4	0.0500	0.50	1	10/08/2021 03:41	WG1753430
1,1-Dichloroethene	ND		0.0500	0.70	1	10/08/2021 03:41	WG1753430
2-Butanone (MEK)	ND		0.500	200	1	10/08/2021 03:41	WG1753430
Tetrachloroethene	ND		0.0500	0.70	1	10/08/2021 03:41	WG1753430
Trichloroethene	ND		0.0500	0.50	1	10/08/2021 03:41	WG1753430
Vinyl chloride	ND		0.0500	0.20	1	10/08/2021 03:41	WG1753430
(S) Toluene-d8	*103*		*89.0-112*			*10/08/2021 03:41*	WG1753430
(S) 4-Bromofluorobenzene	*87.7*		*85.0-114*			*10/08/2021 03:41*	WG1753430
(S) 1,2-Dichloroethane-d4	*113*		*81.0-118*			*10/08/2021 03:41*	WG1753430

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
1,4-Dichlorobenzene	ND		0.100	7.50	1	10/18/2021 14:53	WG1758658
2,4-Dinitrotoluene	ND		0.100	0.13	1	10/18/2021 14:53	WG1758658
Hexachlorobenzene	ND		0.100	0.13	1	10/18/2021 14:53	WG1758658
Hexachloro-1,3-butadiene	ND		0.100	0.50	1	10/18/2021 14:53	WG1758658
Hexachloroethane	ND		0.100	3	1	10/18/2021 14:53	WG1758658
Nitrobenzene	ND		0.100	2	1	10/18/2021 14:53	WG1758658
Pyridine	ND	J3 J4 J6	0.100	5	1	10/18/2021 14:53	WG1758658
3&4-Methyl Phenol	ND		0.100	400	1	10/18/2021 14:53	WG1758658
2-Methylphenol	ND		0.100	200	1	10/18/2021 14:53	WG1758658
Pentachlorophenol	ND		0.100	100	1	10/18/2021 14:53	WG1758658
2,4,5-Trichlorophenol	ND		0.100	400	1	10/18/2021 14:53	WG1758658
2,4,6-Trichlorophenol	ND		0.100	2	1	10/18/2021 14:53	WG1758658

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
(S) 2-Fluorophenol	*24.7*		*19.0-119*			*10/18/2021 14:53*	WG1758658
(S) Phenol-d5	*15.3*		*10.0-67.0*			*10/18/2021 14:53*	WG1758658
(S) Nitrobenzene-d5	*48.4*		*44.0-120*			*10/18/2021 14:53*	WG1758658
(S) 2-Fluorobiphenyl	*59.2*		*44.0-119*			*10/18/2021 14:53*	WG1758658
(S) 2,4,6-Tribromophenol	*49.4*		*43.0-140*			*10/18/2021 14:53*	WG1758658
(S) p-Terphenyl-d14	*51.2*		*50.0-134*			*10/18/2021 14:53*	WG1758658

Sample Narrative:

L1409499-02 WG1758658: Duplicate Analysis performed due to QC failure. Reporting most compliant data.

Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.524	J3 J5 J6 O1	0.0400	1	10/08/2021 12:06	WG1753288

Metals (ICPMS) by Method 6020

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Arsenic	1.12	O1	1.00	5	10/13/2021 19:56	WG1755398
Barium	5.23	J5 O1	2.50	5	10/13/2021 19:56	WG1755398
Cadmium	ND		1.00	5	10/13/2021 19:56	WG1755398
Chromium	ND		5.00	5	10/13/2021 19:56	WG1755398
Lead	6.75	J5 O1	2.00	5	10/13/2021 19:56	WG1755398
Selenium	ND		2.50	5	10/13/2021 19:56	WG1755398
Silver	ND		0.500	5	10/13/2021 19:56	WG1755398

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acetone	ND		0.0815	1.63	10/07/2021 17:37	WG1753015
Acrylonitrile	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
Benzene	0.0116		0.00163	1.63	10/07/2021 17:37	WG1753015
Bromobenzene	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
Bromodichloromethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Bromoform	ND		0.0408	1.63	10/07/2021 17:37	WG1753015
Bromomethane	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
n-Butylbenzene	ND		0.0204	1.63	10/14/2021 13:21	WG1756712
sec-Butylbenzene	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
tert-Butylbenzene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
Carbon tetrachloride	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
Chlorobenzene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Chlorodibromomethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Chloroethane	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
Chloroform	0.00493		0.00408	1.63	10/07/2021 17:37	WG1753015
Chloromethane	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
2-Chlorotoluene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
4-Chlorotoluene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,2-Dibromoethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,2-Dibromo-3-Chloropropane	ND		0.0408	1.63	10/07/2021 17:37	WG1753015
Dibromomethane	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,2-Dichlorobenzene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,3-Dichlorobenzene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,4-Dichlorobenzene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
Dichlorodifluoromethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1-Dichloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,2-Dichloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1-Dichloroethene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
cis-1,2-Dichloroethene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
trans-1,2-Dichloroethene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,2-Dichloropropane	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,3-Dichloropropane	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
2,2-Dichloropropane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1-Dichloropropene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
cis-1,3-Dichloropropene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
trans-1,3-Dichloropropene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
Di-isopropyl ether	ND		0.00163	1.63	10/07/2021 17:37	WG1753015
Ethylbenzene	0.00591		0.00408	1.63	10/07/2021 17:37	WG1753015

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Hexachloro-1,3-butadiene	ND		0.0408	1.63	10/07/2021 17:37	WG1753015
Isopropylbenzene	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
p-Isopropyltoluene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
2-Butanone (MEK)	ND		0.163	1.63	10/07/2021 17:37	WG1753015
Methylene Chloride	ND		0.0408	1.63	10/07/2021 17:37	WG1753015
4-Methyl-2-pentanone (MIBK)	ND		0.0408	1.63	10/07/2021 17:37	WG1753015
Methyl tert-butyl ether	ND		0.00163	1.63	10/07/2021 17:37	WG1753015
Naphthalene	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
n-Propylbenzene	0.00901		0.00815	1.63	10/07/2021 17:37	WG1753015
Styrene	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
1,1,1,2-Tetrachloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1,2,2-Tetrachloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Tetrachloroethene	0.106		0.00408	1.63	10/07/2021 17:37	WG1753015
Toluene	0.0290		0.00815	1.63	10/07/2021 17:37	WG1753015
1,2,3-Trichlorobenzene	ND		0.0204	1.63	10/14/2021 13:21	WG1756712
1,2,4-Trichlorobenzene	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
1,2,3-Trimethylbenzene	ND		0.00815	1.63	10/07/2021 17:37	WG1753015
1,2,4-Trimethylbenzene	0.0322		0.00815	1.63	10/07/2021 17:37	WG1753015
1,3,5-Trimethylbenzene	0.0118		0.00815	1.63	10/07/2021 17:37	WG1753015
1,1,1-Trichloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1,2-Trichloroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Trichloroethene	0.0279	J4	0.00163	1.63	10/07/2021 17:37	WG1753015
Trichlorofluoromethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,1,2-Trichlorotrifluoroethane	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
1,2,3-Trichloropropane	ND		0.0204	1.63	10/07/2021 17:37	WG1753015
Vinyl chloride	ND		0.00408	1.63	10/07/2021 17:37	WG1753015
Xylenes, Total	0.0462		0.0106	1.63	10/07/2021 17:37	WG1753015
(S) Toluene-d8	*96.6*		*85.0-116*		*10/07/2021 17:37*	WG1753015
(S) Toluene-d8	*104*		*85.0-116*		*10/14/2021 13:21*	WG1756712
(S) 4-Bromofluorobenzene	*102*		*79.0-119*		*10/07/2021 17:37*	WG1753015
(S) 4-Bromofluorobenzene	*95.9*		*79.0-119*		*10/14/2021 13:21*	WG1756712
(S) 1,2-Dichloroethane-d4	*106*		*71.0-136*		*10/07/2021 17:37*	WG1753015
(S) 1,2-Dichloroethane-d4	*101*		*71.0-136*		*10/14/2021 13:21*	WG1756712

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.333	10	10/08/2021 15:01	WG1753791
Acenaphthylene	ND		0.333	10	10/08/2021 15:01	WG1753791
Anthracene	ND		0.333	10	10/08/2021 15:01	WG1753791
Benzidine	ND		16.7	10	10/08/2021 15:01	WG1753791
Benzo(a)anthracene	0.488		0.333	10	10/08/2021 15:01	WG1753791
Benzo(b)fluoranthene	0.688		0.333	10	10/08/2021 15:01	WG1753791
Benzo(k)fluoranthene	ND		0.333	10	10/08/2021 15:01	WG1753791
Benzo(g,h,i)perylene	0.546		0.333	10	10/08/2021 15:01	WG1753791
Benzo(a)pyrene	0.521		0.333	10	10/08/2021 15:01	WG1753791
Bis(2-chlorethoxy)methane	ND		3.33	10	10/08/2021 15:01	WG1753791
Bis(2-chloroethyl)ether	ND		3.33	10	10/08/2021 15:01	WG1753791
2,2-Oxybis(1-Chloropropane)	ND		3.33	10	10/08/2021 15:01	WG1753791
4-Bromophenyl-phenylether	ND		3.33	10	10/08/2021 15:01	WG1753791
2-Chloronaphthalene	ND		0.333	10	10/08/2021 15:01	WG1753791
4-Chlorophenyl-phenylether	ND		3.33	10	10/08/2021 15:01	WG1753791
Chrysene	0.518		0.333	10	10/08/2021 15:01	WG1753791
Dibenz(a,h)anthracene	ND		0.333	10	10/08/2021 15:01	WG1753791
3,3-Dichlorobenzidine	ND		3.33	10	10/08/2021 15:01	WG1753791
2,4-Dinitrotoluene	ND		3.33	10	10/08/2021 15:01	WG1753791

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
2,6-Dinitrotoluene	ND		3.33	10	10/08/2021 15:01	WG1753791
Fluoranthene	1.03		0.333	10	10/08/2021 15:01	WG1753791
Fluorene	ND		0.333	10	10/08/2021 15:01	WG1753791
Hexachlorobenzene	ND		3.33	10	10/08/2021 15:01	WG1753791
Hexachloro-1,3-butadiene	ND		3.33	10	10/08/2021 15:01	WG1753791
Hexachlorocyclopentadiene	ND		3.33	10	10/08/2021 15:01	WG1753791
Hexachloroethane	ND		3.33	10	10/08/2021 15:01	WG1753791
Indeno(1,2,3-cd)pyrene	0.457		0.333	10	10/08/2021 15:01	WG1753791
Isophorone	ND		3.33	10	10/08/2021 15:01	WG1753791
Naphthalene	ND		0.333	10	10/08/2021 15:01	WG1753791
Nitrobenzene	ND		3.33	10	10/08/2021 15:01	WG1753791
n-Nitrosodimethylamine	ND		3.33	10	10/08/2021 15:01	WG1753791
n-Nitrosodiphenylamine	ND		3.33	10	10/08/2021 15:01	WG1753791
n-Nitrosodi-n-propylamine	ND		3.33	10	10/08/2021 15:01	WG1753791
Phenanthrene	0.610		0.333	10	10/08/2021 15:01	WG1753791
Benzylbutyl phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Bis(2-ethylhexyl)phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Di-n-butyl phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Diethyl phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Dimethyl phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Di-n-octyl phthalate	ND		3.33	10	10/08/2021 15:01	WG1753791
Pyrene	0.860		0.333	10	10/08/2021 15:01	WG1753791
1,2,4-Trichlorobenzene	ND		3.33	10	10/08/2021 15:01	WG1753791
4-Chloro-3-methylphenol	ND		3.33	10	10/08/2021 15:01	WG1753791
2-Chlorophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
2,4-Dichlorophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
2,4-Dimethylphenol	ND		3.33	10	10/08/2021 15:01	WG1753791
4,6-Dinitro-2-methylphenol	ND		33.3	100	10/11/2021 15:17	WG1753791
2,4-Dinitrophenol	ND		33.3	100	10/11/2021 15:17	WG1753791
2-Nitrophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
4-Nitrophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
Pentachlorophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
Phenol	ND		3.33	10	10/08/2021 15:01	WG1753791
2,4,6-Trichlorophenol	ND		3.33	10	10/08/2021 15:01	WG1753791
(S) 2-Fluorophenol	*53.8*		*35.0-115*		*10/08/2021 15:01*	WG1753791
(S) 2-Fluorophenol	*0.000*	J7	*35.0-115*		*10/11/2021 15:17*	WG1753791
(S) Phenol-d5	*0.000*	J7	*33.0-122*		*10/11/2021 15:17*	WG1753791
(S) Phenol-d5	*56.2*		*33.0-122*		*10/08/2021 15:01*	WG1753791
(S) Nitrobenzene-d5	*0.000*	J7	*37.0-122*		*10/11/2021 15:17*	WG1753791
(S) Nitrobenzene-d5	*51.7*		*37.0-122*		*10/08/2021 15:01*	WG1753791
(S) 2-Fluorobiphenyl	*57.8*		*44.0-115*		*10/08/2021 15:01*	WG1753791
(S) 2-Fluorobiphenyl	*0.000*	J7	*44.0-115*		*10/11/2021 15:17*	WG1753791
(S) 2,4,6-Tribromophenol	*68.0*		*39.0-132*		*10/08/2021 15:01*	WG1753791
(S) 2,4,6-Tribromophenol	*0.000*	J7	*39.0-132*		*10/11/2021 15:17*	WG1753791
(S) p-Terphenyl-d14	*0.000*	J7	*54.0-127*		*10/11/2021 15:17*	WG1753791
(S) p-Terphenyl-d14	*55.7*		*54.0-127*		*10/08/2021 15:01*	WG1753791

Sample Narrative:

L1409499-03 WG1753791: Dilution due to matrix impact on instrumentation at lower dilution

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Preparation by Method 1311

Analyte	Result	Qualifier	Prep date / time	Batch
TCLP Extraction	-		10/8/2021 5:39:13 PM	WG1753668
TCLP ZHE Extraction	-		10/6/2021 4:45:24 PM	WG1752313
Fluid	1		10/8/2021 5:39:13 PM	WG1753668
Initial pH	5.58		10/8/2021 5:39:13 PM	WG1753668
Final pH	4.95		10/8/2021 5:39:13 PM	WG1753668

Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Mercury	ND		0.0100	0.20	1	10/11/2021 08:23	WG1754241

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Arsenic	ND		0.100		1	10/13/2021 20:06	WG1754232
Barium	1.19		0.100		1	10/13/2021 20:06	WG1754232
Cadmium	ND		0.100		1	10/13/2021 20:06	WG1754232
Chromium	ND		0.100		1	10/13/2021 20:06	WG1754232
Lead	1.45		0.100		1	10/13/2021 20:06	WG1754232
Selenium	ND		0.100		1	10/13/2021 20:06	WG1754232
Silver	ND		0.100		1	10/13/2021 20:06	WG1754232

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Benzene	ND		0.0500	0.50	1	10/08/2021 04:01	WG1753430
Carbon tetrachloride	ND		0.0500	0.50	1	10/08/2021 04:01	WG1753430
Chlorobenzene	ND		0.0500	100	1	10/08/2021 04:01	WG1753430
Chloroform	ND		0.250	6	1	10/08/2021 04:01	WG1753430
1,2-Dichloroethane	ND	J4	0.0500	0.50	1	10/08/2021 04:01	WG1753430
1,1-Dichloroethene	ND		0.0500	0.70	1	10/08/2021 04:01	WG1753430
2-Butanone (MEK)	ND		0.500	200	1	10/08/2021 04:01	WG1753430
Tetrachloroethene	ND		0.0500	0.70	1	10/08/2021 04:01	WG1753430
Trichloroethene	ND		0.0500	0.50	1	10/08/2021 04:01	WG1753430
Vinyl chloride	ND		0.0500	0.20	1	10/08/2021 04:01	WG1753430
(S) Toluene-d8	*104*		*89.0-112*			*10/08/2021 04:01*	WG1753430
(S) 4-Bromofluorobenzene	*92.2*		*85.0-114*			*10/08/2021 04:01*	WG1753430
(S) 1,2-Dichloroethane-d4	*114*		*81.0-118*			*10/08/2021 04:01*	WG1753430

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
1,4-Dichlorobenzene	ND		0.100	7.50	1	10/18/2021 15:57	WG1758658
2,4-Dinitrotoluene	ND		0.100	0.13	1	10/18/2021 15:57	WG1758658
Hexachlorobenzene	ND		0.100	0.13	1	10/18/2021 15:57	WG1758658
Hexachloro-1,3-butadiene	ND		0.100	0.50	1	10/18/2021 15:57	WG1758658
Hexachloroethane	ND		0.100	3	1	10/18/2021 15:57	WG1758658
Nitrobenzene	ND		0.100	2	1	10/18/2021 15:57	WG1758658
Pyridine	ND	J4	0.100	5	1	10/18/2021 15:57	WG1758658
3&4-Methyl Phenol	ND		0.100	400	1	10/18/2021 15:57	WG1758658
2-Methylphenol	ND		0.100	200	1	10/18/2021 15:57	WG1758658
Pentachlorophenol	ND		0.100	100	1	10/18/2021 15:57	WG1758658
2,4,5-Trichlorophenol	ND		0.100	400	1	10/18/2021 15:57	WG1758658
2,4,6-Trichlorophenol	ND		0.100	2	1	10/18/2021 15:57	WG1758658

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
(S) 2-Fluorophenol	*27.3*		*19.0-119*			*10/18/2021 15:57*	WG1758658
(S) Phenol-d5	*17.4*		*10.0-67.0*			*10/18/2021 15:57*	WG1758658
(S) Nitrobenzene-d5	*53.2*		*44.0-120*			*10/18/2021 15:57*	WG1758658
(S) 2-Fluorobiphenyl	*64.2*		*44.0-119*			*10/18/2021 15:57*	WG1758658
(S) 2,4,6-Tribromophenol	*56.0*		*43.0-140*			*10/18/2021 15:57*	WG1758658
(S) p-Terphenyl-d14	*57.5*		*50.0-134*			*10/18/2021 15:57*	WG1758658

Sample Narrative:

L1409499-04 WG1758658: Duplicate Analysis performed due to QC failure. Reporting most compliant data.

Method Blank (MB)

(MB) R3714681-1 10/11/21 08:11

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Mercury	U	U	0.00330	0.0100

Laboratory Control Sample (LCS)

(LCS) R3714681-2 10/11/21 08:13

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Mercury	0.0300	0.0358	119	82.0-119	

L1408461-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1408461-01 10/11/21 08:15 • (MS) R3714681-3 10/11/21 08:17 • (MSD) R3714681-4 10/11/21 08:19

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.0300	ND	0.0352	0.0353	117	118	1	82.0-119			0.269	20

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3714139-1 10/08/21 12:01

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Mercury	U	U	0.0180	0.0400

Laboratory Control Sample (LCS)

(LCS) R3714139-2 10/08/21 12:04

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Mercury	0.500	0.485	96.9	80.0-124	

L1409499-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1409499-03 10/08/21 12:06 • (MS) R3714139-3 10/08/21 12:09 • (MSD) R3714139-4 10/08/21 12:11

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.500	0.524	1.18	0.873	131	69.9	1	80.0-124	J5	J3 J6	29.8	20

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3716422-1 10/13/21 19:27

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Arsenic	U	U	0.0330	0.100
Barium	U	U	0.0330	0.100
Cadmium	U	U	0.0330	0.100
Chromium	U	U	0.0330	0.100
Lead	U	U	0.0330	0.100
Selenium	U	U	0.0330	0.100
Silver	U	U	0.0330	0.100

Laboratory Control Sample (LCS)

(LCS) R3716422-2 10/13/21 19:29

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Arsenic	10.0	9.84	98.4	87.0-113	
Barium	10.0	10.0	100	88.0-113	
Cadmium	10.0	9.76	97.6	88.0-113	
Chromium	10.0	9.64	96.4	90.0-113	
Lead	10.0	9.80	98.0	86.0-113	
Selenium	10.0	10.3	103	83.0-114	
Silver	2.00	1.80	90.0	84.0-115	

L1412273-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1412273-02 10/13/21 19:32 • (MS) R3716422-4 10/13/21 19:37 • (MSD) R3716422-5 10/13/21 19:40

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	10.0	ND	9.53	9.46	95.3	94.6	1	87.0-113			0.749	20
Barium	10.0	0.132	10.2	10.1	101	100	1	88.0-113			0.807	20
Cadmium	10.0	ND	9.61	9.59	96.1	95.9	1	88.0-113			0.298	20
Chromium	10.0	ND	9.67	9.63	96.7	96.3	1	90.0-113			0.361	20
Lead	10.0	ND	9.72	9.65	97.2	96.5	1	86.0-113			0.707	20
Selenium	10.0	ND	9.78	9.72	97.8	97.2	1	83.0-114			0.629	20
Silver	2.00	ND	1.77	1.75	88.4	87.6	1	84.0-115			0.848	20

L1412282-04 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1412282-04 10/13/21 19:43 • (MS) R3716422-6 10/13/21 19:45 • (MSD) R3716422-7 10/13/21 19:48

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Arsenic	10.0	ND	9.93	10.0	99.3	100	1	87.0-113			0.801	20
Barium	10.0	1.54	11.2	11.3	97.1	98.1	1	88.0-113			0.902	20
Cadmium	10.0	ND	9.85	9.88	98.5	98.8	1	88.0-113			0.295	20
Chromium	10.0	ND	9.67	9.74	96.7	97.4	1	90.0-113			0.692	20
Lead	10.0	ND	9.81	9.88	98.1	98.8	1	86.0-113			0.684	20
Selenium	10.0	ND	10.3	10.3	102	103	1	83.0-114			0.768	20
Silver	2.00	ND	1.79	1.81	89.6	90.4	1	84.0-115			0.797	20

Method Blank (MB)

(MB) R3716093-1 10/13/21 19:49

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Arsenic	U	U	0.100	1.00
Barium	U	U	0.152	2.50
Cadmium	U	U	0.0855	1.00
Chromium	U	U	0.297	5.00
Lead	U	U	0.0990	2.00
Selenium	U	U	0.180	2.50
Silver	U	U	0.0865	0.500

Laboratory Control Sample (LCS)

(LCS) R3716093-2 10/13/21 19:53

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Arsenic	100	96.6	96.6	82.0-118	
Barium	100	91.4	91.4	86.0-116	
Cadmium	100	105	105	84.0-116	
Chromium	100	101	101	83.0-119	
Lead	100	98.3	98.3	84.0-118	
Selenium	100	101	101	80.0-119	
Silver	20.0	19.8	98.9	83.0-118	

L1409499-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1409499-03 10/13/21 19:56 • (MS) R3716093-5 10/13/21 20:06 • (MSD) R3716093-6 10/13/21 20:09

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	100	1.12	102	111	101	110	5	82.0-118			7.80	20
Barium	100	5.23	663	658	658	653	5	86.0-116	J5	J5	0.809	20
Cadmium	100	ND	101	106	101	106	5	84.0-116			5.01	20
Chromium	100	ND	108	116	104	112	5	83.0-119			6.99	20
Lead	100	6.75	1300	1420	1290	1410	5	84.0-118	J5	J5	8.87	20
Selenium	100	ND	95.3	101	95.3	101	5	80.0-119			5.44	20
Silver	20.0	ND	18.5	19.7	92.4	98.3	5	83.0-118			6.20	20

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3715774-3 10/07/21 14:38

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Acetone	U	U	0.0365	0.0500
Acrylonitrile	U	U	0.00361	0.0125
Benzene	U	U	0.000467	0.00100
Bromobenzene	U	U	0.000900	0.0125
Bromodichloromethane	U	U	0.000725	0.00250
Bromoform	U	U	0.00117	0.0250
Bromomethane	U	U	0.00197	0.0125
sec-Butylbenzene	U	U	0.00288	0.0125
tert-Butylbenzene	U	U	0.00195	0.00500
Carbon tetrachloride	U	U	0.000898	0.00500
Chlorobenzene	U	U	0.000210	0.00250
Chlorodibromomethane	U	U	0.000612	0.00250
Chloroethane	U	U	0.00170	0.00500
Chloroform	U	U	0.00103	0.00250
Chloromethane	U	U	0.00435	0.0125
2-Chlorotoluene	U	U	0.000865	0.00250
4-Chlorotoluene	U	U	0.000450	0.00500
1,2-Dibromo-3-Chloropropane	U	U	0.00390	0.0250
1,2-Dibromoethane	U	U	0.000648	0.00250
Dibromomethane	U	U	0.000750	0.00500
1,2-Dichlorobenzene	U	U	0.000425	0.00500
1,3-Dichlorobenzene	U	U	0.000600	0.00500
1,4-Dichlorobenzene	U	U	0.000700	0.00500
Dichlorodifluoromethane	U	U	0.00161	0.00250
1,1-Dichloroethane	U	U	0.000491	0.00250
1,2-Dichloroethane	U	U	0.000649	0.00250
1,1-Dichloroethene	U	U	0.000606	0.00250
cis-1,2-Dichloroethene	U	U	0.000734	0.00250
trans-1,2-Dichloroethene	U	U	0.00104	0.00500
1,2-Dichloropropane	U	U	0.00142	0.00500
1,1-Dichloropropene	U	U	0.000809	0.00250
1,3-Dichloropropane	U	U	0.000501	0.00500
cis-1,3-Dichloropropene	U	U	0.000757	0.00250
trans-1,3-Dichloropropene	U	U	0.00114	0.00500
2,2-Dichloropropane	U	U	0.00138	0.00250
Di-isopropyl ether	U	U	0.000410	0.00100
Ethylbenzene	U	U	0.000737	0.00250
Hexachloro-1,3-butadiene	U	U	0.00600	0.0250
Isopropylbenzene	U	U	0.000425	0.00250
p-Isopropyltoluene	U	U	0.00255	0.00500

Method Blank (MB)

(MB) R3715774-3 10/07/21 14:38

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
2-Butanone (MEK)	0.112		0.0635	0.100
Methylene Chloride	0.00782	J	0.00664	0.0250
4-Methyl-2-pentanone (MIBK)	U	U	0.00228	0.0250
Methyl tert-butyl ether	U	U	0.000350	0.00100
Naphthalene	U	U	0.00488	0.0125
n-Propylbenzene	U	U	0.000950	0.00500
Styrene	U	U	0.000229	0.0125
1,1,1,2-Tetrachloroethane	U	U	0.000948	0.00250
1,1,2,2-Tetrachloroethane	U	U	0.000695	0.00250
Tetrachloroethene	U	U	0.000896	0.00250
Toluene	U	U	0.00130	0.00500
1,1,2-Trichlorotrifluoroethane	U	U	0.000754	0.00250
1,2,4-Trichlorobenzene	U	U	0.00440	0.0125
1,1,1-Trichloroethane	U	U	0.000923	0.00250
1,1,2-Trichloroethane	U	U	0.000597	0.00250
Trichloroethene	U	U	0.000584	0.00100
Trichlorofluoromethane	U	U	0.000827	0.00250
1,2,3-Trichloropropane	U	U	0.00162	0.0125
1,2,3-Trimethylbenzene	U	U	0.00158	0.00500
1,2,4-Trimethylbenzene	U	U	0.00158	0.00500
1,3,5-Trimethylbenzene	U	U	0.00200	0.00500
Vinyl chloride	U	U	0.00116	0.00250
Xylenes, Total	U	U	0.000880	0.00650
(S) Toluene-d8	*100*			*85.0-116*
(S) 4-Bromofluorobenzene	*96.4*			*79.0-119*
(S) 1,2-Dichloroethane-d4	*97.6*			*71.0-136*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3715774-1 10/07/21 13:21 • (LCSD) R3715774-2 10/07/21 13:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Acetone	0.625	0.799	0.733	128	117	36.0-164			8.62	20
Acrylonitrile	0.625	0.682	0.709	109	113	65.0-134			3.88	20
Benzene	0.125	0.126	0.131	101	105	77.0-121			3.89	20
Bromobenzene	0.125	0.125	0.125	100	100	78.0-121			0.000	20
Bromodichloromethane	0.125	0.140	0.142	112	114	75.0-127			1.42	20
Bromoform	0.125	0.121	0.118	96.8	94.4	67.0-132			2.51	20
Bromomethane	0.125	0.141	0.142	113	114	53.0-143			0.707	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3715774-1 10/07/21 13:21 • (LCSD) R3715774-2 10/07/21 13:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
sec-Butylbenzene	0.125	0.110	0.120	88.0	96.0	73.0-126			8.70	20
tert-Butylbenzene	0.125	0.121	0.129	96.8	103	73.0-125			6.40	20
Carbon tetrachloride	0.125	0.132	0.142	106	114	70.0-135			7.30	20
Chlorobenzene	0.125	0.115	0.117	92.0	93.6	79.0-120			1.72	20
Chlorodibromomethane	0.125	0.121	0.121	96.8	96.8	74.0-126			0.000	20
Chloroethane	0.125	0.135	0.134	108	107	59.0-139			0.743	20
Chloroform	0.125	0.128	0.134	102	107	78.0-123			4.58	20
Chloromethane	0.125	0.130	0.139	104	111	50.0-136			6.69	20
2-Chlorotoluene	0.125	0.123	0.123	98.4	98.4	75.0-122			0.000	20
4-Chlorotoluene	0.125	0.116	0.124	92.8	99.2	72.0-124			6.67	20
1,2-Dibromo-3-Chloropropane	0.125	0.101	0.114	80.8	91.2	61.0-132			12.1	20
1,2-Dibromoethane	0.125	0.128	0.124	102	99.2	78.0-122			3.17	20
Dibromomethane	0.125	0.132	0.133	106	106	78.0-125			0.755	20
1,2-Dichlorobenzene	0.125	0.112	0.117	89.6	93.6	78.0-121			4.37	20
1,3-Dichlorobenzene	0.125	0.111	0.119	88.8	95.2	77.0-121			6.96	20
1,4-Dichlorobenzene	0.125	0.108	0.115	86.4	92.0	75.0-120			6.28	20
Dichlorodifluoromethane	0.125	0.128	0.143	102	114	29.0-149			11.1	20
1,1-Dichloroethane	0.125	0.131	0.137	105	110	76.0-125			4.48	20
1,2-Dichloroethane	0.125	0.141	0.155	113	124	73.0-128			9.46	20
1,1-Dichloroethene	0.125	0.135	0.140	108	112	70.0-131			3.64	20
cis-1,2-Dichloroethene	0.125	0.127	0.125	102	100	77.0-123			1.59	20
trans-1,2-Dichloroethene	0.125	0.131	0.137	105	110	74.0-125			4.48	20
1,2-Dichloropropane	0.125	0.133	0.136	106	109	76.0-123			2.23	20
1,1-Dichloropropene	0.125	0.134	0.140	107	112	76.0-125			4.38	20
1,3-Dichloropropane	0.125	0.120	0.121	96.0	96.8	77.0-121			0.830	20
cis-1,3-Dichloropropene	0.125	0.134	0.135	107	108	74.0-126			0.743	20
trans-1,3-Dichloropropene	0.125	0.127	0.128	102	102	71.0-130			0.784	20
2,2-Dichloropropane	0.125	0.111	0.113	88.8	90.4	67.0-133			1.79	20
Di-isopropyl ether	0.125	0.134	0.137	107	110	69.0-127			2.21	20
Ethylbenzene	0.125	0.119	0.120	95.2	96.0	76.0-122			0.837	20
Hexachloro-1,3-butadiene	0.125	0.105	0.124	84.0	99.2	61.0-135			16.6	20
Isopropylbenzene	0.125	0.120	0.128	96.0	102	68.0-134			6.45	20
p-Isopropyltoluene	0.125	0.118	0.125	94.4	100	73.0-127			5.76	20
2-Butanone (MEK)	0.625	0.777	0.769	124	123	51.0-148			1.03	20
Methylene Chloride	0.125	0.118	0.118	94.4	94.4	70.0-128			0.000	20
4-Methyl-2-pentanone (MIBK)	0.625	0.663	0.659	106	105	65.0-135			0.605	20
Methyl tert-butyl ether	0.125	0.141	0.139	113	111	73.0-125			1.43	20
Naphthalene	0.125	0.100	0.115	80.0	92.0	62.0-129			14.0	20
n-Propylbenzene	0.125	0.118	0.123	94.4	98.4	73.0-125			4.15	20
Styrene	0.125	0.124	0.126	99.2	101	76.0-124			1.60	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3715774-1 10/07/21 13:21 • (LCSD) R3715774-2 10/07/21 13:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	0.125	0.121	0.124	96.8	99.2	78.0-125			2.45	20
1,1,2,2-Tetrachloroethane	0.125	0.111	0.106	88.8	84.8	70.0-124			4.61	20
Tetrachloroethene	0.125	0.115	0.120	92.0	96.0	73.0-128			4.26	20
Toluene	0.125	0.115	0.119	92.0	95.2	77.0-121			3.42	20
1,1,2-Trichlorotrifluoroethane	0.125	0.109	0.111	87.2	88.8	66.0-136			1.82	20
1,2,4-Trichlorobenzene	0.125	0.103	0.122	82.4	97.6	67.0-129			16.9	20
1,1,1-Trichloroethane	0.125	0.138	0.151	110	121	73.0-130			9.00	20
1,1,2-Trichloroethane	0.125	0.125	0.120	100	96.0	78.0-121			4.08	20
Trichloroethene	0.125	0.148	0.156	118	125	77.0-123		J4	5.26	20
Trichlorofluoromethane	0.125	0.127	0.136	102	109	62.0-140			6.84	20
1,2,3-Trichloropropane	0.125	0.131	0.128	105	102	73.0-125			2.32	20
1,2,3-Trimethylbenzene	0.125	0.111	0.117	88.8	93.6	82.0-118			5.26	20
1,2,4-Trimethylbenzene	0.125	0.120	0.124	96.0	99.2	75.0-123			3.28	20
1,3,5-Trimethylbenzene	0.125	0.116	0.121	92.8	96.8	73.0-124			4.22	20
Vinyl chloride	0.125	0.143	0.148	114	118	56.0-135			3.44	20
Xylenes, Total	0.375	0.356	0.376	94.9	100	78.0-124			5.46	20
(S) Toluene-d8				*95.8*	*96.3*	*85.0-116*				
(S) 4-Bromofluorobenzene				*102*	*103*	*79.0-119*				
(S) 1,2-Dichloroethane-d4				*113*	*110*	*71.0-136*				

L1412206-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1412206-03 10/07/21 22:39 • (MS) R3715774-4 10/07/21 23:36 • (MSD) R3715774-5 10/07/21 23:54

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Acetone	19.1	2.89	11.0	10.8	47.7	46.5	27.2	36.0-164			1.83	20
Acrylonitrile	19.1	ND	17.8	17.4	105	102	27.2	65.0-134			2.27	20
Benzene	3.81	ND	2.86	3.89	83.7	114	27.2	77.0-121		J3	30.5	20
Bromobenzene	3.81	ND	3.18	4.05	93.5	119	27.2	78.0-121		J3	24.1	20
Bromodichloromethane	3.81	ND	3.26	3.97	95.9	117	27.2	75.0-127			19.6	20
Bromoform	3.81	ND	3.22	3.48	94.7	102	27.2	67.0-132			7.76	20
Bromomethane	3.81	ND	2.84	4.04	83.5	119	27.2	53.0-143		J3	34.9	20
sec-Butylbenzene	3.81	2.36	4.58	5.85	65.3	103	27.2	73.0-126	J6	J3	24.4	20
tert-Butylbenzene	3.81	ND	2.81	4.08	82.6	120	27.2	73.0-125		J3	36.9	20
Carbon tetrachloride	3.81	ND	2.68	4.31	78.8	127	27.2	70.0-135		J3	46.6	20
Chlorobenzene	3.81	ND	2.62	3.50	77.1	103	27.2	79.0-120	J6	J3	28.8	20
Chlorodibromomethane	3.81	ND	3.18	3.73	93.5	110	27.2	74.0-126			15.9	20
Chloroethane	3.81	ND	2.49	3.63	73.2	107	27.2	59.0-139		J3	37.3	20
Chloroform	3.81	ND	2.91	3.87	85.6	114	27.2	78.0-123		J3	28.3	20

L1412206-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1412206-03 10/07/21 22:39 • (MS) R3715774-4 10/07/21 23:36 • (MSD) R3715774-5 10/07/21 23:54

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloromethane	3.81	ND	2.61	3.92	76.8	115	27.2	50.0-136		J3	40.1	20
2-Chlorotoluene	3.81	ND	2.95	3.99	86.8	117	27.2	75.0-122		J3	30.0	20
4-Chlorotoluene	3.81	ND	2.88	3.93	84.7	116	27.2	72.0-124		J3	30.8	20
1,2-Dibromo-3-Chloropropane	3.81	ND	2.87	3.35	84.4	98.5	27.2	61.0-132			15.4	20
1,2-Dibromoethane	3.81	ND	3.46	3.70	102	109	27.2	78.0-122			6.70	20
Dibromomethane	3.81	ND	3.48	3.87	102	114	27.2	78.0-125			10.6	20
1,2-Dichlorobenzene	3.81	ND	2.92	3.50	85.9	103	27.2	78.0-121			18.1	20
1,3-Dichlorobenzene	3.81	ND	2.73	3.50	80.3	103	27.2	77.0-121		J3	24.7	20
1,4-Dichlorobenzene	3.81	ND	2.72	3.38	80.0	99.4	27.2	75.0-120		J3	21.6	20
Dichlorodifluoromethane	3.81	ND	2.65	4.44	77.9	131	27.2	29.0-149		J3	50.5	20
1,1-Dichloroethane	3.81	ND	2.86	3.98	84.1	117	27.2	76.0-125		J3	32.7	20
1,2-Dichloroethane	3.81	ND	3.60	4.16	106	122	27.2	73.0-128			14.4	20
1,1-Dichloroethene	3.81	ND	2.54	4.14	74.7	122	27.2	70.0-131		J3	47.9	20
cis-1,2-Dichloroethene	3.81	ND	2.83	3.81	83.2	112	27.2	77.0-123		J3	29.5	20
trans-1,2-Dichloroethene	3.81	ND	2.59	3.84	76.2	113	27.2	74.0-125		J3	38.9	20
1,2-Dichloropropane	3.81	ND	3.46	4.12	102	121	27.2	76.0-123			17.4	20
1,1-Dichloropropene	3.81	ND	2.68	4.19	78.8	123	27.2	76.0-125		J3	44.0	20
1,3-Dichloropropane	3.81	ND	3.23	3.68	95.0	108	27.2	77.0-121			13.0	20
cis-1,3-Dichloropropene	3.81	ND	3.45	4.28	101	126	27.2	74.0-126		J3	21.5	20
trans-1,3-Dichloropropene	3.81	ND	3.49	4.12	103	121	27.2	71.0-130			16.6	20
2,2-Dichloropropane	3.81	ND	2.88	4.18	84.7	123	27.2	67.0-133		J3	36.8	20
Di-isopropyl ether	3.81	ND	3.50	4.20	103	124	27.2	69.0-127			18.2	20
Ethylbenzene	3.81	0.503	2.99	3.99	73.1	103	27.2	76.0-122	J6	J3	28.7	20
Hexachloro-1,3-butadiene	3.81	ND	3.19	4.79	93.8	141	27.2	61.0-135		J3 J5	40.1	20
Isopropylbenzene	3.81	0.596	3.07	4.07	72.8	102	27.2	68.0-134		J3	28.0	20
p-Isopropyltoluene	3.81	0.156	3.19	4.41	89.2	125	27.2	73.0-127		J3	32.1	20
2-Butanone (MEK)	19.1	ND	23.2	24.2	136	142	27.2	51.0-148			4.22	20
Methylene Chloride	3.81	ND	2.77	3.55	81.5	104	27.2	70.0-128		J3	24.7	20
4-Methyl-2-pentanone (MIBK)	19.1	ND	20.1	20.4	118	120	27.2	65.0-135			1.48	20
Methyl tert-butyl ether	3.81	ND	3.75	4.11	110	121	27.2	73.0-125			9.16	20
Naphthalene	3.81	9.67	9.55	11.6	0.000	56.8	27.2	62.0-129	J6	J6	19.4	20
n-Propylbenzene	3.81	2.47	4.84	6.11	69.7	107	27.2	73.0-125	J6	J3	23.2	20
Styrene	3.81	ND	2.89	3.64	85.0	107	27.2	76.0-124		J3	23.0	20
1,1,1,2-Tetrachloroethane	3.81	ND	3.00	3.60	88.2	106	27.2	78.0-125			18.2	20
1,1,2,2-Tetrachloroethane	3.81	ND	3.65	4.03	107	119	27.2	70.0-124			9.90	20
Tetrachloroethene	3.81	ND	2.30	3.51	67.6	103	27.2	73.0-128	J6	J3	41.7	20
Toluene	3.81	ND	2.57	3.53	75.6	104	27.2	77.0-121	J6	J3	31.5	20
1,1,2-Trichlorotrifluoroethane	3.81	ND	2.31	3.98	67.9	117	27.2	66.0-136		J3	53.1	20
1,2,4-Trichlorobenzene	3.81	ND	2.90	3.98	85.3	117	27.2	67.0-129		J3	31.4	20
1,1,1-Trichloroethane	3.81	ND	2.80	4.17	82.4	123	27.2	73.0-130		J3	39.3	20

L1412206-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1412206-03 10/07/21 22:39 • (MS) R3715774-4 10/07/21 23:36 • (MSD) R3715774-5 10/07/21 23:54

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
1,1,2-Trichloroethane	3.81	ND	3.46	3.86	102	114	27.2	78.0-121			10.9	20
Trichloroethene	3.81	ND	2.93	4.12	86.2	121	27.2	77.0-123		J3	33.8	20
Trichlorofluoromethane	3.81	ND	2.57	4.26	75.6	125	27.2	62.0-140		J3	49.5	20
1,2,3-Trichloropropane	3.81	ND	3.63	4.10	107	121	27.2	73.0-125			12.2	20
1,2,3-Trimethylbenzene	3.81	0.384	2.96	3.78	75.8	99.9	27.2	82.0-118	J6	J3	24.3	20
1,2,4-Trimethylbenzene	3.81	0.273	3.02	4.07	80.8	112	27.2	75.0-123		J3	29.6	20
1,3,5-Trimethylbenzene	3.81	ND	2.72	3.77	77.7	109	27.2	73.0-124		J3	32.4	20
Vinyl chloride	3.81	ND	2.76	4.44	81.2	131	27.2	56.0-135		J3	46.7	20
Xylenes, Total	11.5	ND	7.69	10.6	74.3	103	27.2	78.0-124	J6	J3	31.8	20
(S) Toluene-d8					*99.9*	*98.9*		*85.0-116*				
(S) 4-Bromofluorobenzene					*103*	*99.6*		*79.0-119*				
(S) 1,2-Dichloroethane-d4					*107*	*104*		*71.0-136*				

Sample Narrative:

OS: Non-target compounds too high to run at a lower dilution.

QUALITY CONTROL SUMMARY

L1409499-01,03

Method Blank (MB)

(MB) R3717414-3 10/14/21 10:01

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
n-Butylbenzene	U	U	0.00525	0.0125
1,2,3-Trichlorobenzene	U	U	0.00733	0.0125
(S) Toluene-d8	*102*			*85.0-116*
(S) 4-Bromofluorobenzene	*96.9*			*79.0-119*
(S) 1,2-Dichloroethane-d4	*115*			*71.0-136*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3717414-1 10/14/21 08:44 • (LCSD) R3717414-2 10/14/21 09:04

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
n-Butylbenzene	0.125	0.101	0.103	80.8	82.4	70.0-128			1.96	20
1,2,3-Trichlorobenzene	0.125	0.117	0.125	93.6	100	66.0-130			6.61	20
(S) Toluene-d8				*100*	*101*	*85.0-116*				
(S) 4-Bromofluorobenzene				*98.8*	*99.9*	*79.0-119*				
(S) 1,2-Dichloroethane-d4				*116*	*116*	*71.0-136*				

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3715765-3 10/08/21 03:00

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Benzene	U		0.0167	0.0500
Carbon tetrachloride	U		0.0167	0.0500
Chlorobenzene	U		0.0167	0.0500
Chloroform	U		0.0833	0.250
1,2-Dichloroethane	U		0.0167	0.0500
1,1-Dichloroethene	U		0.0167	0.0500
2-Butanone (MEK)	U		0.167	0.500
Tetrachloroethene	U		0.0167	0.0500
Trichloroethene	U		0.0167	0.0500
Vinyl chloride	U		0.0167	0.0500
(S) Toluene-d8	*101*			*89.0-112*
(S) 4-Bromofluorobenzene	*87.9*			*85.0-114*
(S) 1,2-Dichloroethane-d4	*110*			*81.0-118*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3715765-1 10/08/21 01:39 • (LCSD) R3715765-2 10/08/21 01:59

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Benzene	0.250	0.285	0.277	114	111	79.0-120			2.85	20
Carbon tetrachloride	0.250	0.289	0.287	116	115	72.0-136			0.694	20
Chlorobenzene	0.250	0.282	0.271	113	108	82.0-118			3.98	20
Chloroform	0.250	0.297	0.288	119	115	79.0-124			3.08	20
1,2-Dichloroethane	0.250	0.339	0.325	136	130	73.0-128	J4	J4	4.22	20
1,1-Dichloroethene	0.250	0.249	0.243	99.6	97.2	71.0-131			2.44	20
2-Butanone (MEK)	1.25	1.35	1.23	108	98.4	56.0-143			9.30	20
Tetrachloroethene	0.250	0.260	0.255	104	102	74.0-129			1.94	20
Trichloroethene	0.250	0.267	0.266	107	106	79.0-123			0.375	20
Vinyl chloride	0.250	0.303	0.304	121	122	58.0-137			0.329	20
(S) Toluene-d8				*100*	*100*	*89.0-112*				
(S) 4-Bromofluorobenzene				*94.0*	*91.1*	*85.0-114*				
(S) 1,2-Dichloroethane-d4				*113*	*113*	*81.0-118*				

L1411414-06 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1411414-06 10/08/21 04:42 • (MS) R3715765-4 10/08/21 10:07 • (MSD) R3715765-5 10/08/21 10:28

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Benzene	0.250	ND	0.171	0.228	68.4	91.2	1	79.0-120	J6	J3	28.6	20
Carbon tetrachloride	0.250	ND	0.148	0.235	59.2	94.0	1	72.0-136	J6	J3	45.4	20
Chlorobenzene	0.250	ND	0.179	0.230	71.6	92.0	1	82.0-118	J6	J3	24.9	20
Chloroform	0.250	ND	ND	ND	76.0	99.6	1	79.0-124	J6	J3	26.9	20
1,2-Dichloroethane	0.250	ND	0.258	0.308	103	123	1	73.0-128			17.7	20
1,1-Dichloroethene	0.250	ND	0.123	0.187	49.2	74.8	1	71.0-131	J6	J3	41.3	20
2-Butanone (MEK)	1.25	0.884	2.17	2.09	103	96.5	1	56.0-143			3.76	20
Tetrachloroethene	0.250	ND	0.135	0.209	54.0	83.6	1	74.0-129	J6	J3	43.0	20
Trichloroethene	0.250	ND	0.140	0.214	56.0	85.6	1	79.0-123	J6	J3	41.8	20
Vinyl chloride	0.250	ND	0.160	0.240	64.0	96.0	1	58.0-137		J3	40.0	20
(S) Toluene-d8					*101*	*101*		*89.0-112*				
(S) 4-Bromofluorobenzene					*96.9*	*94.2*		*85.0-114*				
(S) 1,2-Dichloroethane-d4					*112*	*111*		*81.0-118*				

L1412116-02 Original Sample (OS) • Matrix Spike (MS)

(OS) L1412116-02 10/08/21 07:04 • (MS) R3715765-6 10/08/21 10:48

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Benzene	0.250	ND	0.281	112	1	79.0-120	
Carbon tetrachloride	0.250	ND	0.299	120	1	72.0-136	
Chlorobenzene	0.250	ND	0.276	110	1	82.0-118	
Chloroform	0.250	ND	0.299	120	1	79.0-124	
1,2-Dichloroethane	0.250	ND	0.336	134	1	73.0-128	J5
1,1-Dichloroethene	0.250	ND	0.252	101	1	71.0-131	
2-Butanone (MEK)	1.25	ND	1.18	94.4	1	56.0-143	
Tetrachloroethene	0.250	ND	0.271	108	1	74.0-129	
Trichloroethene	0.250	ND	0.316	126	1	79.0-123	J5
Vinyl chloride	0.250	ND	0.319	128	1	58.0-137	
(S) Toluene-d8				*104*		*89.0-112*	
(S) 4-Bromofluorobenzene				*95.7*		*85.0-114*	
(S) 1,2-Dichloroethane-d4				*113*		*81.0-118*	

Method Blank (MB)

(MB) R3714770-2 10/08/21 12:10

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Acenaphthene	U	U	0.00539	0.0333
Acenaphthylene	U	U	0.00469	0.0333
Anthracene	U	U	0.00593	0.0333
Benzidine	U	U	0.0626	1.67
Benzo(a)anthracene	U	U	0.00587	0.0333
Benzo(b)fluoranthene	U	U	0.00621	0.0333
Benzo(k)fluoranthene	U	U	0.00592	0.0333
Benzo(g,h,i)perylene	U	U	0.00609	0.0333
Benzo(a)pyrene	U	U	0.00619	0.0333
Bis(2-chlorethoxy)methane	U	U	0.0100	0.333
Bis(2-chloroethyl)ether	U	U	0.0110	0.333
2,2-Oxybis(1-Chloropropane)	U	U	0.0144	0.333
4-Bromophenyl-phenylether	U	U	0.0117	0.333
2-Chloronaphthalene	U	U	0.00585	0.0333
4-Chlorophenyl-phenylether	U	U	0.0116	0.333
Chrysene	U	U	0.00662	0.0333
Dibenz(a,h)anthracene	U	U	0.00923	0.0333
3,3-Dichlorobenzidine	U	U	0.0123	0.333
2,4-Dinitrotoluene	U	U	0.00955	0.333
2,6-Dinitrotoluene	U	U	0.0109	0.333
Fluoranthene	U	U	0.00601	0.0333
Fluorene	U	U	0.00542	0.0333
Hexachlorobenzene	U	U	0.0118	0.333
Hexachloro-1,3-butadiene	U	U	0.0112	0.333
Hexachlorocyclopentadiene	U	U	0.0175	0.333
Hexachloroethane	U	U	0.0131	0.333
Indeno(1,2,3-cd)pyrene	U	U	0.00941	0.0333
Isophorone	U	U	0.0102	0.333
Naphthalene	U	U	0.00836	0.0333
Nitrobenzene	U	U	0.0116	0.333
n-Nitrosodimethylamine	U	U	0.0494	0.333
n-Nitrosodiphenylamine	U	U	0.0252	0.333
n-Nitrosodi-n-propylamine	U	U	0.0111	0.333
Phenanthrene	U	U	0.00661	0.0333
Benzylbutyl phthalate	U	U	0.0104	0.333
Bis(2-ethylhexyl)phthalate	U	U	0.0422	0.333
Di-n-butyl phthalate	U	U	0.0114	0.333
Diethyl phthalate	U	U	0.0110	0.333
Dimethyl phthalate	U	U	0.0706	0.333
Di-n-octyl phthalate	U	U	0.0225	0.333

Method Blank (MB)

(MB) R3714770-2 10/08/21 12:10

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Pyrene	U	U	0.00648	0.0333
1,2,4-Trichlorobenzene	U	U	0.0104	0.333
4-Chloro-3-methylphenol	U	U	0.0108	0.333
2-Chlorophenol	U	U	0.0110	0.333
2,4-Dichlorophenol	U	U	0.00970	0.333
2,4-Dimethylphenol	U	U	0.00870	0.333
4,6-Dinitro-2-methylphenol	U	U	0.0755	0.333
2,4-Dinitrophenol	U	U	0.0779	0.333
2-Nitrophenol	U	U	0.0119	0.333
4-Nitrophenol	U	U	0.0104	0.333
Pentachlorophenol	U	U	0.00896	0.333
Phenol	U	U	0.0134	0.333
2,4,6-Trichlorophenol	U	U	0.0107	0.333
(S) 2-Fluorophenol	*71.2*			*35.0-115*
(S) Phenol-d5	*66.1*			*33.0-122*
(S) Nitrobenzene-d5	*60.1*			*37.0-122*
(S) 2-Fluorobiphenyl	*69.1*			*44.0-115*
(S) 2,4,6-Tribromophenol	*77.2*			*39.0-132*
(S) p-Terphenyl-d14	*71.5*			*54.0-127*

Laboratory Control Sample (LCS)

(LCS) R3714770-1 10/08/21 11:49

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acenaphthene	0.666	0.420	63.1	40.0-123	
Acenaphthylene	0.666	0.427	64.1	32.0-132	
Anthracene	0.666	0.453	68.0	47.0-123	
Benzidine	1.33	0.233	17.5	10.0-48.0	
Benzo(a)anthracene	0.666	0.502	75.4	49.0-126	
Benzo(b)fluoranthene	0.666	0.470	70.6	45.0-132	
Benzo(k)fluoranthene	0.666	0.448	67.3	47.0-132	
Benzo(g,h,i)perylene	0.666	0.477	71.6	43.0-134	
Benzo(a)pyrene	0.666	0.469	70.4	45.0-129	
Bis(2-chlorethoxy)methane	0.666	0.352	52.9	36.0-121	
Bis(2-chloroethyl)ether	0.666	0.482	72.4	31.0-120	
2,2-Oxybis(1-Chloropropane)	0.666	0.421	63.2	33.0-131	
4-Bromophenyl-phenylether	0.666	0.472	70.9	46.0-124	
2-Chloronaphthalene	0.666	0.420	63.1	41.0-114	

Laboratory Control Sample (LCS)

(LCS) R3714770-1 10/08/21 11:49

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Chlorophenyl-phenylether	0.666	0.444	66.7	45.0-121	
Chrysene	0.666	0.458	68.8	50.0-124	
Dibenz(a,h)anthracene	0.666	0.470	70.6	45.0-134	
3,3-Dichlorobenzidine	1.33	0.756	56.8	22.0-121	
2,4-Dinitrotoluene	0.666	0.523	78.5	46.0-126	
2,6-Dinitrotoluene	0.666	0.466	70.0	46.0-124	
Fluoranthene	0.666	0.475	71.3	50.0-127	
Fluorene	0.666	0.451	67.7	43.0-125	
Hexachlorobenzene	0.666	0.462	69.4	45.0-122	
Hexachloro-1,3-butadiene	0.666	0.349	52.4	32.0-123	
Hexachlorocyclopentadiene	0.666	0.442	66.4	13.0-123	
Hexachloroethane	0.666	0.397	59.6	28.0-117	
Indeno(1,2,3-cd)pyrene	0.666	0.507	76.1	45.0-133	
Isophorone	0.666	0.356	53.5	30.0-122	
Naphthalene	0.666	0.340	51.1	35.0-123	
Nitrobenzene	0.666	0.356	53.5	34.0-122	
n-Nitrosodimethylamine	0.666	0.401	60.2	23.0-120	
n-Nitrosodiphenylamine	0.666	0.429	64.4	38.0-127	
n-Nitrosodi-n-propylamine	0.666	0.429	64.4	36.0-120	
Phenanthrene	0.666	0.444	66.7	50.0-121	
Benzylbutyl phthalate	0.666	0.487	73.1	46.0-132	
Bis(2-ethylhexyl)phthalate	0.666	0.487	73.1	51.0-133	
Di-n-butyl phthalate	0.666	0.466	70.0	51.0-128	
Diethyl phthalate	0.666	0.464	69.7	50.0-124	
Dimethyl phthalate	0.666	0.431	64.7	48.0-124	
Di-n-octyl phthalate	0.666	0.481	72.2	45.0-140	
Pyrene	0.666	0.451	67.7	47.0-110	
1,2,4-Trichlorobenzene	0.666	0.357	53.6	34.0-118	
4-Chloro-3-methylphenol	0.666	0.378	56.8	45.0-122	
2-Chlorophenol	0.666	0.456	68.5	34.0-121	
2,4-Dichlorophenol	0.666	0.381	57.2	40.0-122	
2,4-Dimethylphenol	0.666	0.373	56.0	30.0-127	
4,6-Dinitro-2-methylphenol	0.666	0.532	79.9	29.0-132	
2,4-Dinitrophenol	0.666	0.478	71.8	10.0-105	
2-Nitrophenol	0.666	0.424	63.7	36.0-123	
4-Nitrophenol	0.666	0.500	75.1	30.0-132	
Pentachlorophenol	0.666	0.499	74.9	25.0-133	
Phenol	0.666	0.407	61.1	34.0-121	
2,4,6-Trichlorophenol	0.666	0.471	70.7	39.0-126	
(S) 2-Fluorophenol			*69.7*	*35.0-115*	

1 Cp 2 Tc 3 Ss 4 Cn 5 Sr 6 Qc 7 Gl 8 Al 9 Sc

Laboratory Control Sample (LCS)

(LCS) R3714770-1 10/08/21 11:49

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
(S) Phenol-d5			*65.9*	*33.0-122*	
(S) Nitrobenzene-d5			*58.6*	*37.0-122*	
(S) 2-Fluorobiphenyl			*67.3*	*44.0-115*	
(S) 2,4,6-Tribromophenol			*82.3*	*39.0-132*	
(S) p-Terphenyl-d14			*67.0*	*54.0-127*	

L1409499-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1409499-01 10/08/21 13:57 • (MS) R3714770-3 10/08/21 14:18 • (MSD) R3714770-4 10/08/21 14:40

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Acenaphthene	0.650	ND	0.415	0.508	54.0	68.7	10	40.0-123		J3	20.2	20
Acenaphthylene	0.650	0.374	0.623	0.800	38.3	65.9	10	32.0-132		J3	24.9	20
Anthracene	0.650	0.371	0.597	0.780	34.8	63.3	10	47.0-123	J6	J3	26.6	20
Benzidine	1.30	ND	ND	ND	0.000	0.000	10	10.0-48.0	J6	J6	0.000	20
Benzo(a)anthracene	0.650	1.46	1.19	1.50	0.000	6.19	10	49.0-126	J6	J3 J6	23.0	20
Benzo(b)fluoranthene	0.650	2.09	1.53	1.89	0.000	0.000	10	45.0-132	J6	J3 J6	21.1	20
Benzo(k)fluoranthene	0.650	0.693	0.770	0.963	11.8	41.8	10	47.0-132	J6	J3 J6	22.3	20
Benzo(g,h,i)perylene	0.650	1.45	1.24	1.48	0.000	4.64	10	43.0-134	J6	J6	17.6	20
Benzo(a)pyrene	0.650	1.52	1.26	1.54	0.000	3.10	10	45.0-129	J6	J6	20.0	20
Bis(2-chlorethoxy)methane	0.650	ND	ND	ND	58.3	67.2	10	36.0-121			13.5	20
Bis(2-chloroethyl)ether	0.650	ND	ND	ND	71.1	80.3	10	31.0-120			11.6	20
2,2-Oxybis(1-Chloropropane)	0.650	ND	ND	ND	58.8	67.2	10	33.0-131			12.7	20
4-Bromophenyl-phenylether	0.650	ND	ND	ND	66.6	82.2	10	46.0-124		J3	20.3	20
2-Chloronaphthalene	0.650	ND	0.382	0.474	58.8	73.4	10	41.0-114		J3	21.5	20
4-Chlorophenyl-phenylether	0.650	ND	ND	ND	66.8	79.1	10	45.0-121			16.3	20
Chrysene	0.650	1.42	1.09	1.43	0.000	1.55	10	50.0-124	J6	J3 J6	27.0	20
Dibenz(a,h)anthracene	0.650	ND	0.531	0.652	35.7	54.6	10	45.0-134	J6	J3	20.5	20
3,3-Dichlorobenzidine	1.30	ND	ND	ND	36.8	27.8	10	22.0-121		J3	28.7	20
2,4-Dinitrotoluene	0.650	ND	ND	ND	69.4	86.7	10	46.0-126		J3	21.6	20
2,6-Dinitrotoluene	0.650	ND	ND	ND	64.5	81.3	10	46.0-124		J3	22.5	20
Fluoranthene	0.650	2.83	1.48	2.04	0.000	0.000	10	50.0-127	V	J3 V	31.8	20
Fluorene	0.650	ND	0.459	0.593	51.5	72.6	10	43.0-125		J3	25.5	20
Hexachlorobenzene	0.650	ND	ND	ND	65.8	80.3	10	45.0-122			19.2	20
Hexachloro-1,3-butadiene	0.650	ND	ND	ND	60.3	76.2	10	32.0-123		J3	22.6	20
Hexachlorocyclopentadiene	0.650	ND	ND	ND	0.000	0.000	10	13.0-123	J6	J6	0.000	20
Hexachloroethane	0.650	ND	ND	ND	46.6	62.7	10	28.0-117		J3	28.8	20
Indeno(1,2,3-cd)pyrene	0.650	1.41	1.20	1.48	0.000	10.8	10	45.0-133	J6	J3 J6	20.9	20
Isophorone	0.650	ND	ND	ND	58.6	67.8	10	30.0-122			13.9	20

QUALITY CONTROL SUMMARY

L1409499-01,03

L1409499-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1409499-01 10/08/21 13:57 • (MS) R3714770-3 10/08/21 14:18 • (MSD) R3714770-4 10/08/21 14:40

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Naphthalene	0.650	ND	0.441	0.536	39.1	54.0	10	35.0-123			19.4	20
Nitrobenzene	0.650	ND	ND	ND	60.0	66.3	10	34.0-122			9.29	20
n-Nitrosodimethylamine	0.650	ND	ND	ND	0.000	0.000	10	23.0-120	J6	J6	0.000	20
n-Nitrosodiphenylamine	0.650	ND	ND	ND	63.5	74.1	10	38.0-127			14.8	20
n-Nitrosodi-n-propylamine	0.650	ND	ND	ND	59.5	73.7	10	36.0-120		J3	20.6	20
Phenanthrene	0.650	1.78	0.852	1.31	0.000	0.000	10	50.0-121	J6	J3 J6	42.4	20
Benzylbutyl phthalate	0.650	ND	ND	ND	74.5	92.4	10	46.0-132		J3	20.9	20
Bis(2-ethylhexyl)phthalate	0.650	ND	ND	ND	72.3	88.9	10	51.0-133			19.9	20
Di-n-butyl phthalate	0.650	ND	ND	ND	65.1	80.0	10	51.0-128			20.0	20
Diethyl phthalate	0.650	ND	ND	ND	68.8	76.0	10	50.0-124			9.38	20
Dimethyl phthalate	0.650	ND	ND	ND	0.000	0.000	10	48.0-124	J6	J6	0.000	20
Di-n-octyl phthalate	0.650	ND	ND	ND	69.8	87.8	10	45.0-140		J3	22.1	20
Pyrene	0.650	2.34	1.41	1.88	0.000	0.000	10	47.0-110	J6	J3 J6	28.6	20
1,2,4-Trichlorobenzene	0.650	ND	ND	ND	59.5	71.8	10	34.0-118			18.1	20
4-Chloro-3-methylphenol	0.650	ND	ND	ND	66.3	87.2	10	45.0-122		J3	26.6	20
2-Chlorophenol	0.650	ND	ND	ND	61.8	69.7	10	34.0-121			11.3	20
2,4-Dichlorophenol	0.650	ND	ND	ND	65.5	75.9	10	40.0-122			14.0	20
2,4-Dimethylphenol	0.650	ND	ND	ND	52.5	62.8	10	30.0-127			17.4	20
4,6-Dinitro-2-methylphenol	0.650	ND	ND	ND	0.000	0.000	10	29.0-132	J6	J6	0.000	20
2,4-Dinitrophenol	0.650	ND	ND	ND	140	136	10	10.0-105	J5	J5	4.02	20
2-Nitrophenol	0.650	ND	ND	ND	67.2	80.5	10	36.0-123			17.3	20
4-Nitrophenol	0.650	ND	ND	ND	71.5	84.7	10	30.0-132			16.2	20
Pentachlorophenol	0.650	ND	ND	ND	55.4	68.6	10	25.0-133		J3	20.7	20
Phenol	0.650	ND	ND	ND	60.3	72.0	10	34.0-121			17.0	20
2,4,6-Trichlorophenol	0.650	ND	ND	ND	71.1	84.7	10	39.0-126			16.8	20
(S) 2-Fluorophenol					*64.5*	*74.8*		*35.0-115*				
(S) Phenol-d5					*63.1*	*71.8*		*33.0-122*				
(S) Nitrobenzene-d5					*66.5*	*75.2*		*37.0-122*				
(S) 2-Fluorobiphenyl					*67.1*	*77.1*		*44.0-115*				
(S) 2,4,6-Tribromophenol					*73.8*	*86.1*		*39.0-132*				
(S) p-Terphenyl-d14					*59.4*	*75.9*		*54.0-127*				

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3717973-2 10/18/21 12:47

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
1,4-Dichlorobenzene	U		0.0333	0.100
2,4-Dinitrotoluene	U		0.0333	0.100
Hexachlorobenzene	U		0.0333	0.100
Hexachloro-1,3-butadiene	U		0.0333	0.100
Hexachloroethane	U		0.0333	0.100
Nitrobenzene	U		0.0333	0.100
2-Methylphenol	U		0.0333	0.100
3&4-Methyl Phenol	U		0.0333	0.100
Pentachlorophenol	U		0.0333	0.100
2,4,5-Trichlorophenol	U		0.0333	0.100
2,4,6-Trichlorophenol	U		0.0333	0.100
Pyridine	U		0.0333	0.100
(S) 2-Fluorophenol	*28.4*			*19.0-119*
(S) Phenol-d5	*17.3*			*10.0-67.0*
(S) Nitrobenzene-d5	*57.8*			*44.0-120*
(S) 2-Fluorobiphenyl	*68.6*			*44.0-119*
(S) 2,4,6-Tribromophenol	*57.0*			*43.0-140*
(S) p-Terphenyl-d14	*63.6*			*50.0-134*

Laboratory Control Sample (LCS)

(LCS) R3717973-1 10/18/21 12:25

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
1,4-Dichlorobenzene	0.500	0.342	68.4	29.0-112	
2,4-Dinitrotoluene	0.500	0.473	94.6	57.0-128	
Hexachlorobenzene	0.500	0.369	73.8	53.0-125	
Hexachloro-1,3-butadiene	0.500	0.355	71.0	22.0-124	
Hexachloroethane	0.500	0.343	68.6	21.0-115	
Nitrobenzene	0.500	0.323	64.6	45.0-121	
2-Methylphenol	0.500	0.233	46.6	30.0-117	
3&4-Methyl Phenol	0.500	0.245	49.0	29.0-110	
Pentachlorophenol	0.500	0.390	78.0	35.0-138	
2,4,5-Trichlorophenol	0.500	0.409	81.8	50.0-125	
2,4,6-Trichlorophenol	0.500	0.337	67.4	53.0-123	
Pyridine	0.500	0.0281	5.62	13.5-58.9	J4
(S) 2-Fluorophenol			*30.5*	*19.0-119*	
(S) Phenol-d5			*19.4*	*10.0-67.0*	
(S) Nitrobenzene-d5			*56.9*	*44.0-120*	

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Laboratory Control Sample (LCS)

(LCS) R3717973-1 10/18/21 12:25

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
(S) 2-Fluorobiphenyl			*76.4*	*44.0-119*	
(S) 2,4,6-Tribromophenol			*71.0*	*43.0-140*	
(S) p-Terphenyl-d14			*64.9*	*50.0-134*	

L1409499-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1409499-02 10/18/21 14:53 • (MS) R3717973-3 10/18/21 15:14 • (MSD) R3717973-4 10/18/21 15:36

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
1,4-Dichlorobenzene	0.500	ND	0.334	0.322	66.8	64.4	1	29.0-112			3.66	20
2,4-Dinitrotoluene	0.500	ND	0.445	0.441	89.0	88.2	1	57.0-128			0.903	20
Hexachlorobenzene	0.500	ND	0.355	0.354	71.0	70.8	1	53.0-125			0.282	20
Hexachloro-1,3-butadiene	0.500	ND	0.342	0.334	68.4	66.8	1	22.0-124			2.37	20
Hexachloroethane	0.500	ND	0.327	0.321	65.4	64.2	1	21.0-115			1.85	20
Nitrobenzene	0.500	ND	0.309	0.307	61.8	61.4	1	45.0-121			0.649	20
2-Methylphenol	0.500	ND	0.232	0.235	46.4	47.0	1	30.0-117			1.28	20
3&4-Methyl Phenol	0.500	ND	0.234	0.242	46.8	48.4	1	29.0-110			3.36	20
Pentachlorophenol	0.500	ND	0.373	0.376	74.6	75.2	1	35.0-138			0.801	20
2,4,5-Trichlorophenol	0.500	ND	0.378	0.395	75.6	79.0	1	50.0-125			4.40	20
2,4,6-Trichlorophenol	0.500	ND	0.308	0.328	61.6	65.6	1	53.0-123			6.29	20
Pyridine	0.500	ND	ND	ND	0.000	9.26	1	13.5-58.9	J6	J3 J6	200	20
(S) 2-Fluorophenol					*31.4*	*31.5*		*19.0-119*				
(S) Phenol-d5					*19.7*	*19.7*		*10.0-67.0*				
(S) Nitrobenzene-d5					*55.0*	*55.8*		*44.0-120*				
(S) 2-Fluorobiphenyl					*72.4*	*73.1*		*44.0-119*				
(S) 2,4,6-Tribromophenol					*70.5*	*69.5*		*43.0-140*				
(S) p-Terphenyl-d14					*61.1*	*59.1*		*50.0-134*				

Sample Narrative:

OS: Duplicate Analysis performed due to QC failure. Reporting most compliant data.

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
J7	Surrogate recovery cannot be used for control limit evaluation due to dilution.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
U	Below Detectable Limits: Indicates that the analyte was not detected.
V	The sample concentration is too high to evaluate accurate spike recoveries.

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Company Name/Address:
Geo Consultants - Kevil, KY

325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

Email To: lindseyd@geoconsultantscorp.com

Report to: **David Lindsey**

Project Description: Staten Isl Warehouse, Port Richmond

City/State Collected: Staten Island New York

Please Circle: PT MT CT ET

SDG # L1409907
B186

Phone: 270-462-3882

Client Project #: FUSRAP

Lab Project #

Collected by (print): David Lindsey

Site/Facility ID #: Staten Island

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ___ Y ___

Acctnum: GEOCONKKY
Template: T195295
Prelogin: P873895
PM: 732 - Donna Eidson
PB:
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres									Remarks	Sample # (lab only)
SS-15-1135	✓	SCM	1.5-2	9-23-21	1135	1	X										-01
SB-15-0406	✓	SCM	4-6	9-23-21	1145	1	X										-02
SB-15-0608	✓	SCM	6-8	9-23-21	1150	1	X										-03
SS-10-0750	✓	SCM	0.-0.5	9-23-21	0750	1	X										-04
SB-10-0517	✓	SCM	0.5-1.7	9-23-21	0820	1	X										-05
SB-10-0465	✓	SCM	4-6.5	9-23-21	0825	1	X										-06
SS-09-0840	✓	SCM	0-0.5	9-23-21	0840	1	X										-07
SB-09-0117	✓	SCM	1-1.7	9-23-21	0913	1	X										-08
SB-09-0506	✓	SCM	5-6	9-23-21	0920	1	X										-09
	✓	SCM				1	X										

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks: no ice required

pH ______ Temp ______
Flow ______ Other ______

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking # 5318 9945 1517

Relinquished by : (Signature) David Lindsey | Date: 9-27-21 | Time: 1314 | Received by: (Signature)

Trip Blank Received: Yes / No
0 HCL / MeoH
TBR

Relinquished by : (Signature) | Date: | Time: | Received by: (Signature)

Temp: AOR °C 19.1 HC=19.1 | Bottles Received: 9

If preservation required by Login: Date/Time

Relinquished by : (Signature) | Date: | Time: | Received for lab by: (Signature)

Date: 9/28/21 Time: 9:45

Hold:

Condition: NCF / OK

<500 cpm

Cp
Tc
Ss
Cn
Sr
Qc
Gl
Al
Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.628		0.229	0.228	10/11/2021 17:29	WG1753087
URANIUM-235	0.0345	~~J~~	0.0574	0.0865	10/11/2021 17:29	WG1753087
URANIUM-238	0.838		0.221	0.145	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*49.0*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.526	X	0.229	0.467	10/26/2021 19:19	WG1756346
Bismuth-212	0.968	~~J~~ X	0.837	1.58	10/26/2021 19:19	WG1756346
Bismuth-214 (Ra-226)	0.978	X	0.193	0.222	10/26/2021 19:19	WG1756346
Lead-212	0.835	X	0.163	0.196	10/26/2021 19:19	WG1756346
Lead-214	0.697	X	0.165	0.266	10/26/2021 19:19	WG1756346
Potassium-40	13.1	X	2.03	1.1	10/26/2021 19:19	WG1756346
Thallium-208	0.379	X	0.101	0.132	10/26/2021 19:19	WG1756346
Uranium-235	0.126	(U) X	0.0714	0.692	10/26/2021 19:19	WG1756346
Thorium-234 (U-238)	1.70	~~J~~ X	1.34	2.55	10/26/2021 19:19	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.30		0.323	0.172	10/11/2021 17:29	WG1753087
URANIUM-235	0.0477	J	0.0615	0.0847	10/11/2021 17:29	WG1753087
URANIUM-238	2.40		0.314	0.0967	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*73.8*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.12	X	0.415	0.453	10/26/2021 19:36	WG1756346
Bismuth-212	1.96	~~J~~ X	1.26	2.24	10/26/2021 19:36	WG1756346
Bismuth-214 (Ra-226)	2.35	X	0.334	0.316	10/26/2021 19:36	WG1756346
Lead-212	2.06	X	0.285	0.308	10/26/2021 19:36	WG1756346
Lead-214	2.44	X	0.307	0.294	10/26/2021 19:36	WG1756346
Potassium-40	9.56	X	2.00	1.67	10/26/2021 19:36	WG1756346
Thallium-208	0.893	X	0.160	0.168	10/26/2021 19:36	WG1756346
Uranium-235	0.344	~~U~~ X(J)	0.0916	0.622	10/26/2021 19:36	WG1756346
Thorium-234 (U-238)	2.31	X	1.14	1.76	10/26/2021 19:36	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.834		0.186	0.161	10/11/2021 17:29	WG1753087
URANIUM-235	0.0168	(U) J	0.0614	0.0949	10/11/2021 17:29	WG1753087
URANIUM-238	0.807		0.154	0.0721	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*82.3*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.36	X	0.232	0.277	10/26/2021 19:38	WG1756346
Bismuth-212	1.10	~~J~~ X	0.737	1.36	10/26/2021 19:38	WG1756346
Bismuth-214 (Ra-226)	0.942	X	0.150	0.189	10/26/2021 19:38	WG1756346
Lead-212	1.13	X	0.164	0.199	10/26/2021 19:38	WG1756346
Lead-214	1.20	X	0.186	0.198	10/26/2021 19:38	WG1756346
Potassium-40	14.2	X	1.68	1.03	10/26/2021 19:38	WG1756346
Thallium-208	0.337	X	0.0741	0.094	10/26/2021 19:38	WG1756346
Uranium-235	0.176	(U)X,J	0.0720	0.612	10/26/2021 19:38	WG1756346
Thorium-234 (U-238)	1.43	~~J~~ X	1.17	2.25	10/26/2021 19:38	WG1756346

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.17		0.335	0.204	10/11/2021 17:29	WG1753087
URANIUM-235	0.212		0.107	0.0924	10/11/2021 17:29	WG1753087
URANIUM-238	2.35		0.335	0.158	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*62.6*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.75	X	0.421	0.632	10/26/2021 16:09	WG1756374
Bismuth-212	0.869	~~U~~ X	1.38	2.82	10/26/2021 16:09	WG1756374
Bismuth-214 (Ra-226)	2.58	X	0.387	0.377	10/26/2021 16:09	WG1756374
Lead-212	2.05	X	0.325	0.323	10/26/2021 16:09	WG1756374
Lead-214	2.49	X	0.386	0.401	10/26/2021 16:09	WG1756374
Potassium-40	10.7	X	2.23	2.14	10/26/2021 16:09	WG1756374
Thallium-208	0.553	X	0.145	0.192	10/26/2021 16:09	WG1756374
Uranium-235	0.330	(U) X	0.122	1.09	10/26/2021 16:09	WG1756374
Thorium-234 (U-238)	1.51	(U) X	1.98	4.26	10/26/2021 16:09	WG1756374

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.55		0.316	0.122	10/11/2021 17:29	WG1753087
URANIUM-235	0.0727	~~J~~	0.0760	0.0989	10/11/2021 17:29	WG1753087
URANIUM-238	2.73		0.320	0.064	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*81.3*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.31	X	0.484	0.711	10/26/2021 17:15	WG1756374
Bismuth-212	3.43	X	1.49	2.55	10/26/2021 17:15	WG1756374
Bismuth-214 (Ra-226)	2.64	X	0.383	0.366	10/26/2021 17:15	WG1756374
Lead-212	3.04	X	0.413	0.3	10/26/2021 17:15	WG1756374
Lead-214	2.35	X	0.367	0.415	10/26/2021 17:15	WG1756374
Potassium-40	9.04	X	1.95	1.75	10/26/2021 17:15	WG1756374
Thallium-208	0.833	X	0.177	0.221	10/26/2021 17:15	WG1756374
Uranium-235	0.222	(U) X	0.123	1.13	10/26/2021 17:15	WG1756374
Thorium-234 (U-238)	1.13	(U) X	2.06	4.55	10/26/2021 17:15	WG1756374

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.909		0.200	0.114	10/11/2021 17:29	WG1753087
URANIUM-235	0.0986		0.0701	0.0682	10/11/2021 17:29	WG1753087
URANIUM-238	1.16		0.220	0.0954	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*83.6*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.935	X	0.285	0.483	10/26/2021 17:30	WG1756374
Bismuth-212	0.281	~~U~~ X	0.933	1.9	10/26/2021 17:30	WG1756374
Bismuth-214 (Ra-226)	1.09	X	0.220	0.262	10/26/2021 17:30	WG1756374
Lead-212	1.07	X	0.182	0.217	10/26/2021 17:30	WG1756374
Lead-214	1.16	X	0.191	0.251	10/26/2021 17:30	WG1756374
Potassium-40	16.2	X	2.50	1.29	10/26/2021 17:30	WG1756374
Thallium-208	0.409	X	0.109	0.136	10/26/2021 17:30	WG1756374
Uranium-235	0.0877	(U) X	0.0657	0.507	10/26/2021 17:30	WG1756374
Thorium-234 (U-238)	0.740	~~J~~ X	0.672	1.41	10/26/2021 17:30	WG1756374

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.72		0.283	0.139	10/11/2021 17:29	WG1753087
URANIUM-235	0.0733	~~J~~	0.0723	0.0901	10/11/2021 17:29	WG1753087
URANIUM-238	1.99		0.298	0.114	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*74.7*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.15	X	0.336	0.594	10/26/2021 17:32	WG1756374
Bismuth-212	0.917	~~U~~ X	1.10	2.17	10/26/2021 17:32	WG1756374
Bismuth-214 (Ra-226)	1.61	X	0.270	0.313	10/26/2021 17:32	WG1756374
Lead-212	1.42	X	0.265	0.352	10/26/2021 17:32	WG1756374
Lead-214	1.94	X	0.323	0.324	10/26/2021 17:32	WG1756374
Potassium-40	11.9	X	2.23	2.08	10/26/2021 17:32	WG1756374
Thallium-208	0.389	X	0.109	0.139	10/26/2021 17:32	WG1756374
Uranium-235	0.221	(U) X	0.116	0.95	10/26/2021 17:32	WG1756374
Thorium-234 (U-238)	1.34	(U) X	1.68	3.48	10/26/2021 17:32	WG1756374

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.59		0.288	0.175	10/11/2021 17:29	WG1753087
URANIUM-235	0.0304	(U) J	0.0761	0.12	10/11/2021 17:29	WG1753087
URANIUM-238	1.48		0.272	0.147	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*74.5*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.52	X	0.406	0.649	10/26/2021 18:17	WG1756374
Bismuth-212	2.81	X	1.45	2.46	10/26/2021 18:17	WG1756374
Bismuth-214 (Ra-226)	1.35	X	0.293	0.408	10/26/2021 18:17	WG1756374
Lead-212	1.75	X	0.290	0.287	10/26/2021 18:17	WG1756374
Lead-214	1.50	X	0.287	0.384	10/26/2021 18:17	WG1756374
Potassium-40	11.1	X	2.20	1.44	10/26/2021 18:17	WG1756374
Thallium-208	0.454	X	0.144	0.208	10/26/2021 18:17	WG1756374
Uranium-235	0.238	(U) X, J	0.112	1.05	10/26/2021 18:17	WG1756374
Thorium-234 (U-238)	1.13	(U) X	1.81	4.02	10/26/2021 18:17	WG1756374

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.94		0.279	0.146	10/11/2021 17:29	WG1753087
URANIUM-235	0.0611	~~J~~	0.0714	0.096	10/11/2021 17:29	WG1753087
URANIUM-238	1.92		0.267	0.0869	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*83.0*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.48	X	0.350	0.445	10/26/2021 18:33	WG1756374
Bismuth-212	2.04	~~J~~ X	1.28	2.25	10/26/2021 18:33	WG1756374
Bismuth-214 (Ra-226)	1.79	X	0.285	0.255	10/26/2021 18:33	WG1756374
Lead-212	1.51	X	0.239	0.274	10/26/2021 18:33	WG1756374
Lead-214	1.87	X	0.269	0.312	10/26/2021 18:33	WG1756374
Potassium-40	8.93	X	2.06	1.92	10/26/2021 18:33	WG1756374
Thallium-208	0.597	X	0.138	0.161	10/26/2021 18:33	WG1756374
Uranium-235	0.150	(U)X	0.0775	0.615	10/26/2021 18:33	WG1756374
Thorium-234 (U-238)	2.14	X	1.03	1.69	10/26/2021 18:33	WG1756374

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1409907
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.
"J" - Indicates an unusually uncertain or estimated result.
"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-15-1135	Soil	L1409907-01
SB-15-0406	Soil	L1409907-02
SB-15-0608	Soil	L1409907-03
SS-10-0750	Soil	L1409907-04
SB-10-0517	Soil	L1409907-05
SB-10-0465	Soil	L1409907-06
SS-09-0840	Soil	L1409907-07
SB-09-0117	Soil	L1409907-08
SB-09-0506	Soil	L1409907-09

Validation Report By: **Amanda Leigh Dick** **03/05/2022**
(print) **Date**

Amanda Leigh Dick
(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/11/2022**
(print) **Date**

TLRucker
(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SB-15-0406, SB-10-0465, SB-09-0506	X
2	C6	3	-9.4 – 7.9			SB-15-0608	X
3	C6	1	18.8	8	8.4 – 10.6	SS-15-1135, SS-10-0750, SB-10-0517, SB-09-0117	X
2	P3	1	5.3			SS-09-0840	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detectors/geometries have one or more quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	12.2	SB-15-0406, SB-10-0465, SB-09-0506	X
3	C6	1	14.3	SS-15-1135, SS-10-0750, SB-10-0517, SB-09-0117	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following sample results did not meet the project RDL goal.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-10-0750	Th-234	0.992	3.472	1
SB-10-0517	Th-234	1.0275	3.59625	1
SS-09-0840	Th-234	0.838	2.933	1
SB-09-0117	Th-234	0.904	3.164	1

The Ra-226 result was greater than the project action limit in the following samples: SB-15-0406: 2.35 pCi/g, SB-10-0750: 2.58 pCi/g, and SB-10-0517: 2.64 pCi/g.

No sample results exhibited excess uncertainty.

There were no samples that had negative results with uncertainties smaller than their absolute value.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U). The following sample results were qualified as U: SS-15-1135: U-235; SB-15-0608: U-235; SS-10-0750: U-235 and Th-234; SB-10-0517: U-235 and Th-234; SB-10-0465: U-235; SS-09-0840: U-235 and Th-234; SB-09-0117: U-235 and Th-234; SB-09-0506: U-235.

Method Blank

There was no indication of blank contamination for the gamma spectrometry analysis.

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S-D|}{\frac{S+D}{2}} \right) * 100$$

$$NAD = \frac{|S-D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, <3).

There were no field duplicates associated with this SDG.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the alpha spectrometry analyses.

Initial Calibration

The initial calibration met project acceptance criteria.

Continuing Calibration

The continuing calibration met project acceptance criteria.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The RDL was met for all radionuclides of interest.

The following sample had a result greater than the project action limits: SB-10-0750: U-235 0.212 pCi/g.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty**. It is recommended that sample concentrations less than the L_c are qualified as non-detect (U). The following sample results were qualified U:**

Sample-specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SB-15-0608	U-235	0.0168	0.021	0.03465	U
SB-09-0117	U-235	0.0304	0.024	0.0396	U

Matrix Spike

A non-SDG sample was used as a matrix spike. The percent recoveries were within acceptable limits.

Method Blank

There was no indication of blank contamination for the alpha spectrometry analysis.

Laboratory Control Sample:

The percent recoveries were within acceptable limits. Please see table below.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the alpha spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<20%, <3).

There were no field duplicates associated with this SDG.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

No spectral interferences were observed in all of the alpha spectrometry analyses.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not agreement. **It is recommended that the following sample results for U-235 (both alpha and gamma) be qualified as estimated (J) due to incomparable results:**

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SB-15-0406	U-235	0.0477	0.021	0.344	0.0458	151.29%	5.881	J
SB-15-0608	U-235	0.0168	0.021	0.176	0.036	165.15%	3.820	J
SB-09-0117	U-235	0.0304	0.024	0.238	0.056	154.69%	3.407	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1409907

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for surrogate recovery results (e.g., org. form II)		Y
Check for LCS results (e.g., org. form III, inorg. form XII)		Y
Check for method blank results (e.g., org. form IV, inorg. form III)		Y
Check for MS/MSD results (e.g., inorg. form V)		Y
Check for laboratory duplicate results (e.g., inorg. form VI)		Y
Check for Method Calibration and Run Documentation		
organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	N/A
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	N/A
other:	initial calibration data	
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

~~The calibration documentation are missing for both alpha and gamma analyses.~~
Calibration standard COAs were missing as well.

~~A revision was issued by the laboratory containing some of the missing items.~~

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: Amanda Leigh Dick & CMJ Date: 03/05/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

Page 1 of 1

SDG No: L1409907

Analyte Group: Gamma Spectroscopy and Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-15-1135	L1409907-01	soil	Gamma Spec. and Isotopic Uranium	
SB-15-0406	L1409907-02	soil	Gamma Spec. and Isotopic Uranium	
SB-15-0608	L1409907-03	soil	Gamma Spec. and Isotopic Uranium	
SB-10-0750	L1409907-04	soil	Gamma Spec. and Isotopic Uranium	
SB-10-0517	L1409907-05	soil	Gamma Spec. and Isotopic Uranium	
SB-10-0465	L1409907-06	soil	Gamma Spec. and Isotopic Uranium	
SS-09-0840	L1409907-07	soil	Gamma Spec. and Isotopic Uranium	
SB-09-0117	L1409907-08	soil	Gamma Spec. and Isotopic Uranium	
SB-09-0506	L1409907-09	soil	Gamma Spec. and Isotopic Uranium	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1409907

Analysis: **Radiological**

Method: Gamma Spectrometry and ISO U

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Samples qualified as indicated due to reporting levels and incomparable results.

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick & CMJ Date: 03/05/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: The RDL was not met for Thorium-234 in samples: SB-10-0751, SB-10-0517, SS-09-0840, and SB-09-0117.

The Ra-226 result was greater than the project action limit in the following samples: SB-15-0406: 2.35 pCi/g, SB-10-0750: 2.58 pCi/g, and SB-10-0517: 2.64 pCi/g.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No Issues.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action
No Issues				

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
U-238	0.5 pCi/g	0.145 pCi/g	No Issues
U-235	0.5 pCi/g	0.0865 pCi/g	
U-234	0.5 pCi/g	0.228pCi/g	No Issues
Ra-226	0.5 pCi/g	0.222 pCi/g	No Issues
Th-234	<1 pCi/g		All samples exceeded MDA
Ac-228	<1 pCi/g	0.467 pCi/g	No Issues
K-40	<1 pCi/g	1.1 pCi/g	All samples exceeded MDA

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks:

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: The initial and continuing calibrations met project acceptance criteria.
A monthly background was performed with no high values.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.3%	898.04 keV	1	< 5%		
5.3%	159.00 keV	2	< 5%		
-9.04%	661.66 keV	2	< 5%		
7.9%	898.04 keV	2	< 5%		
18.8%	136.47 keV	3	< 5%		
-6.5%	136.47 keV	4	< 5%		
-16.4	136.47 keV	5	< 5%		
6.5%	159.00 keV	5	< 5%		
5.3%	513.99 keV	2	< 5%		

Actions: see CENWK 4.3.1.1 and QAPP
1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: A long monthly background and an efficiency curve was performed. Any samples that were counted on detectors with delta values greater than 5% and/or 95% CL (1.96 σ) greater than 8%: were qualified as "X".
No documentation of an energy calibration was given. Additionally, there was no indication that a Peak-to-Comption Ration Calibration was performed.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Not applicable.

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Not applicable.

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks:

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
	No Issues	on Both blanks		

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks:

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations:

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks: No Issues.

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken
No Issues			

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks:

The Isotopic Uranium Analysis has tracer recovery for all samples between 49% to 88.2
All of these recoveries are within acceptable recovery limits.

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

	Alpha	
	aqueous	solid
	80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: WG1753087

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks:

Isotopic Uranium-238 LCS recovery is 96.5%. No qualification of the Istopic Uranium analysis.

Isotopic Uranium-234 LCS recovery is 98.1%. No qualification of the Istopic Uranium analysis.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: MSL1410500-01 WG1753087

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks:

U-238 recovery for MS is 111.7% and MSD is 107.3%

U-234 recovery for MS is 104.1% and MSD is 106.0%

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: ______________________

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks:

U-238 recovery for MS is 111.7% and MSD is 107.3%. The RPD forU-238 is 3.6%.

U-234 recovery for MS is 104.1% and MSD is 106.0% The RPD for U-234 is 1.1%

All RPD/NAD results were within project requirements. Please see calculation sheets.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues. Gamma Spectrometer system identified and calculated the the amount of the of the identified radionuclides as expected.

Radiochemical Data Review Checklist

~~**XIII. Tentatively Identified Radionuclides (gamma spectroscopy)**~~

Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~

~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~

~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and gamma results not comparable	SB-15-0406. DVQ: "J"
U-235	Alpha and gamma results not comparable	SB-15-0608. DVQ: "J"
U-235	Alpha and gamma results not comparable	SB-09-0506. DVQ: "J"

Actions:

~~1. Qualify all tentatively identified radionuclides as estimated (J).~~

~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~

~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

See calculation sheet

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks:

No issues.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:
Formula has a "CF" code which means Correction Factor.
The Correction Factor is not in the data package.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:
Formula has a "CF" code which means Correction Factor.
The Correction Factor is not in the data package.

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: SDG sample results were qualified per QAPP and CENWK guidance.

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

Report to: **David Lindsey**

Email To: **lindseyd@geoconsultantscorp.com**

Project Description:

City/State Collected: Staten Island

Please Circle: PT MT CT ET

Phone: **270-462-3882**

Client Project #

Lab Project #

SDG # 1410266

H159

Collected by (print): David Lindsey

Site/Facility ID # Staten Island

P.O. #

Acctnum: **GEOCONKKY**

Template: **T195321**

Prelogin: **P873890**

PM: 732 - Donna Eidson

PB: BF 9/17/21

Shipped Via: **FedEX Ground**

Collected by (signature):

Immediately Packed on Ice N ___ Y ✓

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	DODSV8270 4ozClr-NoPres	DODV8260 40mlAmb/MeOH10ml/Syr	Metals 2ozClr-NoPres	TCLP 1L-Clr-NoPres						Remarks	Sample # (lab only)
SB-16-0000	Grab	SS	Surface	9-27-21	1004	4	X	X	X	X							-01/02
		SS				4	X	X	X	X							

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking # 5318 9945 1506

Sample Receipt Checklist
COC Seal Present/Intact: __NP __Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: ✓Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
	9-27-21	1232		None	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3.8+0=3.8 °C	Bottles Received: 1
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/28/21	Time: 930

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

ANALYTICAL REPORT

October 18, 2021

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Geo Consultants - Kevil, KY

Sample Delivery Group:	L1410266
Samples Received:	09/28/2021
Project Number:	
Description:	
Site:	STATEN ISLAND
Report To:	David Lindsey 325 Kentucky Ave Kevil, KY 42053

Entire Report Reviewed By:

Donna Eidson
Project Manager

Pace Analytical National
12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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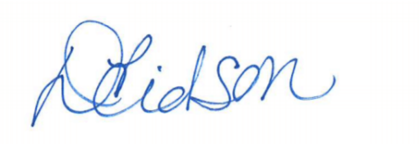
			Collected by	Collected date/time	Received date/time	
SB-16-0000 L1410266-01 Waste			David L.	09/27/21 10:04	09/28/21 09:30	

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Preparation by Method 1311	WG1753667	1	10/08/21 11:48	10/08/21 11:48	CJW	Mt. Juliet, TN
Preparation by Method 1311	WG1754149	1	10/10/21 07:38	10/10/21 07:38	APH	Mt. Juliet, TN
Mercury by Method 7470A	WG1754656	1	10/11/21 11:39	10/11/21 13:36	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1754821	1	10/11/21 16:15	10/12/21 10:42	CCE	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1754410	1	10/11/21 14:00	10/11/21 14:00	BMB	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C	WG1755406	1	10/15/21 06:22	10/16/21 00:41	JNJ	Mt. Juliet, TN

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Donna Eidson
Project Manager

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Sample Delivery Group (SDG) Narrative

Analysis was performed from an improper container for the following samples.

Lab Sample ID	Project Sample ID	Method
L1410266-01	SB-16-0000	1311

Cp Tc Ss Cn Sr Qc Gl Al Sc

Preparation by Method 1311

Analyte	Result	Qualifier	Prep date / time	Batch
TCLP Extraction	-		10/10/2021 7:38:17 AM	WG1754149
TCLP ZHE Extraction	-		10/8/2021 11:48:46 AM	WG1753667
Fluid	1		10/10/2021 7:38:17 AM	WG1754149
Initial pH	6.65		10/10/2021 7:38:17 AM	WG1754149
Final pH	4.87		10/10/2021 7:38:17 AM	WG1754149

Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Mercury	ND		0.0100	0.20	1	10/11/2021 13:36	WG1754656

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Arsenic	ND		0.100		1	10/12/2021 10:42	WG1754821
Barium	1.15		0.100		1	10/12/2021 10:42	WG1754821
Cadmium	ND		0.100		1	10/12/2021 10:42	WG1754821
Chromium	ND		0.100		1	10/12/2021 10:42	WG1754821
Lead	2.12	O1	0.100		1	10/12/2021 10:42	WG1754821
Selenium	ND		0.100		1	10/12/2021 10:42	WG1754821
Silver	ND		0.100		1	10/12/2021 10:42	WG1754821

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
Benzene	ND		0.0500	0.50	1	10/11/2021 14:00	WG1754410
Carbon tetrachloride	ND		0.0500	0.50	1	10/11/2021 14:00	WG1754410
Chlorobenzene	ND		0.0500	100	1	10/11/2021 14:00	WG1754410
Chloroform	ND		0.250	6	1	10/11/2021 14:00	WG1754410
1,2-Dichloroethane	ND		0.0500	0.50	1	10/11/2021 14:00	WG1754410
1,1-Dichloroethene	ND		0.0500	0.70	1	10/11/2021 14:00	WG1754410
2-Butanone (MEK)	ND		0.500	200	1	10/11/2021 14:00	WG1754410
Tetrachloroethene	ND		0.0500	0.70	1	10/11/2021 14:00	WG1754410
Trichloroethene	ND		0.0500	0.50	1	10/11/2021 14:00	WG1754410
Vinyl chloride	ND		0.0500	0.20	1	10/11/2021 14:00	WG1754410
(S) Toluene-d8	*105*		*89.0-112*			*10/11/2021 14:00*	WG1754410
(S) 4-Bromofluorobenzene	*92.5*		*85.0-114*			*10/11/2021 14:00*	WG1754410
(S) 1,2-Dichloroethane-d4	*120*	J1	*81.0-118*			*10/11/2021 14:00*	WG1754410

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
1,4-Dichlorobenzene	ND		0.100	7.50	1	10/16/2021 00:41	WG1755406
2,4-Dinitrotoluene	ND		0.100	0.13	1	10/16/2021 00:41	WG1755406
Hexachlorobenzene	ND		0.100	0.13	1	10/16/2021 00:41	WG1755406
Hexachloro-1,3-butadiene	ND		0.100	0.50	1	10/16/2021 00:41	WG1755406
Hexachloroethane	ND		0.100	3	1	10/16/2021 00:41	WG1755406
Nitrobenzene	ND		0.100	2	1	10/16/2021 00:41	WG1755406
Pyridine	ND	J3	0.100	5	1	10/16/2021 00:41	WG1755406
3&4-Methyl Phenol	ND		0.100	400	1	10/16/2021 00:41	WG1755406
2-Methylphenol	ND		0.100	200	1	10/16/2021 00:41	WG1755406
Pentachlorophenol	ND		0.100	100	1	10/16/2021 00:41	WG1755406
2,4,5-Trichlorophenol	ND		0.100	400	1	10/16/2021 00:41	WG1755406
2,4,6-Trichlorophenol	ND		0.100	2	1	10/16/2021 00:41	WG1755406

Semi Volatile Organic Compounds (GC/MS) by Method 8270C

Analyte	Result mg/l	Qualifier	RDL mg/l	Limit mg/l	Dilution	Analysis date / time	Batch
(S) 2-Fluorophenol	*22.4*		*19.0-119*			*10/16/2021 00:41*	WG1755406
(S) Phenol-d5	*14.0*		*10.0-67.0*			*10/16/2021 00:41*	WG1755406
(S) Nitrobenzene-d5	*40.7*	J2	*44.0-120*			*10/16/2021 00:41*	WG1755406
(S) 2-Fluorobiphenyl	*50.0*		*44.0-119*			*10/16/2021 00:41*	WG1755406
(S) 2,4,6-Tribromophenol	*50.5*		*43.0-140*			*10/16/2021 00:41*	WG1755406
(S) p-Terphenyl-d14	*55.0*		*50.0-134*			*10/16/2021 00:41*	WG1755406

QUALITY CONTROL SUMMARY

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3714844-1 10/11/21 13:32

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Mercury	U	U	0.00330	0.0100

Laboratory Control Sample (LCS)

(LCS) R3714844-2 10/11/21 13:34

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Mercury	0.0300	0.0328	109	82.0-119	

L1410266-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1410266-01 10/11/21 13:36 • (MS) R3714844-3 10/11/21 13:39 • (MSD) R3714844-4 10/11/21 13:41

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.0300	ND	0.0334	0.0336	111	112	1	82.0-119			0.597	20

Method Blank (MB)

(MB) R3715327-1 10/12/21 10:37

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Arsenic	U	U	0.0330	0.100
Barium	U	U	0.0330	0.100
Cadmium	U	U	0.0330	0.100
Chromium	U	U	0.0330	0.100
Lead	U	U	0.0330	0.100
Selenium	U	U	0.0330	0.100
Silver	U	U	0.0330	0.100

Laboratory Control Sample (LCS)

(LCS) R3715327-2 10/12/21 10:39

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Arsenic	10.0	9.79	97.9	87.0-113	
Barium	10.0	9.95	99.5	88.0-113	
Cadmium	10.0	9.70	97.0	88.0-113	
Chromium	10.0	9.63	96.3	90.0-113	
Lead	10.0	9.65	96.5	86.0-113	
Selenium	10.0	10.1	101	83.0-114	
Silver	2.00	1.77	88.7	84.0-115	

L1410266-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1410266-01 10/12/21 10:42 • (MS) R3715327-4 10/12/21 10:48 • (MSD) R3715327-5 10/12/21 10:50

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	10.0	ND	9.89	9.87	98.9	98.7	1	87.0-113			0.204	20
Barium	10.0	1.15	11.2	11.1	101	99.3	1	88.0-113			1.19	20
Cadmium	10.0	ND	9.86	9.80	98.6	98.0	1	88.0-113			0.606	20
Chromium	10.0	ND	9.67	9.67	96.2	96.3	1	90.0-113			0.0163	20
Lead	10.0	2.12	11.8	11.6	97.0	95.1	1	86.0-113			1.63	20
Selenium	10.0	ND	10.3	10.2	103	102	1	83.0-114			0.825	20
Silver	2.00	ND	1.81	1.80	90.4	90.1	1	84.0-115			0.278	20

1 Cp 2 Tc 3 Ss 4 Cn 5 Sr 6 Qc 7 Gl 8 Al 9 Sc

Method Blank (MB)

(MB) R3716112-3 10/11/21 12:32

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Benzene	U		0.0167	0.0500
Carbon tetrachloride	U		0.0167	0.0500
Chlorobenzene	U		0.0167	0.0500
Chloroform	U		0.0833	0.250
1,2-Dichloroethane	U		0.0167	0.0500
1,1-Dichloroethene	U		0.0167	0.0500
2-Butanone (MEK)	U		0.167	0.500
Tetrachloroethene	U		0.0167	0.0500
Trichloroethene	U		0.0167	0.0500
Vinyl chloride	U		0.0167	0.0500
(S) Toluene-d8	*106*			*89.0-112*
(S) 4-Bromofluorobenzene	*92.6*			*85.0-114*
(S) 1,2-Dichloroethane-d4	*119*	J1		*81.0-118*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3716112-1 10/11/21 10:19 • (LCSD) R3716112-2 10/11/21 10:41

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Benzene	0.250	0.261	0.254	104	102	79.0-120			2.72	20
Carbon tetrachloride	0.250	0.269	0.244	108	97.6	72.0-136			9.75	20
Chlorobenzene	0.250	0.240	0.237	96.0	94.8	82.0-118			1.26	20
Chloroform	0.250	0.272	0.267	109	107	79.0-124			1.86	20
1,2-Dichloroethane	0.250	0.281	0.276	112	110	73.0-128			1.80	20
1,1-Dichloroethene	0.250	0.266	0.236	106	94.4	71.0-131			12.0	20
2-Butanone (MEK)	1.25	1.55	1.51	124	121	56.0-143			2.61	20
Tetrachloroethene	0.250	0.234	0.228	93.6	91.2	74.0-129			2.60	20
Trichloroethene	0.250	0.236	0.225	94.4	90.0	79.0-123			4.77	20
Vinyl chloride	0.250	0.272	0.251	109	100	58.0-137			8.03	20
(S) Toluene-d8				*103*	*103*	*89.0-112*				
(S) 4-Bromofluorobenzene				*96.5*	*96.4*	*85.0-114*				
(S) 1,2-Dichloroethane-d4				*115*	*114*	*81.0-118*				

Method Blank (MB)

(MB) R3717280-2 10/15/21 23:16

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
1,4-Dichlorobenzene	U		0.0333	0.100
2,4-Dinitrotoluene	U		0.0333	0.100
Hexachlorobenzene	U		0.0333	0.100
Hexachloro-1,3-butadiene	U		0.0333	0.100
Hexachloroethane	U		0.0333	0.100
Nitrobenzene	U		0.0333	0.100
2-Methylphenol	U		0.0333	0.100
3&4-Methyl Phenol	U		0.0333	0.100
Pentachlorophenol	U		0.0333	0.100
2,4,5-Trichlorophenol	U		0.0333	0.100
2,4,6-Trichlorophenol	U		0.0333	0.100
Pyridine	U		0.0333	0.100
(S) 2-Fluorophenol	*27.8*			*19.0-119*
(S) Phenol-d5	*16.7*			*10.0-67.0*
(S) Nitrobenzene-d5	*52.3*			*44.0-120*
(S) 2-Fluorobiphenyl	*63.1*			*44.0-119*
(S) 2,4,6-Tribromophenol	*56.5*			*43.0-140*
(S) p-Terphenyl-d14	*68.2*			*50.0-134*

Laboratory Control Sample (LCS)

(LCS) R3717280-1 10/15/21 22:54

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
1,4-Dichlorobenzene	0.500	0.309	61.8	29.0-112	
2,4-Dinitrotoluene	0.500	0.499	99.8	57.0-128	
Hexachlorobenzene	0.500	0.362	72.4	53.0-125	
Hexachloro-1,3-butadiene	0.500	0.294	58.8	22.0-124	
Hexachloroethane	0.500	0.304	60.8	21.0-115	
Nitrobenzene	0.500	0.285	57.0	45.0-121	
2-Methylphenol	0.500	0.246	49.2	30.0-117	
3&4-Methyl Phenol	0.500	0.252	50.4	29.0-110	
Pentachlorophenol	0.500	0.434	86.8	35.0-138	
2,4,5-Trichlorophenol	0.500	0.400	80.0	50.0-125	
2,4,6-Trichlorophenol	0.500	0.319	63.8	53.0-123	
Pyridine	0.500	0.177	35.4	13.5-58.9	
(S) 2-Fluorophenol			*31.9*	*19.0-119*	
(S) Phenol-d5			*18.8*	*10.0-67.0*	
(S) Nitrobenzene-d5			*45.6*	*44.0-120*	

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

1 Cp 2 Tc 3 Ss 4 Cn 5 Sr 6 Qc 7 Gl 8 Al 9 Sc

Laboratory Control Sample (LCS)

(LCS) R3717280-1 10/15/21 22:54

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
(S) 2-Fluorobiphenyl			*69.0*	*44.0-119*	
(S) 2,4,6-Tribromophenol			*70.5*	*43.0-140*	
(S) p-Terphenyl-d14			*68.3*	*50.0-134*	

L1410266-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1410266-01 10/16/21 00:41 • (MS) R3717280-3 10/16/21 01:03 • (MSD) R3717280-4 10/16/21 01:25

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
1,4-Dichlorobenzene	0.500	ND	0.249	0.290	49.8	58.0	1	29.0-112			15.2	20
2,4-Dinitrotoluene	0.500	ND	0.439	0.512	87.8	102	1	57.0-128			15.4	20
Hexachlorobenzene	0.500	ND	0.314	0.361	62.8	72.2	1	53.0-125			13.9	20
Hexachloro-1,3-butadiene	0.500	ND	0.250	0.272	50.0	54.4	1	22.0-124			8.43	20
Hexachloroethane	0.500	ND	0.243	0.289	48.6	57.8	1	21.0-115			17.3	20
Nitrobenzene	0.500	ND	0.243	0.270	48.6	54.0	1	45.0-121			10.5	20
2-Methylphenol	0.500	ND	0.194	0.233	38.8	46.6	1	30.0-117			18.3	20
3&4-Methyl Phenol	0.500	ND	0.199	0.232	39.8	46.4	1	29.0-110			15.3	20
Pentachlorophenol	0.500	ND	0.362	0.419	72.4	83.8	1	35.0-138			14.6	20
2,4,5-Trichlorophenol	0.500	ND	0.349	0.389	69.8	77.8	1	50.0-125			10.8	20
2,4,6-Trichlorophenol	0.500	ND	0.279	0.319	55.8	63.8	1	53.0-123			13.4	20
Pyridine	0.500	ND	ND	0.136	18.9	27.2	1	13.5-58.9		J3	36.2	20
(S) 2-Fluorophenol					*24.0*	*27.6*		*19.0-119*				
(S) Phenol-d5					*13.8*	*17.8*		*10.0-67.0*				
(S) Nitrobenzene-d5					*39.9*	*44.4*		*44.0-120*	J2			
(S) 2-Fluorobiphenyl					*57.2*	*67.0*		*44.0-119*				
(S) 2,4,6-Tribromophenol					*59.0*	*73.0*		*43.0-140*				
(S) p-Terphenyl-d14					*57.8*	*65.1*		*50.0-134*				

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J1	Surrogate recovery limits have been exceeded; values are outside upper control limits.
J2	Surrogate recovery limits have been exceeded; values are outside lower control limits.
J3	The associated batch QC was outside the established quality control range for precision.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
U	Below Detectable Limits: Indicates that the analyte was not detected.

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Company Name/Address:

Geo Consultants - Kevil, KY

325 Kentucky Ave
Kevil, KY 42053

Billing Information:

Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122

Report to: David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description: Staten Isl Warehouse, Port Richmond

City/State Collected: Staten Island New York

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project # FUSRAP

Lab Project #

Collected by (print): David Lindsey

Site/Facility ID #

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ✓ Y ___

SDG # L1410500
B224

Acctnum: GEOCONKKY
Template: T195295
Prelogin: P873895
PM: 732 - Donna Eidson
PB:
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres									Remarks	Sample # (lab only)
SS-04-0926	G	SCM	0-0.5	9-22-21	0926	1	X										-01
SB-04-0102	G	SCM	1-2	9-22-21	1610	1	X										-02
SB-04-0406	G	SCM	4-6	9-22-21	1630	1	X										-03
SS-02-0835	G	SCM	0-0.5	9-24-21	0835	1	X										-04
SB-02-0501	G	SCM	0.5-1	9-24-21	0840	1	X										-05
SB-02-0102	G	SCM	1-2	9-24-21	0845	1	X										-06
SB-DUP-02	G	SCM	0.5-1	9/24/21	0840	1	X										-07
SS-MS-04	G	SCM	0-0.5	9/22/21	0926	1	X										-01
SS-MSD-04	G	SCM	0-0.5	9/22/21	0926	1	X										-01
		SCM				1	X										

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks: no ice required

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)		
	9-27-21	1420		Trip Blank Received: Yes / No 0 HCL / MeoH TBR	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 22.0 °C 21.9+.1=22.0 Bottles Received: 9	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21 Time: 10:45 ~~9:30~~	Hold:

Condition: NCF / OK

<500 cpm

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.53		0.363	0.238	10/11/2021 17:29	WG1753087
URANIUM-235	0.248	J	0.112	0.0888	10/11/2021 17:29	WG1753087
URANIUM-238	2.65		0.345	0.145	10/11/2021 17:29	WG1753087
(T) URANIUM-232	*67.6*			*30.0-110*	*10/11/2021 17:29*	WG1753087

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.585	~~J~~ X	0.330	0.745	10/26/2021 14:12	WG1756346
Bismuth-212	0.826	~~U~~ X	1.31	2.66	10/26/2021 14:12	WG1756346
Bismuth-214 (Ra-226)	4.60	X	0.535	0.388	10/26/2021 14:12	WG1756346
Lead-212	0.142	~~J3 U~~ X	0.227	0.411	10/26/2021 14:12	WG1756346
Lead-214	5.57	X	0.581	0.399	10/26/2021 14:12	WG1756346
Potassium-40	9.77	X	2.39	2.65	10/26/2021 14:12	WG1756346
Thallium-208	0.370	X	0.120	0.162	10/26/2021 14:12	WG1756346
Uranium-235	0.466	~~U~~ X(J)	0.117	0.715	10/26/2021 14:12	WG1756346
Thorium-234 (U-238)	2.02	~~J~~ X	1.14	2.09	10/26/2021 14:12	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	4.81	J	0.442	0.173	10/18/2021 16:50	WG1754721
URANIUM-235	0.293		0.113	0.0804	10/18/2021 16:50	WG1754721
URANIUM-238	4.78		0.430	0.101	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*68.3*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.86	X	0.449	0.732	10/26/2021 15:28	WG1756346
Bismuth-212	1.88	~~J~~ X	1.34	2.45	10/26/2021 15:28	WG1756346
Bismuth-214 (Ra-226)	3.59	X	0.440	0.379	10/26/2021 15:28	WG1756346
Lead-212	1.18	X	0.317	0.495	10/26/2021 15:28	WG1756346
Lead-214	4.58	X	0.553	0.376	10/26/2021 15:28	WG1756346
Potassium-40	11.1	X	2.33	2.53	10/26/2021 15:28	WG1756346
Thallium-208	0.455	X	0.138	0.197	10/26/2021 15:28	WG1756346
Uranium-235	0.507	(U) X	0.152	1.15	10/26/2021 15:28	WG1756346
Thorium-234 (U-238)	4.85	X	2.65	4.12	10/26/2021 15:28	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.84	J	0.277	0.163	10/18/2021 16:50	WG1754721
URANIUM-235	0.0512	~~J~~	0.0518	0.0617	10/18/2021 16:50	WG1754721
URANIUM-238	2.04		0.277	0.103	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*69.5*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.04	X	0.367	0.678	10/26/2021 16:30	WG1756346
Bismuth-212	1.56	~~J~~ X	1.43	2.73	10/26/2021 16:30	WG1756346
Bismuth-214 (Ra-226)	1.07	X	0.275	0.396	10/26/2021 16:30	WG1756346
Lead-212	1.03	X	0.283	0.425	10/26/2021 16:30	WG1756346
Lead-214	1.31	X	0.316	0.405	10/26/2021 16:30	WG1756346
Potassium-40	14.0	X	2.83	2.78	10/26/2021 16:30	WG1756346
Thallium-208	0.338	X	0.130	0.192	10/26/2021 16:30	WG1756346
Uranium-235	0.236	(U) X	0.137	1.2	10/26/2021 16:30	WG1756346
Thorium-234 (U-238)	2.07	~~J~~ X	2.05	4.06	10/26/2021 16:30	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.622	J	0.185	0.163	10/18/2021 16:50	WG1754721
URANIUM-235	0.00538	(U) J	0.0433	0.0799	10/18/2021 16:50	WG1754721
URANIUM-238	0.819		0.183	0.0912	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*77.0*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.12	X	0.285	0.455	10/26/2021 17:37	WG1756346
Bismuth-212	1.20	~~J~~ X	0.859	1.51	10/26/2021 17:37	WG1756346
Bismuth-214 (Ra-226)	1.09	X	0.209	0.24	10/26/2021 17:37	WG1756346
Lead-212	1.13	X	0.215	0.253	10/26/2021 17:37	WG1756346
Lead-214	1.12	X	0.197	0.217	10/26/2021 17:37	WG1756346
Potassium-40	13.2	X	2.06	1.01	10/26/2021 17:37	WG1756346
Thallium-208	0.271	X	0.0947	0.134	10/26/2021 17:37	WG1756346
Uranium-235	0.0995	(U) X	0.0858	0.723	10/26/2021 17:37	WG1756346
Thorium-234 (U-238)	0.808	(U) X	1.22	2.37	10/26/2021 17:37	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.809	J	0.181	0.158	10/18/2021 16:50	WG1754721
URANIUM-235	0.00939	(U) J	0.0585	0.0928	10/18/2021 16:50	WG1754721
URANIUM-238	0.752		0.166	0.132	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*82.6*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.27	X	0.225	0.278	10/26/2021 18:36	WG1756346
Bismuth-212	1.84	X	0.750	1.28	10/26/2021 18:36	WG1756346
Bismuth-214 (Ra-226)	1.10	X	0.155	0.164	10/26/2021 18:36	WG1756346
Lead-212	1.30	X	0.174	0.202	10/26/2021 18:36	WG1756346
Lead-214	1.22	X	0.185	0.195	10/26/2021 18:36	WG1756346
Potassium-40	15.1	X	1.70	0.865	10/26/2021 18:36	WG1756346
Thallium-208	0.487	X	0.0817	0.0843	10/26/2021 18:36	WG1756346
Uranium-235	0.174	(U) X, J	0.0705	0.615	10/26/2021 18:36	WG1756346
Thorium-234 (U-238)	1.02	~~U~~ X	1.19	2.37	10/26/2021 18:36	WG1756346

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.634	J	0.169	0.145	10/18/2021 16:50	WG1754721
URANIUM-235	0.0521	~~J~~	0.0528	0.0658	10/18/2021 16:50	WG1754721
URANIUM-238	0.918		0.182	0.112	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*90.4*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.08	X	0.204	0.301	10/26/2021 18:38	WG1756346
Bismuth-212	1.35	X	0.620	1.02	10/26/2021 18:38	WG1756346
Bismuth-214 (Ra-226)	1.03	X	0.158	0.172	10/26/2021 18:38	WG1756346
Lead-212	0.873	X	0.137	0.178	10/26/2021 18:38	WG1756346
Lead-214	1.12	X	0.148	0.164	10/26/2021 18:38	WG1756346
Potassium-40	7.50	X	1.37	1.79	10/26/2021 18:38	WG1756346
Thallium-208	0.367	X	0.0701	0.0855	10/26/2021 18:38	WG1756346
Uranium-235	0.0332	(U) X	0.0506	0.442	10/26/2021 18:38	WG1756346
Thorium-234 (U-238)	0.369	(U) X	0.839	1.76	10/26/2021 18:38	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.787	J	0.166	0.0996	10/18/2021 16:50	WG1754721
URANIUM-235	-0.00463	U	0.0441	0.0811	10/18/2021 16:50	WG1754721
URANIUM-238	0.795		0.157	0.0525	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*95.2*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.13	X	0.285	0.427	10/26/2021 18:41	WG1756346
Bismuth-212	2.18	X	1.03	1.73	10/26/2021 18:41	WG1756346
Bismuth-214 (Ra-226)	1.13	X	0.212	0.224	10/26/2021 18:41	WG1756346
Lead-212	1.09	X	0.216	0.266	10/26/2021 18:41	WG1756346
Lead-214	1.36	X	0.219	0.2	10/26/2021 18:41	WG1756346
Potassium-40	13.9	X	2.11	0.994	10/26/2021 18:41	WG1756346
Thallium-208	0.484	X	0.105	0.102	10/26/2021 18:41	WG1756346
Uranium-235	0.100	(U) X	0.0929	0.739	10/26/2021 18:41	WG1756346
Thorium-234 (U-238)	0.463	(U) X	1.18	2.42	10/26/2021 18:41	WG1756346

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410500
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}$U by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic
Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.
"J" - Indicates an unusually uncertain or estimated result.
"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

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[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-04-0926	Soil	L1410500-01
SB-04-0102	Soil	L1410500-02
SB-04-0406	Soil	L1410500-03
SS-02-0835	Soil	L1410500-04
SB-02-0501	Soil	L1410500-05
SB-02-0102	Soil	L1410500-06
SB-DUP-02	Soil	L1410500-07

Validation Report By: **Amanda Leigh Dick** **03/08/2022**
(print) **Date**

Amanda Leigh Dick

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/11/2022**
(print) **Date**

TL Rucker

(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SS-04-0926	X
2	C6	3	-9.4-7.9			SB-02-0501	X
4	C6	1	-6.5			SB-02-0102	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	SS-02-0835, SB-DUP-02	X
2	P3	1	5.3			SB-04-0102, SB-04-0406	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detector/geometry has one quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	12.2	SS-04-0926	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples did not meet the RDL project goal of <1 pCi/g for Th-234: SS-02-0835, SB-02-0102, and SB-DUP-02. Please see table below.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-02-0835	Th-234	0.611	2.1385	1
SB-02-0102	Th-234	0.41935	1.46773	1
SB-DUP-02	Th-234	0.5915	2.07025	1

The following samples had results that exceeded the project action limit: SS-04-0926: Ra-226 4.60 pCi/g SB-04-0102: Ra-226 3.59 pCi/g.

No samples exhibited excess uncertainty:

There were no samples that had negative results with uncertainties smaller than their absolute values.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows: SB-04-0102: U-235; SB-04-0406: U-235; SS-02-0835: U-235 and Th-234; SB-02-0501: U-235; SB-02-0102: U-235 and Th-234; and SB-DUP-02: U-235 and Th-234.

Method Blank

There was no indication of blank contamination for the gamma spectrometry analysis.

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, <3).

All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

The initial calibration met project acceptance criteria for all reported analytes.

Continuing Calibration

The continuing calibration met project acceptance criteria for all reported analytes.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was met for all radionuclides of interest.

The following sample had a Uranium-235 result above the project action limit: SS-04-0926: U-235 0.248 pCi/g and SB-04-0102: U-235 0.293 pCi/g.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty**. It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows:**

Sample-Specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C	Qualifier
SS-02-0835	U-235	0.00538	0.014	0.0231	U
SB-02-0501	U-235	0.00939	0.02	0.033	U
SB-DUP-02	U-235	-0.0046	0.017	0.02805	U

Matrix Spike

The percent recoveries for the MS/MSD were within acceptable limits for all alpha spectrometry analyses.

Method Blank

There was no indication of blank contamination in the Method Blank.

Laboratory Control Sample:

The percent recoveries were within acceptable limits for LCS R3715413-2. The Uranium-234 percent recovery is outside the lower acceptable limit (75%-125%) for LCS R3720206-2. **It is recommended that the following associated Uranium-234 sample results be qualified as estimated (J): SB-04-0102, SB-04-0406, SS-02-0835, SB-02-0501, SB-02-0102, and SB-DUP-02.** Please see table below.

Radiochemistry - LCS % Recovery Calculation

Sample ID	Analyte	Found Value (pCi/g)	True Value (pCi/g)	LCS (% Recovery)	Qualifier
LCS R3720206-2	U-234	3.48	4.78	72.803%	J

<u>Duplicate Analysis</u>:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the alpha spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<20%, <3).

All field duplicate results were within a factor of 4 from the original result.

<u>Sample-Specific Chemical Recovery:</u>

The percent recoveries for tracers were within acceptable limits.

<u>Spectral Analysis:</u>

There was some tailing from the Uranium-234, Uranium-235, and Uranium-238 peaks from sample MSD R3715413-4. However, there was no peak interference. Therefore, no qualification is required. Sample SB-02-0501 had a Uranium-232 peak energy outside 40 keV from the theoretical energy. However, peak identification was not impacted. Therefore, no qualification is required.

<u>Quantification</u>:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, two samples were not in agreement. **It is recommended that the following samples results for U-235 be qualified as estimated (J) due to incomparable results:**

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SS-04-0926	U-235	0.248	0.038	0.466	0.0585	61.06%	3.125	J
SB-02-0501	U-235	0.00939	0.02	0.174	0.03525	179.52%	4.062	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410500

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ tracer recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation (org. forms V through X)	N/A
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence (inorg. forms II, IV, and VIII through XIV)	N/A
other: (Radiological)	initial calibration data	Y
	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

The case narrative did not cover project sample IDs vs laboratory sample IDs.
Additionally, it also did not cover each analytical type included in this SDG.
No discrepancies were listed in the case narrative.

The following project sample ID's from the results form do not match the project sample ID's from the COC: SS-04-0102, SS-02-0501, and SS-02-0102.
According to the COC, these are subsurface samples.

The sample result forms were missing the extraction dates and sample matrix.
The calibration documentation are missing for both alpha and gamma analyses.

Calibration standard COAs were missing.

A revision was issued by the laboratory containing some of the missing items.

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: Amanda Leigh Dick Date: 03/08/2022

QA Review By: ______ Date: ______

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410500

Analyte Group: Gamma Spectroscopy and Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-04-0926	L1410500-01	Soil	Gamma Spec & Iso U	
SB-04-0102	L1410500-02	Soil	Gamma Spec & Iso U	Wrong Sample ID on Result forms.
SB-04-0406	L1410500-03	Soil	Gamma Spec & Iso U	
SS-02-0835	L1410500-04	Soil	Gamma Spec & Iso U	
SB-02-0501	L1410500-05	Soil	Gamma Spec & Iso U	Wrong Sample ID on Result forms.
SB-02-0102	L1410500-06	Soil	Gamma Spec & Iso U	Wrong Sample ID on Result forms.
SB-DUP-02	L1410500-07	Soil	Gamma Spec & Iso U	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410500

Analysis: Gamma Spectroscopy and Isotopic Uranium

Method: DOE Ga-01-R/901.1 and D3972 U-02

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Sample results qualified as indicated due to LCS recoveries and incomparable results .

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick Date: 03/08/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: The project MDA goal was exceeded for several Potassium-40 and Thorium-234 sample results. Two samples had results that exceeded project action limits: SS-04-0926 and SB-04-0102.

The alpha LCS (LCS R3720206-2) had an Uranium-234 recovery result less than the 75% project QC limit. All associated sample U-234 results were qualified "J".

The RDL was not met for several samples. Please see page 9 of this report.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No samples were re-analyzed or diluted.

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	< 1 pCi/g	2.65 pCi/g	SS-04-0926
Thorium-234	< 1 pCi/g	2.09 pCi/g	SS-04-0926
Potassium-40	< 1 pCi/g	2.53 pCi/g	SB-04-0102
Thorium-234	< 1 pCi/g	4.12 pCi/g	SB-04-0102
Potassium-40	< 1 pCi/g	2.78 pCi/g	SB-04-0406
Thorium-234	< 1 pCi/g	4.06 pCi/g	SB-04-0406
Potassium-40	< 1 pCi/g	1.01 pCi/g	SS-02-0835
Thorium-234	< 1 pCi/g	2.37 pCi/g	SS-02-0835
Thorium-234	< 1 pCi/g	2.37 pCi/g	SB-02-0501
Potassium-40	< 1 pCi/g	1.79 pCi/g	SB-02-0102
Thorium-234	< 1 pCi/g	1.76 pCi/g	SB-02-0102
Thorium-234	< 1 pCi/g	2.42 pCi/g	SB-DUP-02
Actinium-228		LC<Result	SS-04-0926. No DVQ.
Uranium-235		LC<Result	SS-04-0926. No DVQ.
Thorium-234		LC<Result	SS-04-0926. No DVQ.
Uranium-235 γ		LC>Result	SB-04-0102. DVQ: "U"

Cont. on next page.

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The following samples had results that exceeded project action limits:
SS-04-0926: U-235 0.248 pCi/g, Ra-226 4.60 pCi/g
SB-04-0102: U-235 0.293 pCi/g, Ra-226 3.59 pCi/g

There were no samples that negative results with uncertainties smaller than their absolute values.

The sample-specific detection limit (LC) was calculated for sample results less than the critical level
Sample concentrations less than the LC were qualified "U". Please see calculation sheet.

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Radiochemical Data Review Checklist

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Uranium-235 α		LC<Result	SB-04-0406. No DVQ.
Uranium-235 γ		LC>Result	SB-04-0406. DVQ: "U"
Thorium-234		LC<Result	SB-04-0406. No DVQ.
Uranium-235 α		LC>Result	SS-02-0835. DVQ: "U"
Uranium-235 γ		LC>Result	SS-02-0835. DVQ: "U"
Thorium-234		LC>Result	SS-02-0835. DVQ: "U"
Uranium-235 α		LC>Result	SB-02-0501. DVQ: "U"
Uranium-235 γ		LC>Result	SB-02-0501. DVQ: "U"
Thorium-234		LC<Result	SB-02-0501. No DVQ.
Uranium-235 α		LC<Result	SB-02-0102. No DVQ.
Uranium-235 γ		LC>Result	SB-02-0102. DVQ: "U"
Thorium-234		LC>Result	SB-02-0102. DVQ: "U"
Uranium-235 α		LC>Result	SB-DUP-02. DVQ: "U"
Uranium-235 γ		LC>Result	SB-DUP-02. DVQ: "U"
Thorium-234		LC>Result	SB-DUP-02. DVQ: "U"

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. The following samples had results that did not meet the RDL: SS-02-0835: Th-234, SB-02-0102: Th-234, & SB-DUP-02: Th-234.

For concentration ten times the MDC, the calculation CSU>0.25*Rs was used to identify excess reported uncertainty. No samples exhibited excess uncertainty:

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: The initial and continuing calibration met project acceptance criteria.

A background count was performed the same month the samples were counted. The background did not contain high results.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
Delta Value: 6.3%	898.04 keV	Detector 1	Delta Value: < 5%		
Delta Value: 5.3%	159.00 keV	Detector 2	Delta Value: < 5%		
Delta Value: 7.9%	898.04 keV	Detector 2	Delta Value: < 5%		
Delta Value: 18.8%	136.47 keV	Detector 3	Delta Value: < 5%		
Delta Value: 6.5%	159.00 keV	Detector 5	Delta Value: < 5%		
Delta Value: 5.3%	513.99 keV	Detector 2	Delta Value: < 5%		
Delta Value: -9.4%	661.66 keV	Detector 2	Delta Value: < 5%		
Delta Value: -6.5%	136.47 keV	Detector 4	Delta Value: < 5%		
Delta Value: -16.4%	136.47 keV	Detector 5	Delta Value: < 5%		

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Daily source checks were performed for each detector. Co-60 energies were over 1.0 keV of known energies for Detector 4 on 10/26/2021. All other energies were within the 1.0 keV limit. The FWHM was greater than 3.0 keV for several energies with confirmed isotopes.
A long monthly back ground was performed. No high results were noted.
There was no mention of a Peak-to-Compton Ratio Calibration being performed.
Samples counted on detectors with high delta values and/or 95% CL (1.96 σ) greater than 8% were qualified as "X. The daily source check failed high on detector 1 (12.2%).

Radiochemical Data Review Checklist

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations: SDG samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations: SDG samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: Alpha: MB R3715413-1 & MB R3720206-1
Gamma: MB R3722645-1

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
10/11/2021	MB R3715413-1	U-238	0.147 pCi/g & 0.124 pCi/g	0.157 pCi/g & 0.124 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			
10/26/2021	MB R3722645-1	Ac-228	0.168 pCi/g & 0.151 pCi/g	0.376 pCi/g & 0.151 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			
10/26/2021	MB R3722645-1	Th-234	1.01 pCi/g & 0.582 pCi/g	1.06 pCi/g & 0.582 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks: All blank results were less than the MDA. All alpha |Zblk| results were less than 3.
There were no project blanks associated with this SDG.

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations: No detects found.

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations: None

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: All tracer recoveries were within project QC limits. No standard documentation was provided.

Radiochemical Data Review Checklist

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

	Alpha aqueous	solid
%R	80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: Alpha: LCS R3715413-2 & LCS R3720206-2
Gamma: LCS R3722645-2 & LCSD R3722645-4

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Uranium-234	10/18/21	72.7%	SB-04-0102. U-234 qualified "J".
			SB-04-0406. U-234 qualified "J".
			SS-02-0835. U-234 qualified "J".
			SB-02-0501. U-234 qualified "J".
			SB-02-0102. U-234 qualified "J".
			SB-DUP-02. U-234 qualified "J".

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: The LCS recovery results not listed above were within project QC limits.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: SS-04-0926
MS R3715413-3 & MSD R3715413-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All Matrix Spike recovery results were within project QC limits.

Radiochemical Data Review Checklist

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: Alpha: DUP R3715413-5, MSD R3715413-4, DUP R3720206-5 & MSD R3720206-4
Gamma: DUP R3722645-3 & LCSD R3722645-4
Project DUP: SB-DUP-02

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
U-235 (DUP R3715413-5)		46.93%	1.464	NAD less than 3. No qualification needed.
U-235 (DUP R3720206-5)		129.24%	2.530	NAD less than 3. No qualification needed.
Ac-228 (DUP R3722645-3)		38.06%	1.09	NAD less than 3. No qualification needed.
K-40 (DUP R3722645-3)		25.30%	1.682	NAD less than 3. No qualification needed.
Th-234 (DUP R3722645-3)		97.83%	1.131	NAD less than 3. No qualification needed.

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: The duplicate results not listed above had RPD% value less than 20%.
All field duplicate results were within project requirements. Please see calculation sheets.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-234	Some tailing	MSD R3715413-4
U-235	Some tailing	MSD R3715413-4
U-238	Some tailing	MSD R3715413-4
U-232	Outside of 40 kev of theoretical	SB-02-0501. No DVQ on tracer.

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: There were no overlapping or interferent peaks. All SDG sample had acceptable resolution. All radionuclides of interest were within 40 keV from their theoretical energies.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: Please see below.

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: Each target radionuclide peaks were within 2 keV of the observed standard peak. However, the peak search parameters were set at 3 keV instead of 2 keV. All radionuclides of interest were identified.

There were no interferent or overlapping peaks.

Radiochemical Data Review Checklist

~~XIII. Tentatively Identified Radionuclides (gamma spectroscopy)~~ Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~

~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~

~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and gamma results not comparable	SS-04-0926. DVQ: "J"
U-235	Alpha and gamma results not comparable	SB-02-0501. DVQ: "J"

Actions:

~~1. Qualify all tentatively identified radionuclides as estimated (J).~~
~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide, as suspect, qualify the data as rejected (R).~~

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

Please see calculation sheet.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected
U-234	Some tailing	MSD R3715413-4
U-238	Some tailing	MSD R3715413-4

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: All background levels were low. There were no known energy shifts or extraneous peaks.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculation sheets.

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculation sheets.

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: Data qualified using parameters and guidance from the QAPP, CENWK, and QSM 5.1.

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
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Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Report to:
David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description: Staten Isl Warehouse, Port Richmond

City/State Collected: Staten Island New York

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project #: FUSRAP

Lab Project #

Site/Facility ID #

P.O. #

Collected by (print): David Lindsey

Collected by (signature): [signature]

Immediately Packed on Ice N ✓ Y ___

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

SDG # L1410504
B225

Acctnum: GEOCONKKY
Template: T195295
Prelogin: P873895
PM: 732 - Donna Eidson
PB:
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres									Remarks	Sample # (lab only)
SS-11-1100	✓	SCM	3-4'	9-23-21	1100	1	X										-01
SB-11-0405	✓	SCM	4-5'	9-23-21	1105	1	X										-02
SB-11-0506	✓	SCM	5-6	9-23-21	1110	1	X										-03
SS-12-1115	✓	SCM	2-3	9-23-21	1115	1	X										-04
SB-12-0304	✓	SCM	3-4	9-23-21	1120	1	X										-05
SB-12-0506	✓	SCM	5-6	9-23-21	1125	1	X										-06
SS-14-1205	✓	SCM	1.5-2	9-23-21	1205	1	X										-07
SB-14-2540	✓	SCM	2.5-4	9-23-21	1210	1	X										-08
SB-14-0608	✓	SCM	6-8	9-23-21	1215	1	X										-09
SB-DUP-11	~~✓~~	SCM	4-5	9/23/21	1105	1	X										-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks: no ice required

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: ~~NP~~ _Y _N
COC Signed/Accurate: ✓Y _N
Bottles arrive intact: ✓Y _N
Correct bottles used: ✓Y _N
Sufficient volume sent: ✓Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: ✓Y _N
RAD Screen <0.5 mR/hr: ✓Y _N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No (HCL / MeoH, TBR)
[signature]	9-27-21	1435		0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: Ambient 23.1+.1=23.2 Bottles Received: 10
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

2600 cpm

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.784	J	0.241	0.177	10/18/2021 16:50	WG1754721
URANIUM-235	0.0912	~~J~~	0.0887	0.106	10/18/2021 16:50	WG1754721
URANIUM-238	0.800		0.235	0.148	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*56.0*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.812	X	0.273	0.511	11/02/2021 11:25	WG1756382
Bismuth-212	1.18	~~J~~ X	0.893	1.54	11/02/2021 11:25	WG1756382
Bismuth-214 (Ra-226)	0.599	X	0.188	0.279	11/02/2021 11:25	WG1756382
Lead-212	0.805	X	0.177	0.241	11/02/2021 11:25	WG1756382
Lead-214	0.651	X	0.156	0.239	11/02/2021 11:25	WG1756382
Potassium-40	10.8	X	1.95	1.52	11/02/2021 11:25	WG1756382
Thallium-208	0.228	X	0.0902	0.143	11/02/2021 11:25	WG1756382
Uranium-235	0.115	~~J~~ X	0.0782	0.139	11/02/2021 11:25	WG1756382
Thorium-234 (U-238)	0.694	(U) X	1.08	2.28	11/02/2021 11:25	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.46	J	0.250	0.127	10/18/2021 16:50	WG1754721
URANIUM-235	0.0359	J (U)	0.0562	0.0821	10/18/2021 16:50	WG1754721
URANIUM-238	1.80	J	0.270	0.104	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*84.9*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.02	X	0.265	0.325	11/02/2021 11:04	WG1756382
Bismuth-212	2.15	X	0.794	1.23	11/02/2021 11:04	WG1756382
Bismuth-214 (Ra-226)	1.90	X	0.211	0.18	11/02/2021 11:04	WG1756382
Lead-212	1.92	X	0.197	0.179	11/02/2021 11:04	WG1756382
Lead-214	1.91	X	0.200	0.191	11/02/2021 11:04	WG1756382
Potassium-40	10.6	X	1.37	1.08	11/02/2021 11:04	WG1756382
Thallium-208	0.699	X	0.0933	0.089	11/02/2021 11:04	WG1756382
Uranium-235	0.187	X(J)	0.0762	0.129	11/02/2021 11:04	WG1756382
Thorium-234 (U-238)	-1.46	(U) X, J	1.47	3.28	11/02/2021 11:04	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.02	J	0.236	0.171	10/18/2021 16:50	WG1754721
URANIUM-235	0.0294	(U) J	0.0742	0.117	10/18/2021 16:50	WG1754721
URANIUM-238	1.06		0.232	0.143	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*77.9*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.38	X	0.346	0.515	11/02/2021 12:29	WG1756382
Bismuth-212	1.16	~~J~~ X	1.08	1.93	11/02/2021 12:29	WG1756382
Bismuth-214 (Ra-226)	1.08	X	0.246	0.303	11/02/2021 12:29	WG1756382
Lead-212	1.40	X	0.225	0.258	11/02/2021 12:29	WG1756382
Lead-214	1.20	X	0.204	0.239	11/02/2021 12:29	WG1756382
Potassium-40	13.0	X	2.26	1.86	11/02/2021 12:29	WG1756382
Thallium-208	0.352	X	0.110	0.163	11/02/2021 12:29	WG1756382
Uranium-235	0.241	X(J)	0.0894	0.144	11/02/2021 12:29	WG1756382
Thorium-234 (U-238)	1.12	(U) X	1.27	2.64	11/02/2021 12:29	WG1756382

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.939	J	0.210	0.151	10/18/2021 16:50	WG1754721
URANIUM-235	0.00489	(U) J	0.0575	0.0998	10/18/2021 16:50	WG1754721
URANIUM-238	0.988		0.198	0.0904	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*82.7*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.985	X	0.288	0.402	11/02/2021 11:20	WG1756382
Bismuth-212	1.55	~~J~~ X	1.15	2.08	11/02/2021 11:20	WG1756382
Bismuth-214 (Ra-226)	1.24	X	0.255	0.304	11/02/2021 11:20	WG1756382
Lead-212	1.44	X	0.195	0.167	11/02/2021 11:20	WG1756382
Lead-214	1.28	X	0.200	0.256	11/02/2021 11:20	WG1756382
Potassium-40	10.5	X	2.07	1.69	11/02/2021 11:20	WG1756382
Thallium-208	0.460	X	0.106	0.11	11/02/2021 11:20	WG1756382
Uranium-235	0.223	X(J)	0.0669	0.0971	11/02/2021 11:20	WG1756382
Thorium-234 (U-238)	1.04	~~J~~ X(U)	0.700	1.58	11/02/2021 11:20	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.35	J	0.309	0.268	10/18/2021 16:50	WG1754721
URANIUM-235	0.0941	~~J~~	0.0839	0.1	10/18/2021 16:50	WG1754721
URANIUM-238	1.43		0.278	0.163	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*60.7*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.854	X	0.307	0.512	11/02/2021 11:23	WG1756382
Bismuth-212	1.35	~~J~~ X	1.04	1.77	11/02/2021 11:23	WG1756382
Bismuth-214 (Ra-226)	3.39	X	0.462	0.26	11/02/2021 11:23	WG1756382
Lead-212	0.942	X	0.216	0.283	11/02/2021 11:23	WG1756382
Lead-214	3.34	X	0.437	0.303	11/02/2021 11:23	WG1756382
Potassium-40	8.80	X	1.92	1.68	11/02/2021 11:23	WG1756382
Thallium-208	0.163	X	0.0978	0.155	11/02/2021 11:23	WG1756382
Uranium-235	0.278	X	0.129	0.214	11/02/2021 11:23	WG1756382
Thorium-234 (U-238)	-0.236	(U) X	1.43	3.17	11/02/2021 11:23	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.20	J	0.239	0.198	10/18/2021 16:50	WG1754721
URANIUM-235	0.0383	U	0.0842	0.124	10/18/2021 16:50	WG1754721
URANIUM-238	1.69		0.249	0.129	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*77.0*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.56	X	0.362	0.515	11/02/2021 11:21	WG1756382
Bismuth-212	1.13	~~U~~ X	1.20	2.33	11/02/2021 11:21	WG1756382
Bismuth-214 (Ra-226)	1.76	X	0.285	0.31	11/02/2021 11:21	WG1756382
Lead-212	1.82	X	0.277	0.258	11/02/2021 11:21	WG1756382
Lead-214	1.64	X	0.269	0.299	11/02/2021 11:21	WG1756382
Potassium-40	11.3	X	2.05	1.83	11/02/2021 11:21	WG1756382
Thallium-208	0.605	X	0.134	0.166	11/02/2021 11:21	WG1756382
Uranium-235	0.196	(U) X	0.0984	0.913	11/02/2021 11:21	WG1756382
Thorium-234 (U-238)	1.04	(U) X	1.63	3.45	11/02/2021 11:21	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.324	J	0.119	0.121	10/18/2021 16:50	WG1754721
URANIUM-235	0.00191	(U) J	0.0224	0.0436	10/18/2021 16:50	WG1754721
URANIUM-238	0.258	J	0.0960	0.0871	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*118*	~~C1~~		*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.462	~~J~~ X	0.219	0.465	11/02/2021 14:22	WG1756382
Bismuth-212	0.551	~~U~~ X	0.795	1.52	11/02/2021 14:22	WG1756382
Bismuth-214 (Ra-226)	0.502	X	0.157	0.228	11/02/2021 14:22	WG1756382
Lead-212	0.682	X	0.140	0.177	11/02/2021 14:22	WG1756382
Lead-214	0.556	X	0.132	0.197	11/02/2021 14:22	WG1756382
Potassium-40	11.1	X	1.82	1.45	11/02/2021 14:22	WG1756382
Thallium-208	0.145	X	0.0717	0.123	11/02/2021 14:22	WG1756382
Uranium-235	0.0667	~~J~~ X	0.0620	0.115	11/02/2021 14:22	WG1756382
Thorium-234 (U-238)	-0.230	(U) X	0.823	1.97	11/02/2021 14:22	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.99	J	0.430	0.248	10/19/2021 11:26	WG1754721
URANIUM-235	0.176	J	0.105	0.0918	10/19/2021 11:26	WG1754721
URANIUM-238	3.10	J	0.414	0.142	10/19/2021 11:26	WG1754721
(T) URANIUM-232	*55.9*			*30.0-110*	*10/19/2021 11:26*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.34	X	0.299	0.397	11/02/2021 12:25	WG1756382
Bismuth-212	0.354	~~U~~ X	0.948	1.92	11/02/2021 12:25	WG1756382
Bismuth-214 (Ra-226)	2.35	X	0.315	0.23	11/02/2021 12:25	WG1756382
Lead-212	1.29	X	0.182	0.164	11/02/2021 12:25	WG1756382
Lead-214	2.44	X	0.288	0.251	11/02/2021 12:25	WG1756382
Potassium-40	9.61	X	1.83	1.33	11/02/2021 12:25	WG1756382
Thallium-208	0.419	X	0.104	0.132	11/02/2021 12:25	WG1756382
Uranium-235	0.266	X	0.0767	0.115	11/02/2021 12:25	WG1756382
Thorium-234 (U-238)	1.57	J ,X(U)	0.812	1.59	11/02/2021 12:25	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.08	J	0.311	0.204	10/18/2021 16:50	WG1754721
URANIUM-235	0.114	J	0.0986	0.124	10/18/2021 16:50	WG1754721
URANIUM-238	2.27	J	0.303	0.13	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*73.8*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.73	X	0.317	0.333	11/02/2021 12:26	WG1756382
Bismuth-212	3.73	X	0.937	1.21	11/02/2021 12:26	WG1756382
Bismuth-214 (Ra-226)	2.44	X	0.255	0.206	11/02/2021 12:26	WG1756382
Lead-212	3.05	X	0.275	0.201	11/02/2021 12:26	WG1756382
Lead-214	2.83	X	0.267	0.216	11/02/2021 12:26	WG1756382
Potassium-40	9.98	X	1.42	1.33	11/02/2021 12:26	WG1756382
Thallium-208	0.933	X	0.116	0.11	11/02/2021 12:26	WG1756382
Uranium-235	0.322	X(J)	0.0934	0.151	11/02/2021 12:26	WG1756382
Thorium-234 (U-238)	-3.93	(U) X, J	2.24	3.99	11/02/2021 12:26	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.01	J	0.293	0.141	10/18/2021 16:50	WG1754721
URANIUM-235	0.128	J	0.0824	0.0826	10/18/2021 16:50	WG1754721
URANIUM-238	2.09		0.290	0.0943	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*83.6*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	5.04	X	0.773	0.722	11/02/2021 14:35	WG1756382
Bismuth-212	4.96	X	2.31	3.85	11/02/2021 14:35	WG1756382
Bismuth-214 (Ra-226)	3.80	X	0.549	0.451	11/02/2021 14:35	WG1756382
Lead-212	4.71	X	0.534	0.331	11/02/2021 14:35	WG1756382
Lead-214	4.31	X	0.528	0.397	11/02/2021 14:35	WG1756382
Potassium-40	19.7	X	3.45	2.35	11/02/2021 14:35	WG1756382
Thallium-208	1.62	X	0.263	0.229	11/02/2021 14:35	WG1756382
Uranium-235	0.608	X(J)	0.157	0.226	11/02/2021 14:35	WG1756382
Thorium-234 (U-238)	2.29	~~J~~ X(U)	1.60	3.31	11/02/2021 14:35	WG1756382

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410504
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.
"J" - Indicates an unusually uncertain or estimated result.
"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-11-1100	Soil	L1410504-01
SB-11-0405	Soil	L1410504-02
SB-11-0506	Soil	L1410504-03
SS-12-1115	Soil	L1410504-04
SB-12-0304	Soil	L1410504-05
SB-12-0506	Soil	L1410504-06
SS-14-1205	Soil	L1410504-07
SB-14-2540	Soil	L1410504-08
SB-14-0608	Soil	L1410504-09
SB-DUP-11	Soil	L1410504-10

Validation Report By: **Amanda Leigh Dick** **03/05/2022**
(print) **Date**

Amanda Leigh Dick
(sign)

Peer Reviewed By: **Thomas L. Rucker** **03/10/22**
(print) **Date**

TLRucker
(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SS-12-1115, SB-14-2540	X
2	C6	3	-9.4-7.9			SB-11-0405, SB-14-0608	X
3	C6	1	18.8	8	8.4 – 10.6	SB-12-0506	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	SB-12-0304	X
4	P3	1	18.3	1	8.8	SS-11-1100, SB-11-0506, SS-14-1205	X
10	P3	1	22.4	2	8.2-8.3	SB-DUP-11	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data

Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detector/geometry has one quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration Check

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
3	C6	1	25.5	SS-12-1115, SB-14-2540	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples did not meet the RDL project goal of <1 pCi/g: SS-11-1100, SB-11-0405, SB-11-0506, SS-12-1115, SB-12-0304, SB-12-0506, SS-14-1205, SB-14-2540, SB-14-0608, and SB-DUP-11. Please see table below.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-11-1100	Th-234	0.5375	1.88125	1
SB-11-0405	Th-234	0.734	2.569	1
SB-11-0506	Th-234	0.633	2.2155	1
SS-12-1115	Th-234	0.34975	1.224125	1
SB-12-0304	Th-234	0.714	2.499	1
SB-12-0506	Th-234	0.816	2.856	1
SS-14-1205	Th-234	0.41125	1.439375	1
SB-14-2540	Th-234	0.40585	1.420475	1
SB-14-0608	Th-234	1.1215	3.92525	1
SB-DUP-11	Th-234	0.799	2.7965	1

The following samples had results greater that the project action limit: SB-12-0304 Ra-226 (3.39 pCi/g), SB-14-2540 Ra-226 (2.35 pCi/g), SB-14-0608 Ra-226 (2.44 pCi/g), SB-DUP-11 Ra-226 (3.80 pCi/g), SB-DUP-11 K-40 (19.7 pCi/g).

No sample results exhibited excess uncertainty.

The following sample had a negative result with an uncertainty smaller than its absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SB-14-0608: Th-234.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows: SS-11-1100: Th-234, SB-11-0405: Th-234, SB-11-0506: Th-234, SS-12-1115: Th-234, SB-12-0304: Th-234, SB-12-0506: U-235 and Th-234, SS-14-1205: Th-234, SB-14-2540: Th-234, SB-14-0608: Th-234, and SB-DUP-11: Th-234.

Method Blank

Thorium-234 was detected in the Method Blank for the gamma spectrometry analysis. **It is recommended that sample results less than 5x the blank value be qualified as non-detect (U) as follows: SS-11-1100, SB-11-0405, SB-11-0506, SS-12-1115, SB-12-0304, SB-12-0506, SS-14-1205, SB-14-2540, SB-14-0608, and SB-DUP-11.**

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and NADs (DERs) with acceptable limits (<3).
All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

The initial calibration met project acceptance criteria.

Continuing Calibration

The continuing calibration met project acceptance criteria.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was met for all radionuclides of interest.

No sample results were seen above the project action limits.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty**. It is recommended that sample concentrations less than the L_c are qualified as non-detect (U) as follows: SB-11-0405, SB-11-0506, SS-12-1115, SB-12-0506, and SS-14-1205.** Please see table below.

Sample-specific Critical Level (LC)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	LC (pCi/g)	Qualifier
SB-11-0405	U-235	0.0359	0.022	0.0363	U
SB-11-0506	U-235	0.0294	0.025	0.04125	U
SS-12-1115	U-235	0.00489	0.019	0.03135	U
SB-12-0506	U-235	0.0383	0.027	0.04455	U
SS-14-1205	U-235	0.00191	0.012	0.0198	U

Matrix Spike

A non-SDG sample was used as a matrix spike. The percent recoveries were within acceptable limits.

Method Blank

There was no indication of blank contamination in the Method Blank.

Laboratory Control Sample:

The Uranium-234 percent recovery for LCS R3720206-2 was below the lower acceptable limit (75%-125%). **All alpha Uranium-234 results associated with this LCS are recommended to be qualified as estimated (J): SS-11-1100, SB-11-0405, SB-11-0506, SS-12-1115, SB-12-0304, SB-12-0506, SS-14-1205, SB-14-2540, SB-14-0608, and SB-DUP-11.** Please see table below.

Radiochemistry - LCS % Recovery Calculation

Sample ID	Analyte	Found Value (pCi/g)	True Value (pCi/g)	LCS (% Recovery)
(LCS) R3720206-2	U-234	3.48	4.78	72.70%

Duplicate Analysis:

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1siman)

The RPDs and NADs (DERs) are within acceptable limits for the duplicate analyses for all alpha spectrometry analyses.

All field duplicate results were within a factor of 4 from the original result. Please see table below.

Sample-Specific Chemical Recovery:

The tracer recovery was greater than the upper project limit requirement (30%-110%) for the following sample: SS-14-1205 (118.3%). **It is recommended that all radionuclide results for that sample be qualified as estimated (J).**

Spectral Analysis:

No spectral interferences were observed in all of the alpha spectrometry analyses. There was a small amount of background noise, but nothing that would interfere with sample results. All detected radionuclide peaks of interest were within 40keV from their theoretical energies. However, the Uranium-232 peak energy was outside its theoretical energy for sample SS-12-1115.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement. **The following sample results are recommended to be qualified as estimated (J) due to incomparable results:**

SDG #: L1410504								
Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SB-11-0405	U-238	1.8	0.135	-1.46	0.735	1917.65%	4.362	J
SB-14-2540	U-238	3.1	0.207	1.57	0.406	65.52%	3.357	J
SB-14-0608	U-238	2.27	0.1515	-3.93	1.12	-746.99%	5.486	J
SB-11-0405	U-235	0.0359	0.022	0.187	0.0381	135.58%	3.434	J
SB-11-0506	U-235	0.0294	0.025	0.241	0.0447	156.51%	4.132	J
SS-12-1115	U-235	0.00489	0.019	0.223	0.03345	191.42%	5.670	J
SB-14-0608	U-235	0.114	0.033	0.322	0.0467	95.41%	3.637	J
SB-DUP-11	U-235	0.128	0.034	0.608	0.0785	130.43%	5.611	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410504

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ tracer recovery results (e.g., org. form II)		Y
Check for LCS results (e.g., org. form III, inorg. form XII)		Y
Check for method blank results (e.g., org. form IV, inorg. form III)		Y
Check for MS/MSD results (e.g., inorg. form V)		Y
Check for laboratory duplicate results (e.g., inorg. form VI)		Y
Check for Method Calibration and Run Documentation		
organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other: (Radiological)	initial calibration data	Y
	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

The case narrative did not cover analytical methods performed in this SDG.
The case narrative also didn't cover project sample vs laboratory sample IDs.
No sample discrepancies were listed in the case narrative.

The calibration documentation are missing for both alpha and gamma analyses.
The laboratory issued a revision with some of the missing information.
Calibration standard COAs are not found in the package .

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: Amanda Leigh Dick   Date: 03/05/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410504

Analyte Group: Gamma Spectroscopy and Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-11-1100	L1410504-01	Soil	Gamma Spec. and Isotopic Uranium	
SB-11-0405	L1410504-02	Soil	Gamma Spec. and Isotopic Uranium	
SB-11-0506	L1410504-03	Soil	Gamma Spec. and Isotopic Uranium	
SS-12-1115	L1410504-04	Soil	Gamma Spec. and Isotopic Uranium	
SB-12-0304	L1410504-05	Soil	Gamma Spec. and Isotopic Uranium	
SB-12-0506	L1410504-06	Soil	Gamma Spec. and Isotopic Uranium	
SS-14-1205	L1410504-07	Soil	Gamma Spec. and Isotopic Uranium	
SB-14-2540	L1410504-08	Soil	Gamma Spec. and Isotopic Uranium	
SB-14-0608	L1410504-09	Soil	Gamma Spec. and Isotopic Uranium	
SB-DUP-11	L1410504-10	Soil	Gamma Spec. and Isotopic Uranium	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410504

Laboratory: Pace Analytical

Analysis: Gamma Spectroscopy and Isotopic Uranium

Method: DOE Ga-01-R/901.1 and D3972 U-02

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Samples results qualified as indicated due to tracer recoveries, LCS recoveries and incomparable results,

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick Date: 03/05/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: Sample SS-14-1205 had a Uranium-232 tracer recovery result (118.3%) greater than the QC limits (30%-110%.). Sample results qualified "J".

Thorium-234 was detected in the gamma Method Blank (MB R3724570-3). All samples with results < 5x the blank result were qualified as "U"

Some sample results were greater than the project action limits.

The alpha LCS had a low Uranium-234 percent recovery. All alpha Uranium-234 results were qualified "J".

Sample SB-14-0608 had a Th-234 negative result with an uncertainty less than its absolute value.

Several samples had incomparable U-235 and/or U-238 results.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No sample results were re-analyzed or diluted.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	<1 pCi/g	1.52 pCi/g	SS-11-1100. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	2.28 pCi/g	SS-11-1100. No DVQ.
Potassium-40	<1 pCi/g	1.08 pCi/g	SB-11-0405. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	3.28 pCi/g	SB-11-0405. No DVQ.
Potassium-40	<1 pCi/g	1.86 pCi/g	SB-11-0506. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	2.64 pCi/g	SB-11-0506. No DVQ.
Potassium-40	<1 pCi/g	1.69 pCi/g	SS-12-1115. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	1.58 pCi/g	SS-12-1115. No DVQ.
Potassium-40	<1 pCi/g	1.68 pCi/g	SB-12-0304. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	3.17 pCi/g	SB-12-0304. No DVQ.
Potassium-40	<1 pCi/g	1.83 pCi/g	SB-12-0506. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	3.45 pCi/g	SB-12-0506. No DVQ.
Potassium-40	<1 pCi/g	1.45 pCi/g	SS-14-1205. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	1.97 pCi/g	SS-14-1205. No DVQ.
Potassium-40	<1 pCi/g	1.33 pCi/g	SB-14-2540. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	1.59 pCi/g	SB-14-2540. No DVQ.

Deviations continued on next page.

Actions: **SEE CENWK 4.1.3.3a and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. ~~If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
3. ~~If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
4. ~~If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The following sample had negative result with an uncertainty smaller than the absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify the results. SB-14-0608

Sample SB-12-0304 had a Ra-226 result (3.39 pCi/g) greater than the project action limit of 2.294 pCi/g.
Sample SB-14-2540 has a Ra-226 result (2.35 pCi/g) greater than the project action limit of 2.294 pCi/g.
Sample SB-14-0608 has a Ra-226 result (2.44 pCi/g) greater than the project action limit of 2.294 pCi/g.
Sample SB-DUP-11 has a Ra-226 result (3.80 pCi/g) greater than the project action limit of 2.294 pCi/g.
Sample SB-DUP-11 has a K-40 result (19.7 pCi/g) greater than the project action limit of 18.81 pCi/g.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	<1 pCi/g	1.33 pCi/g,	SB-14-0608. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	3.99 pCi/g,	SB-14-0608. No DVQ.
Potassium-40	<1 pCi/g	2.35 pCi/g,	SB-DUP-11. No DVQ.
Thorium-234 (U-238)	<1 pCi/g	3.31 pCi/g,	SB-DUP-11. No DVQ.

Actions: **SEE CENWK 4.1.3 and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: The sample-specific detection limit (LC) was calculated for sample results less than the critical level. Sample concentrations less than the LC were qualified "U". Please see calculation sheet.

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. The following samples had results that did not meet the RDL: SS-11-1100: Th-234, SB-11-0405: Th-234, SB-11-0506: Th-234, SS-12-1115: Th-234, SB-12-0304: Th-234, SB-12-0506: Th-234, SS-14-1205: U-235 & Th-234. SB-14-2540: Th-234, SB-14-0608: Th-234,

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected

Actions: **SEE CENWK 4.1.3 and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

For concentrations greater than 10 times the MDC, the calculation CSU>0.25*Rs was used to identify excess reported uncertainty. No samples exhibited excess uncertainty.

V.A1. Calibration Alpha Spectroscopy

SEE CENWK 4.3.1.2.1 and QAPP FOR CRITERIA

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

SEE CENWK 4.3.1.2.1 and QAPP FOR CRITERIA

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency. Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Please see below.

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: **SEE CENWK 4.3.1.2.1 and QAPP FOR CRITERIA**

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: An Energy and Efficiency calibration was performed for each detector. The calibrations met project acceptance criteria.

A background count was performed the same month the samples were counted. The background did not contain high results.

V.B1. Calibration Gamma Spectroscopy **SEE CENWK 4.3.1.1.1 and QAPP FOR CRITERIA**

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy **SEE CENWK 4.3.1.1.1 and QAPP FOR CRITERIA**

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.247%	898.04 kev	1	< 5%		
5.283%	159 kev	2	< 5%		
-9.410%	661.66 kev	2	< 5%		
7.914%	898.04 kev	2	< 5%		
18.765%	136.47 kev	3	< 5%		
-16.417%	136.47 kev	5	< 5%		
6.524%	159 kev	5	< 5%		
18.276%	513.99 kev	4	< 5%		
22.438%	513.99 kev	10	< 5%		
24.525%	513.99 kev	12	< 5%		

Actions: **SEE CENWK 4.3.1.1.1 and QAPP FOR CRITERIA**

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: A long monthly background was performed. No high results were noted.

Samples that counted on detectors with high delta values and/or 95% CL (1.96 σ) greater than 8%; were qualified "X".

No documentation of a energy calibration was provided. Additionally, there was no indication that a Peak-to-Compton ration calibration was performed.

Daily source checks were performed for each detector. Detector 3 source check for Cd-109 (25.5%) was outside the limit of 10% difference from standard.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: **SEE CENWK 4.3.1.4 and QAPP FOR CRITERIA**

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: KPA N/A FOR THIS SDG

V.D1. Calibration Gas Proportional Counters (GrossAB) **SEE CENWK 4.3.1.3.1 and QAPP FOR CRITERIA**

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters **SEE CENWK 4.3.1.3.1 and QAPP FOR CRITERIA**

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: **SEE CENWK 4.3.1.3.1 and QAPP FOR CRITERIA**

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: GPC N/A FOR THIS SDG

Radiochemical Data Review Checklist

VI. Blanks

SEE CENWK 4.2.1 and QAPP FOR CRITERIA

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: Alpha: MB R3720206-1 Gamma: MB R3724570-3

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
11/02/2021	MB R3724570-3	Th-234	0.975 pCi/g and 0.514 pCi/g	0.894 pCi/g and 0.514 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. See next page.			
11/02/2021	MB R3724570-3	U-235	0.0659 pCi/g and 0.0443 pCi/g	0.0783 pCi/g and 0.0443 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error
No project blanks associated with this SDG.				

Remarks: All results from MB R3720206-1 were less than the uncertainty and MDA. No qualification needed. Results from MB R3724570-3 not listed above were less than the uncertainty and MDA. Additionally the alpha |Zblank| value was less than 3.

VI. Blanks (continued)

SEE CENWK 4.2.1 and QAPP FOR CRITERIA

Calculate action levels based on ~~10X~~ 5x the highest blank concentration.

SEE CENWK 4.2.1.3 and QAPP FOR CRITERIA

Deviations: MB R3724570-3.

Radionuclide	Max. Activity Detected	Action Level	Samples Affected
Thorium-234	0.975 pCi/g	4.875 pCi/g	SS-11-1100. Result<AL. DVQ: "U".
			SB-11-0405. Result<AL. DVQ: "U".
			SB-11-0506. Result<AL. DVQ: "U".
			SS-12-1115. Result<AL. DVQ: "U".
			SB-12-0304. Result<AL. DVQ: "U".
			SB-12-0506. Result<AL. DVQ: "U".
			SS-14-1205. Result<AL. DVQ: "U".
			SB-14-2540. Result<AL. DVQ: "U".
			SB-14-0608. Result<AL. DVQ: "U".
			SB-DUP-11. Result<AL. DVQ: "U".

Actions: SEE CENWK 4.2.1 and QAPP FOR CRITERIA

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

VII. Sample-Specific Carrier or Tracer Recovery **SEE CENWK 4.1.2 and QAPP FOR CRITERIA**

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken
Uranium-232	SS-14-1205	118.3%	Sample results qualified: J

Actions: **SEE CENWK 4.1.2 and QAPP FOR CRITERIA**

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: Tracer recovery results not listed above were within QC limts.

Radiochemical Data Review Checklist

VIII. Laboratory Control Sample Information

SEE CENWK 4.2.2 and QAPP FOR CRITERIA

General LCS Criteria:
percent recovery (%R)

Alpha

aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: Alpha: LCS R3720206-2
Gamma: LCS R3724570-1 and LCSD R3724570-2

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Uranium-234	10/18/21	72.80%	All alpha U-234 results qualified with "J"

Actions: **SEE CENWK 4.2.2 and QAPP FOR CRITERIA**

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: The alpha LCS percent recovery result for Uranium-238 was within QC limits

All gamma LCS percent recovery results were within QC limits .

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

SEE CENWK 4.2.3 and QAPP FOR CRITERIA

Project Sample(s) Spiked: Non-SDG sample was spiked (L1410508-02)
MS R3720206-3 & MSD R3720206-4

Deviations: Project samples not selected for analysis

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: SEE CENWK 4.2.3 and QAPP FOR CRITERIA

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All matrix spike recovery results were within project QC limits.

X. Duplicate Sample or Matrix Spike Duplicate Analysis **SEE CENWK 4.2.4, 4.2.5 and QAPP FOR CRITERIA**

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: Alpha: L1410504-01
Gamma: LCSD R3724570-2
Project Field DU: SB-DUP-11

Deviations:

Radionuclide	DER	RPD	NAD RER	Samples Affected
(DUP) R3720206-5				
U-235 α		129%	2.530	NAD is less than 3. No DVQ.

Actions: **SEE CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP FOR CRITERIA**

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: All field duplicate results were within a factor 4 of the original result.
All laboratory duplicates either had RPD % results less than 20% or NAD results less than 3.

Radiochemical Data Review Checklist

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

SEE CENWK 4.1.8, 4.1.9.2 and QAPP FOR CRITERIA

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations: None

Radionuclide	Deficiency	Samples Affected
U-232	Outside 40keV from the theoretical energy	SS-12-1115. No DVQ on tracer.

Actions: **SEE CENWK 4.1.8, 4.1.9.2 and QAPP FOR CRITERIA**

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: There were no overlapping or interferent peaks. There seemed to be a small amount of tailing and noise. However, this did not seem to negatively impact sample results. All detected radionuclide peaks of interest were within 40keV from their theoretical energies.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density **SEE CENWK 4.1.9, 4.1.7 and QAPP FOR CRITERIA**

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: Please see below.

Radionuclide	Deficiency	Samples Affected

Actions: **SEE CENWK 4.1.9, 4.1.7 and QAPP FOR CRITERIA**

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: The energy of all radionuclide peaks of interest was less than 2 keV from the theoretical energy.

There were no overlapping or interferent peaks.

All radionuclides of interest were identified.

The peak search algorithm was set at 3.0, not the required 2 keV for all SDG samples.

XIII. Tentatively Identified Radionuclides (gamma spectroscopy) Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and Gamma results incomparable.	SB-11-0405. DVQ: "J".
U-235	Alpha and Gamma results incomparable.	SB-11-0506. DVQ: "J"
U-235	Alpha and Gamma results incomparable.	SS-12-1115. DVQ: "J"
U-235	Alpha and Gamma results incomparable.	SB-14-0608. DVQ: "J"
U-235	Alpha and Gamma results incomparable.	SB-DUP-11. DVQ: "J".
U-238	Alpha and Gamma results incomparable.	SB-11-0405. DVQ: "J"
U-238	Alpha and Gamma results incomparable.	SB-14-2540. DVQ: "J"
U-238	Alpha and Gamma results incomparable.	SB-14-0608. DVQ; "J"

Actions:

1. Qualify all tentatively identified radionuclides as estimated (J).
2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

Please see calculation sheet

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) **see CENWK and QAPP**

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations: None

Radionuclide/Method	Deficiency	Samples Affected

Actions: **see CENWK and QAPP**

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: No obvious discrepancies in sysmtem performance. A little noise in alpha spectra did not adversely affect data. All background levels were low. There were no known energy shifts.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculation sheets

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculation sheets

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: Data qualified using parameters and guidance from the QAPP, CENWK, and QSM 5.1

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Report to: **David Lindsey**

Email To: **lindseyd@geoconsultantscorp.com**

Project Description: **Staten Isl Warehouse, Port Richmond**

City/State Collected: Staten Island/NewYork

Please Circle: PT MT CT ET

Phone: **270-462-3882**

Client Project # **FUSRAP**

Lab Project #

SDG # L1410508
B226

Site/Facility ID #

P.O. #

Collected by (print): David Lindsey

Collected by (signature):

Immediately Packed on Ice N ✓ Y ___

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Acctnum: **GEOCONKKY**
Template: **T195295**
Prelogin: **P873895**
PM: **732 - Donna Eidson**
PB:
Shipped Via: **FedEX Ground**

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21, U-ISO 16ozHDPE-NoPres	Remarks	Sample # (lab only)
SS-05-0915	G	SCM	0-0.5	9-22-21	0915	1	X		-01
SB-05-0505	G	SCM	0.5-5	9-22-21	1345	1	X		-02
SB-05-0510	G	SCM	5-10	9-22-21	1350	1	X		-03
SS-03-0810	G	SCM	0-0.5	9-24-21	0810	1	X		-04
SB-03-0815	G	SCM	0.5-1	9-24-21	0815	1	X		-05
SB-03-0102	G	SCM	1-2	9-24-21	0820	1	X		-06
SS-01-0825	G	SCM	0-0.5	9-24-21	0825	1	X		-07
SB-01-0501	G	SCM	0.5-1	9-24-21	0827	1	X		-08
SB-01-0102	G	SCM	~~0~~1-2	9-24-21	0830	1	X		-09
		SCM				1	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks: **no ice required**

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
[signature]	9/27/21	1220		0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	IR7 BR Temp: -2 °C Bottles Received: 9 22.4 22.2
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

2500 cpm

Geo Consultants Corp
325 Kentucky Ave
Kevil KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description:

City/State Collected:

Please Circle: PT MT CT ET

Phone: (270) 462-3882

Client Project #: FUSRAP

Lab Project #

SDG # L1410508
B227

Collected by (print): Ben Hooks

Site/Facility ID #

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N X Y ___

Acctnum:
Template:
Prelogin:
PM:
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	GSPEC-Norm21, U-150	Remarks	Sample # (lab only)
SB-MS-05	G	SCM	0.5-5	9/22/21	1345	1	X		-02
SB-MSD-05	G	SCM	0.5-5	9/22/21	1345	1	X		-02
SB-DUP-01	G	SCM	0.5-1	9/24/21	0827	1	X		-10
SS-DUP-03	G	SCM	0-0.5	9/24/21	0810	1	X		-11

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)		
Relinquished by : (Signature)	Date: 9/27/21	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: -.2 °C 22.4 22.2	Bottles Received: 4
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21	Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

25

<500 cpm

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.78	J	0.366	0.161	10/18/2021 16:50	WG1754721
URANIUM-235	0.206		0.102	0.0771	10/18/2021 16:50	WG1754721
URANIUM-238	2.80	J	0.356	0.0771	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*58.2*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.37	X	0.366	0.598	11/02/2021 12:27	WG1756382
Bismuth-212	1.44	~~J~~ X	1.37	2.55	11/02/2021 12:27	WG1756382
Bismuth-214 (Ra-226)	4.05	X	0.532	0.350	11/02/2021 12:27	WG1756382
Lead-212	1.61	X	0.266	0.280	11/02/2021 12:27	WG1756382
Lead-214	4.44	X	0.578	0.472	11/02/2021 12:27	WG1756382
Potassium-40	10.3	X	2.07	2.02	11/02/2021 12:27	WG1756382
Thallium-208	0.426	X	0.125	0.176	11/02/2021 12:27	WG1756382
Uranium-235	0.379	X	0.129	0.215	11/02/2021 12:27	WG1756382
Thorium-234 (U-238)	-6.81	(U) X,J	3.18	5.34	11/02/2021 12:27	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.74	J	0.297	0.157	10/18/2021 16:50	WG1754721
URANIUM-235	0.0665	~~J~~	0.0873	0.121	10/18/2021 16:50	WG1754721
URANIUM-238	1.56		0.271	0.0963	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*63.0*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.19	X	0.299	0.409	11/02/2021 14:24	WG1756382
Bismuth-212	2.30	X	1.02	1.52	11/02/2021 14:24	WG1756382
Bismuth-214 (Ra-226)	1.47	X	0.254	0.260	11/02/2021 14:24	WG1756382
Lead-212	1.20	X	0.174	0.164	11/02/2021 14:24	WG1756382
Lead-214	1.70	X	0.228	0.250	11/02/2021 14:24	WG1756382
Potassium-40	10.6	X	1.99	1.56	11/02/2021 14:24	WG1756382
Thallium-208	0.432	X	0.106	0.128	11/02/2021 14:24	WG1756382
Uranium-235	0.211	X	0.0725	0.114	11/02/2021 14:24	WG1756382
Thorium-234 (U-238)	0.960	~~J~~ X(U)	0.703	1.60	11/02/2021 14:24	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.35	J	0.274	0.201	10/18/2021 16:50	WG1754721
URANIUM-235	0.0181	U	0.0442	0.0744	10/18/2021 16:50	WG1754721
URANIUM-238	1.43	J	0.257	0.115	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*64.5*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.12	X	0.228	0.358	11/02/2021 14:24	WG1756382
Bismuth-212	0.767	~~J~~ X	0.780	1.42	11/02/2021 14:24	WG1756382
Bismuth-214 (Ra-226)	1.20	X	0.184	0.198	11/02/2021 14:24	WG1756382
Lead-212	1.19	X	0.162	0.180	11/02/2021 14:24	WG1756382
Lead-214	1.49	X	0.183	0.195	11/02/2021 14:24	WG1756382
Potassium-40	11.4	X	1.59	1.30	11/02/2021 14:24	WG1756382
Thallium-208	0.332	X	0.0776	0.101	11/02/2021 14:24	WG1756382
Uranium-235	0.124	~~J~~ X	0.0735	0.129	11/02/2021 14:24	WG1756382
Thorium-234 (U-238)	-1.29	(U) X,J	1.41	3.12	11/02/2021 14:24	WG1756382

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.43	J	0.365	0.133	10/18/2021 16:50	WG1754721
URANIUM-235	0.140	J	0.0863	0.0888	10/18/2021 16:50	WG1754721
URANIUM-238	3.96		0.383	0.0635	10/18/2021 16:50	WG1754721
(T) URANIUM-232	*81.2*			*30.0-110*	*10/18/2021 16:50*	WG1754721

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.51	X	0.394	0.511	11/02/2021 12:03	WG1756382
Bismuth-212	2.58	X	1.10	1.79	11/02/2021 12:03	WG1756382
Bismuth-214 (Ra-226)	2.23	X	0.298	0.268	11/02/2021 12:03	WG1756382
Lead-212	2.80	X	0.304	0.216	11/02/2021 12:03	WG1756382
Lead-214	2.62	X	0.300	0.250	11/02/2021 12:03	WG1756382
Potassium-40	11.0	X	1.84	1.79	11/02/2021 12:03	WG1756382
Thallium-208	0.819	X	0.131	0.131	11/02/2021 12:03	WG1756382
Uranium-235	0.370	X(J)	0.104	0.172	11/02/2021 12:03	WG1756382
Thorium-234 (U-238)	3.45	X(U)	1.95	2.91	11/02/2021 12:03	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.52		0.382	0.136	10/19/2021 19:21	WG1754722
URANIUM-235	0.182		0.103	0.106	10/19/2021 19:21	WG1754722
URANIUM-238	3.07	J	0.352	0.0837	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*67.3*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.72	X	0.391	0.609	11/02/2021 15:45	WG1756382
Bismuth-212	0.0268	~~U~~ X	1.15	2.28	11/02/2021 15:45	WG1756382
Bismuth-214 (Ra-226)	1.47	X	0.271	0.316	11/02/2021 15:45	WG1756382
Lead-212	1.67	X	0.239	0.251	11/02/2021 15:45	WG1756382
Lead-214	1.65	X	0.237	0.260	11/02/2021 15:45	WG1756382
Potassium-40	4.68	X	1.43	1.77	11/02/2021 15:45	WG1756382
Thallium-208	0.496	X	0.116	0.144	11/02/2021 15:45	WG1756382
Uranium-235	0.205	X	0.0911	0.156	11/02/2021 15:45	WG1756382
Thorium-234 (U-238)	0.790	(U) X,J	1.28	2.82	11/02/2021 15:45	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.21		0.341	0.148	10/19/2021 19:21	WG1754722
URANIUM-235	0.178		0.0854	0.0706	10/19/2021 19:21	WG1754722
URANIUM-238	3.19		0.336	0.130	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*78.1*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.91	X	0.354	0.466	11/02/2021 12:04	WG1756382
Bismuth-212	1.82	~~J~~ X	1.09	1.90	11/02/2021 12:04	WG1756382
Bismuth-214 (Ra-226)	1.46	X	0.258	0.302	11/02/2021 12:04	WG1756382
Lead-212	1.90	X	0.246	0.214	11/02/2021 12:04	WG1756382
Lead-214	1.78	X	0.247	0.271	11/02/2021 12:04	WG1756382
Potassium-40	8.77	X	1.78	1.87	11/02/2021 12:04	WG1756382
Thallium-208	0.580	X	0.117	0.128	11/02/2021 12:04	WG1756382
Uranium-235	0.183	X	0.0963	0.174	11/02/2021 12:04	WG1756382
Thorium-234 (U-238)	2.06	~~J~~ X(U)	1.51	2.87	11/02/2021 12:04	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.45		0.358	0.128	10/19/2021 19:21	WG1754722
URANIUM-235	0.254		0.103	0.0749	10/19/2021 19:21	WG1754722
URANIUM-238	3.52		0.356	0.0749	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*83.6*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.37	X	0.415	0.520	11/02/2021 17:03	WG1756382
Bismuth-212	3.18	X	1.29	1.92	11/02/2021 17:03	WG1756382
Bismuth-214 (Ra-226)	2.76	X	0.352	0.253	11/02/2021 17:03	WG1756382
Lead-212	2.66	X	0.305	0.252	11/02/2021 17:03	WG1756382
Lead-214	2.88	X	0.331	0.279	11/02/2021 17:03	WG1756382
Potassium-40	6.76	X	1.59	1.74	11/02/2021 17:03	WG1756382
Thallium-208	0.789	X	0.138	0.152	11/02/2021 17:03	WG1756382
Uranium-235	0.350	X	0.106	0.173	11/02/2021 17:03	WG1756382
Thorium-234 (U-238)	2.62	~~J~~ X(U)	1.69	3.04	11/02/2021 17:03	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.597		0.179	0.164	10/19/2021 19:21	WG1754722
URANIUM-235	0.0410	~~J~~	0.0476	0.0606	10/19/2021 19:21	WG1754722
URANIUM-238	0.634	J	0.158	0.0937	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*86.0*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.45	X	0.383	0.584	11/02/2021 14:26	WG1756382
Bismuth-212	2.69	X	1.29	1.94	11/02/2021 14:26	WG1756382
Bismuth-214 (Ra-226)	1.14	X	0.275	0.369	11/02/2021 14:26	WG1756382
Lead-212	1.66	X	0.268	0.263	11/02/2021 14:26	WG1756382
Lead-214	1.07	X	0.255	0.508	11/02/2021 14:26	WG1756382
Potassium-40	6.56	X	1.70	1.67	11/02/2021 14:26	WG1756382
Thallium-208	0.480	X	0.134	0.177	11/02/2021 14:26	WG1756382
Uranium-235	0.131	~~J~~ X	0.102	0.187	11/02/2021 14:26	WG1756382
Thorium-234 (U-238)	-3.88	(U) X,J	2.22	4.71	11/02/2021 14:26	WG1756382

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.66		0.253	0.127	10/19/2021 19:21	WG1754722
URANIUM-235	0.124		0.0803	0.0847	10/19/2021 19:21	WG1754722
URANIUM-238	1.74		0.249	0.0605	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*85.4*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.929	X	0.289	0.388	11/02/2021 14:28	WG1756382
Bismuth-212	1.60	~~J~~ X	1.08	1.78	11/02/2021 14:28	WG1756382
Bismuth-214 (Ra-226)	0.788	X	0.206	0.241	11/02/2021 14:28	WG1756382
Lead-212	0.940	X	0.207	0.258	11/02/2021 14:28	WG1756382
Lead-214	0.939	X	0.188	0.216	11/02/2021 14:28	WG1756382
Potassium-40	7.54	X	1.78	1.41	11/02/2021 14:28	WG1756382
Thallium-208	0.287	X	0.0982	0.122	11/02/2021 14:28	WG1756382
Uranium-235	0.144	~~J~~ X	0.101	0.175	11/02/2021 14:28	WG1756382
Thorium-234 (U-238)	0.856	(U) X	1.27	2.72	11/02/2021 14:28	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.25		0.229	0.123	10/19/2021 19:21	WG1754722
URANIUM-235	0.0837		0.0694	0.0795	10/19/2021 19:21	WG1754722
URANIUM-238	1.35	J	0.230	0.0908	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*89.5*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.51	X	0.430	0.651	11/02/2021 15:42	WG1756382
Bismuth-212	2.39	X	1.39	2.26	11/02/2021 15:42	WG1756382
Bismuth-214 (Ra-226)	1.13	X	0.298	0.389	11/02/2021 15:42	WG1756382
Lead-212	1.56	X	0.269	0.272	11/02/2021 15:42	WG1756382
Lead-214	1.02	X	0.271	0.551	11/02/2021 15:42	WG1756382
Potassium-40	8.19	X	2.05	1.83	11/02/2021 15:42	WG1756382
Thallium-208	0.460	X	0.150	0.213	11/02/2021 15:42	WG1756382
Uranium-235	0.181	~~J~~ X	0.111	0.198	11/02/2021 15:42	WG1756382
Thorium-234 (U-238)	-2.31	(U) X,J	2.14	5.17	11/02/2021 15:42	WG1756382

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

15

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	3.86		0.411	0.150	10/19/2021 19:21	WG1754722
URANIUM-235	0.169		0.0950	0.0877	10/19/2021 19:21	WG1754722
URANIUM-238	3.63		0.396	0.128	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*72.8*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.632	X	0.339	0.624	11/02/2021 17:12	WG1756460
Bismuth-212	1.15	~~U~~ X	1.28	2.43	11/02/2021 17:12	WG1756460
Bismuth-214 (Ra-226)	0.543	X	0.256	0.450	11/02/2021 17:12	WG1756460
Lead-212	1.47	X	0.231	0.221	11/02/2021 17:12	WG1756460
Lead-214	0.795	X	0.223	0.390	11/02/2021 17:12	WG1756460
Potassium-40	1.94	~~J~~ X	1.76	3.10	11/02/2021 17:12	WG1756460
Thallium-208	0.228	X	0.106	0.163	11/02/2021 17:12	WG1756460
Uranium-235	0.0184	(U) X	0.102	0.196	11/02/2021 17:12	WG1756460
Thorium-234 (U-238)	3.17	X	1.39	2.12	11/02/2021 17:12	WG1756460

Radiological Analytical Data Validation
Comments on Data for Case Number L1410508

Event Name:	Staten Island Warehouse FUSRAP Site
SDG Number:	L1410508
Laboratory:	Pace Analytical
Analysis:	Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 4 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.

[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.

[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Client Identification	Laboratory Identification
SS-05-0915	L1410508-01
SB-05-0505	L1410508-02
SB-05-0510	L1410508-03
SS-03-0810	L1410508-04
SB-03-0815	L1410508-05
SB-03-0102	L1410508-06
SS-01-0825	L1410508-07
SB-01-0501	L1410508-08
SB-01-0102	L1410508-09
SB-DUP-01	L1410508-10
SS-DUP-03	L1410508-11

Validation Report By: **C. Martin Johnson** **03/14/2022**
(print) **Date**

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/14/2022**
(print) **Date**

(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SB-05-0505	X
2	C6	3	-9.4-7.9			SB-05-0510	X
3	C6	1	18.8	8	8.4 – 10.6	SS-05-0915, SB-01-0501, SB-DUP-01	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	SB-01-0102	X
4	P3	1	18.3	1	8.8	SB-03-0815, SS-01-0825	X
10	P3	1	22.4	2	8.2-8.3	SS-DUP-03	X
12	P3	1	24.5	1	9.6	SS-03-0810, SB-03-0102	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data

Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detector/geometry has one quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration Check

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
3	C6	1	25.5	SS-05-0915, SB-01-0501, SB-DUP-01	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project MDA goal of <1 pCi/g was not achieved for Thorium 234 (U-238) in the samples as shown in the following table:

RDLs Not Met

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU (pCi/g)	RDL (pCi/g)
SS-05-0915	Th-234 (U-238)	1.59	5.565	1
SB-05-0510	Th-234 (U-238)	0.705	2.4675	1
SB-03-0815	Th-234 (U-238)	0.64	2.24	1
SB-01-0501	Th-234 (U-238)	1.11	3.885	1
SB-01-0102	Th-234 (U-238)	0.635	2.2225	1
SB-DUP-01	Th-234 (U-238)	1.07	3.745	1

The sample-specific critical level (L_c) was calculated as 1.65 CSU. **It is recommended that sample concentrations less than the L_c include were qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SS-05-0915	Th-234(U-238)	-6.81	1.59	2.616	U
SS-DUP-03	U-235	0.0184	0.051	0.084	U
SB-05-0510	Th-234(U-238)	-1.29	0.705	1.16	U
SB-03-0815	Th-234(U-238)	0.790	0.64	1.053	U
SB-01-0501	Th-234(U-238)	-3.88	1.11	1.826	U
SB-01-0102	Th-234(U-238)	0.856	0.635	1.045	U
SB-DUP-01	Th-234(U-238)	-2.31	1.07	1.76	U

Lc = 1.65 * CSU

Method Blank

Thorium-234 was detected in the Method Blank for the gamma spectrometry analysis. **It is recommended that sample results less than 5x the blank value be qualified as non-detect (U) as follows: SS-05-0915, SB-05-0505, SB-05-0510, SS-03-0810, SB-03-0815, SB-03-0102, SS-01-0825, SB-01-0501, SB-01-0102, and SB-DUP-01.**

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have DERs with acceptable limits.

Identification and Quantification:

The following radionuclides: ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been used to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

Calculations

Ten percent of the results were recalculated. No issues were observed.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the alpha spectrometry analyses.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL of <0.5 pCi/g was met for all radionuclides of interest.

No sample results were seen above the project action limits.

The sample-specific critical level (L_c) was calculated as 1.65 CSU. **It is recommended that sample concentrations less than the L_c include be qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SB-05-0510	U-235	0.0181	0.0221	0.0364	U

Lc = 1.65 * CSU

Matrix Spike

A non-SDG sample was used as a matrix spike. The percent recoveries were within acceptable limits.

Method Blank

There was no indication of blank contamination for the alpha spectrometry analysis.

Laboratory Control Sample:

The Uranium-234 percent recovery for LCS R3720206-2 was below the lower acceptable limit (75%-125%). **All alpha Uranium-234 results associated with this LCS are recommended to be qualified as estimated (J): SS-05-0915, SB-05-0505, SB-05-0510, and SS-03-0810.** Please see table below.

Radiochemistry - LCS % Recovery Calculation

Sample ID	**Analyte**	**Found Value (pCi/g)**	**True Value (pCi/g)**	**LCS (% Recovery)**
(LCS) R3720206-2	U-234	3.48	4.78	72.70%

Duplicate Analysis:

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The DERs are within acceptable limits for the duplicate analyses for all alpha spectrometry analyses.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

No spectral interferences were observed in all of the alpha spectrometry analyses. There was a small amount of background noise, but nothing that would interfere with sample results. All detected radionuclide peaks of interest were within 40keV from their theoretical energies.

Quantification:

No quantification issues were observed.

Calculations

Ten percent of the results were recalculated. No issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement. **The following U-235 and U-238 sample results are recommended to be qualified as estimated (J) due to incomparable results.** Please see table below.

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SS-05-0915	U-238	2.80	0.178	-6.81	1.59	479.3%	6.01	J
SB-05-0510	U-238	1.43	0.1285	-1.29	0.705	3885.71%	3.80	J
SS-03-0810	U-235	0.140	0.04315	0.370	0.052	90.20%	3.40	J
SB-03-0815	U-238	3.07	0.176	0.790	0.64	118.13%	4.87	J
SB-01-0501	U-238	0.634	0.079	-3.88	1.11	278.1%	4.06	J
SB-DUP-01	U-238	1.35	0.115	-2.31	1.07	762.5%	3.40	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410508

Analyte Group: **Gamma Spec and Iso U**
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: ______
NCR No. (if applicable): ______

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for surrogate recovery results (e.g., org. form II)		Y
Check for LCS results (e.g., org. form III, inorg. form XII)		Y
Check for method blank results (e.g., org. form IV, inorg. form III)		Y
Check for MS/MSD results (e.g., inorg. form V)		Y
Check for laboratory duplicate results (e.g., inorg. form VI)		Y
Check for Method Calibration and Run Documentation		Y
organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other:	initial calibration data	Y
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

Sample SS-DUP-03 had the incorrect sample ID in the data package. The package has SB-DUP-03 while the COC has SS-DUP-03. This discrepancy does not affect the data.

The package was missing standard COAs and calibration documentation. A revision was issued by the laboratory containing some of the missing items.

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: C. Martin Johnson, Jr. Date: 3/14/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410508

Analyte Group: Alpha Spec and Gamma Spec

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-05-0915	L1410508-01	Soil	Isotopic Uranium and Gamma Spect	
SB-05-0505	L1410508-02	Soil	Isotopic Uranium and Gamma Spect	
SB-05-0510	L1410508-03	Soil	Isotopic Uranium and Gamma Spect	
SS-03-0810	L1410508-04	Soil	Isotopic Uranium and Gamma Spect	
SB-03-0815	L1410508-05	Soil	Isotopic Uranium and Gamma Spect	
SB-03-0102	L1410508-06	Soil	Isotopic Uranium and Gamma Spect	
SS-01-0825	L1410508-07	Soil	Isotopic Uranium and Gamma Spect	
SB-01-0501	L1410508-08	Soil	Isotopic Uranium and Gamma Spect	
SB-01-0102	L1410508-09	Soil	Isotopic Uranium and Gamma Spect	
SB-DUP-01	L1410508-10	Soil	Isotopic Uranium and Gamma Spect	
SS-DUP-03	L1410508-11	Soil	Isotopic Uranium and Gamma Spect	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410508

Analysis: **Isotopic Uranium and Gamma Spec.**

Method: Alpha Spec and Gamma Spec

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Results qualified as indicated due to detection levels, low LCS recoveries, and detetects in the MB.

Definition of Qualifiers:

"U", not detected at the associated level

~~"UJ", not detected and associated value estimated~~ N/A

"J", associated value estimated

"R", associated value unusable or analyte identity unfounded

"=", compound properly identified and value positive

Reviewed by: C. Martin Johnson, Jr. Date: 3/14/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks:

No issues were discussed in the case narrative.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks:

No isssues.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks:

All holding times were met by the laboratory.
Isotopic Uranium was performed in October of 2021.
Gamma Spec was performed in November of 2021.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Isotopic U			See Below
Gamma Spec			See Below

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks:

Not all of the MDA's were met. The MDA of 1.0 pCi/g was not achieved
for Th-234 (U-238).
The following set of samples did not meet the MDA for Th-234 (U-238) for
samples SS-05-0915, SB-05-0510, SB-03-0815, SB-01-0501, SB-01-0102,
SB-DUP-01 and SS-DUP-03.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No issues.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Based on the calibration and check sources used for the calibration of the gamma spect there may be more uncertainity in the results than expected.

These samples have been qualified as unusable(X) based on the CENWK guidance. Hoevever, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only .
marginally greater than would normally be allowed.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations: N/A

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: N/A

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations: N/A

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: N/A

Radiochemical Data Review Checklist

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks:

Date	Lab ID #	Radionulcide	Result and Error (pCi/g)	MDA Result and Error (pCi/g)
2-Nov-21	MB R3724570-3	Th-234	0.975 & 0.514	0.894 & 0.514

Please see next page.

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks:

No issues for the alpha spectrometry. No project blanks associated with this SDG.

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on ~~10X~~ 5x the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations:

Radionuclide	Max. Activity Detected	Action Level	Samples Affected
Th-234	0.975 pCi/g	4.875 pCi/g	SS-05-0915
			SB-05-0505
			SB-05-0510
			SS-03-0810
			SB-03-0815
			SB-03-0102
			SS-01-0825
			SB-01-0501
			SB-01-0102
			SB-DUP-01

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks: The samples listed above had results less than 5x the blank results. Therefore, they were qualified as U.

Radiochemical Data Review Checklist

VII. Sample-Specific Carrier or Tracer Recovery

see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks:

No issues.

Radiochemical Data Review Checklist

VIII. Laboratory Control Sample Information

see CENWK 4.2.2 and QAPP

Gross Alpha

General LCS Criteria:
percent recovery (%R)

aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications:

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
U-234	18-Oct-21	72.70%	SS-05-0915
			SB-05-0505
			SB-05-0510
			SS-03-0810

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks:

The samples listed above were qualified as estimated "J".
The gamma analysis had acceptable LCS recoveries.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: SB-05-0505

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch

see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks:

No issues.

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: DUP R3724570-4

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks:

No qualification of samples due to RPD/NAD results.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No issues.

XIII. Tentatively Identified Radionuclides (gamma spectroscopy)

Data Intercomparison

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and gamma results not comparable.	SS-05-0915: DVQ: J
U-238	Alpha and gamma results not comparable.	SB-05-0510: DVQ: J
U-235	Alpha and gamma results not comparable.	SS-03-0810: DVQ: J
U-238	Alpha and gamma results not comparable.	SB-03-0815: DVQ: J
U-238	Alpha and gamma results not comparable.	SB-01-0501: DVQ: J
U-238	Alpha and gamma results not comparable.	SB-DUP-01: DVQ: J

Actions:

~~1. Qualify all tentatively identified radionuclides as estimated (J).~~
~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~ If the results do not agree within the reported uncertainty of measurement, results shall be qualifiedas "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

The samples listed above were qualified as estimated due to incomparable results.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks:

No issues.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:
Not Applicable	

Remarks:____________________

Calculation Check:

Radionuclide:	Method:

Remarks:____________________

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks:

Results qualified as indicated per CENWK and QSM 5.3

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

Report to: **David Lindsey**

Email To: lindseyd@geoconsultantscorp.com

Project Description: **Staten Isl Warehouse, Port Richmond**

City/State Collected: Staten Island, New York

Please Circle: PT MT CT ET

Phone: **270-462-3882**

Client Project # **FUSRAP**

Lab Project #

Site/Facility ID #

P.O. #

Quote #

Collected by (print): David Lindsey

Collected by (signature):

Immediately Packed on Ice N ✓ Y ___

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Date Results Needed

SDG # L1410531
B228

Acctnum: **GEOCONKKY**
Template: **T195295**
Prelogin: **P873895**
PM: **732 - Donna Eidson**
PB:
Shipped Via: **FedEx Ground**

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21, U-ISO 16ozHDPE-NoPres									Remarks	Sample # (lab only)
SS-16-~~1~~1300	✓	SCM	0-0.5	9-23-21	1300	1	X										-01
SB-16-0235	✓	SCM	2-3.5	9-23-21	1325	1	X										-02
SS-17-1230	✓	SCM	0-0.5	9-24-21	1230	1	X										-03
SB-17-0102	✓	SCM	1-2'	9-24-21	1240	1	X										-04
SS-18-1250	✓	SCM	0-0.5	9-24-21	1250	1	X										-05
SB-18-0102	✓	SCM	1-2'	9-24-21	1300	1	X										-06
SS-19-1310	✓	SCM	0-0.5	9-24-21	1310	1	X										-07
SB-19-0102	✓	SCM	1-2	9-24-21	1315	1	X										-08
SB-19-0203	✓	SCM	2-3	9-24-21	1320	1	X										-09
SB-DUP-16	✓	SCM	2-3.5	9/23/21	1325	1	X										-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_________

Remarks: no ice required

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
[signature]	9-27-21	1445		0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: AZAR °C 22.7+.1=22.4 Bottles Received: 13
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/29/21 Time: 10:15

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

<500 cpm

Company Name/Address:	Billing Information:	Pres Chk
Geo Consultants - Kevil, KY 325 Kentucky Ave Kevil, KY 42053	Accounts Payable 325 Kentucky Ave Kevil, KY 42053	
Report to: David Lindsey	Email To: lindseyd@geoconsultantscorp.com	

Analysis / Container / Preservative: GSPEC-NORM21,U-ISO 16ozHDPE-NoPres

Chain of Custody Page ___ of ___

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SDG # L1410531

Table #

Acctnum: **GEOCONKKY**
Template: **T195295**
Prelogin: **P873895**
PM: **732 - Donna Eidson**
PB:
Shipped Via: **FedEX Ground**

Project Description:	City/State Collected:	Please Circle:
Staten Isl Warehouse, Port Richmond	Staten Island NY	PT MT CT ET

Phone: 270-462-3882	Client Project # FUSRAP	Lab Project #
Collected by (print): Ben Hgoks	Site/Facility ID #	P.O. #
Collected by (signature):	*Rush?* (Lab MUST Be Notified) ___ Same Day ___ Five Day ___ Next Day ___ 5 Day (Rad Only) ___ Two Day ___ 10 Day (Rad Only) ___ Three Day	Quote # Date Results Needed
Immediately Packed on Ice N ✓ Y ___		

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres	Remarks	Sample # (lab only)
SB-MS-18	G	SCM	1-2	9/24/21	1300	1	X		-06
SB-MSD-18	G	SCM	1-2	9/24/21	1300	1	X		-06
SS-DUP-17	G	SCM	1-2	9/24/21	1240	1	X		-11
		SCM				1	X		
		SCM				1	X		
		SCM				1	X		
		SCM				1	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:no ice required

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP __Y __N
COC Signed/Accurate: __Y __N
Bottles arrive intact: __Y __N
Correct bottles used: __Y __N
Sufficient volume sent: __Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: __Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
	9/27/21	1445		0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: AL °C 22.7+.1=22.8 Bottles Received: 13
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.82		0.324	0.23	10/19/2021 19:21	WG1754722
URANIUM-235	0.101	J	0.0767	0.0779	10/19/2021 19:21	WG1754722
URANIUM-238	2.09		0.326	0.176	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*70.7*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.43	X	0.425	0.663	11/03/2021 09:48	WG1759843
Bismuth-212	1.39	~~J~~ X	1.59	2.9	11/03/2021 09:48	WG1759843
Bismuth-214 (Ra-226)	3.34	X	0.467	0.416	11/03/2021 09:48	WG1759843
Lead-212	1.26	X	0.272	0.358	11/03/2021 09:48	WG1759843
Lead-214	4.08	X	0.467	0.384	11/03/2021 09:48	WG1759843
Potassium-40	10.7	X	2.33	2.28	11/03/2021 09:48	WG1759843
Thallium-208	0.306	X	0.126	0.189	11/03/2021 09:48	WG1759843
Uranium-235	0.385	X(J)	0.154	0.26	11/03/2021 09:48	WG1759843
Thorium-234 (U-238)	-5.03	(U) X	2.96	6.01	11/03/2021 09:48	WG1759843

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.04		0.223	0.176	10/19/2021 19:21	WG1754722
URANIUM-235	0.0321	J	0.0441	0.0606	10/19/2021 19:21	WG1754722
URANIUM-238	1.16		0.219	0.137	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*78.8*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.43	X	0.346	0.502	11/03/2021 09:47	WG1759843
Bismuth-212	2.21	X	1.14	1.81	11/03/2021 09:47	WG1759843
Bismuth-214 (Ra-226)	1.34	X	0.267	0.298	11/03/2021 09:47	WG1759843
Lead-212	1.33	X	0.199	0.197	11/03/2021 09:47	WG1759843
Lead-214	1.30	X	0.210	0.277	11/03/2021 09:47	WG1759843
Potassium-40	13.4	X	2.41	1.71	11/03/2021 09:47	WG1759843
Thallium-208	0.473	X	0.112	0.124	11/03/2021 09:47	WG1759843
Uranium-235	0.103	J X	0.0725	0.128	11/03/2021 09:47	WG1759843
Thorium-234 (U-238)	1.18	J X(U)	0.767	1.61	11/03/2021 09:47	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	24.9		1.02	0.111	10/19/2021 19:21	WG1754722
URANIUM-235	1.19	J	0.226	0.0719	10/19/2021 19:21	WG1754722
URANIUM-238	24.9	J	1.02	0.0881	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*72.5*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.61	X	0.333	0.546	11/03/2021 10:02	WG1759843
Bismuth-212	2.76	X	1.25	2.11	11/03/2021 10:02	WG1759843
Bismuth-214 (Ra-226)	15.5	X	1.28	0.308	11/03/2021 10:02	WG1759843
Lead-212	1.64	X	0.235	0.304	11/03/2021 10:02	WG1759843
Lead-214	17.2	X	1.48	0.335	11/03/2021 10:02	WG1759843
Potassium-40	11.1	X	1.77	1.92	11/03/2021 10:02	WG1759843
Thallium-208	0.337	X	0.107	0.174	11/03/2021 10:02	WG1759843
Uranium-235	2.17	X(J)	0.230	0.23	11/03/2021 10:02	WG1759843
Thorium-234 (U-238)	12.3	X(J)	4.51	4.29	11/03/2021 10:02	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	22.0		0.841	0.144	10/19/2021 19:21	WG1754722
URANIUM-235	0.970		0.179	0.0669	10/19/2021 19:21	WG1754722
URANIUM-238	22.1		0.839	0.0843	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*77.4*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.21	X	0.577	0.99	11/03/2021 10:04	WG1759843
Bismuth-212	1.14	U X	2.17	3.95	11/03/2021 10:04	WG1759843
Bismuth-214 (Ra-226)	19.8	X	1.64	0.526	11/03/2021 10:04	WG1759843
Lead-212	1.59	X	0.353	0.501	11/03/2021 10:04	WG1759843
Lead-214	21.8	X	1.80	0.535	11/03/2021 10:04	WG1759843
Potassium-40	9.98	X	2.48	3.21	11/03/2021 10:04	WG1759843
Thallium-208	0.569	X	0.174	0.275	11/03/2021 10:04	WG1759843
Uranium-235	1.28	X	0.899	0.346	11/03/2021 10:04	WG1759843
Thorium-234 (U-238)	18.5	X(J)	6.89	6.04	11/03/2021 10:04	WG1759843

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.03		0.218	0.171	10/20/2021 07:56	WG1754722
URANIUM-235	0.0309	J	0.0429	0.059	10/20/2021 07:56	WG1754722
URANIUM-238	1.18		0.217	0.133	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*83.1*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.02	X	0.257	0.385	11/03/2021 09:56	WG1759843
Bismuth-212	1.51	X	0.893	1.49	11/03/2021 09:56	WG1759843
Bismuth-214 (Ra-226)	1.00	X	0.209	0.22	11/03/2021 09:56	WG1759843
Lead-212	1.15	X	0.197	0.215	11/03/2021 09:56	WG1759843
Lead-214	1.30	X	0.203	0.182	11/03/2021 09:56	WG1759843
Potassium-40	9.59	X	1.69	1.04	11/03/2021 09:56	WG1759843
Thallium-208	0.391	X	0.0954	0.102	11/03/2021 09:56	WG1759843
Uranium-235	0.228	X(J)	0.0857	0.134	11/03/2021 09:56	WG1759843
Thorium-234 (U-238)	-0.109	(U) X	1.12	2.55	11/03/2021 09:56	WG1759843

10

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.838		0.195	0.15	10/19/2021 19:21	WG1754722
URANIUM-235	0.00432	U	0.0399	0.0737	10/19/2021 19:21	WG1754722
URANIUM-238	0.756		0.168	0.0841	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*89.0*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.11		0.219	0.289	11/03/2021 10:44	WG1759843
Bismuth-212	1.29		0.640	1.08	11/03/2021 10:44	WG1759843
Bismuth-214 (Ra-226)	1.22		0.173	0.142	11/03/2021 10:44	WG1759843
Lead-212	1.05		0.147	0.136	11/03/2021 10:44	WG1759843
Lead-214	1.44		0.172	0.163	11/03/2021 10:44	WG1759843
Potassium-40	12.1		1.68	1.23	11/03/2021 10:44	WG1759843
Thallium-208	0.376		0.0711	0.0763	11/03/2021 10:44	WG1759843
Uranium-235	0.203	~~J~~	0.232	0.413	11/03/2021 10:44	WG1759843
Thorium-234 (U-238)	1.27	~~J~~ U	0.787	1.36	11/03/2021 10:44	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.962		0.193	0.158	10/19/2021 19:21	WG1754722
URANIUM-235	0.0521	J	0.0679	0.0933	10/19/2021 19:21	WG1754722
URANIUM-238	0.955		0.182	0.132	10/19/2021 19:21	WG1754722
(T) URANIUM-232	*79.2*			*30.0-110*	*10/19/2021 19:21*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.893	X	0.151	0.202	11/03/2021 10:48	WG1759843
Bismuth-212	1.37	X	0.537	0.819	11/03/2021 10:48	WG1759843
Bismuth-214 (Ra-226)	1.23	X	0.139	0.114	11/03/2021 10:48	WG1759843
Lead-212	1.30	X	0.133	0.107	11/03/2021 10:48	WG1759843
Lead-214	1.25	X	0.132	0.122	11/03/2021 10:48	WG1759843
Potassium-40	12.2	X	1.23	0.751	11/03/2021 10:48	WG1759843
Thallium-208	0.283	X	0.0495	0.0571	11/03/2021 10:48	WG1759843
Uranium-235	0.130	X	0.0521	0.0863	11/03/2021 10:48	WG1759843
Thorium-234 (U-238)	1.45	J X(U)	0.912	1.46	11/03/2021 10:48	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.694		0.204	0.187	10/20/2021 07:56	WG1754722
URANIUM-235	0.0974		0.0693	0.0674	10/20/2021 07:56	WG1754722
URANIUM-238	1.01		0.214	0.135	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*75.7*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.830	X	0.272	0.452	11/03/2021 10:51	WG1759843
Bismuth-212	1.21	J X	0.865	1.47	11/03/2021 10:51	WG1759843
Bismuth-214 (Ra-226)	1.14	X	0.219	0.214	11/03/2021 10:51	WG1759843
Lead-212	1.19	X	0.172	0.161	11/03/2021 10:51	WG1759843
Lead-214	1.29	X	0.193	0.225	11/03/2021 10:51	WG1759843
Potassium-40	9.48	X	1.85	1.32	11/03/2021 10:51	WG1759843
Thallium-208	0.303	X	0.0902	0.118	11/03/2021 10:51	WG1759843
Uranium-235	0.152	X	0.0625	0.101	11/03/2021 10:51	WG1759843
Thorium-234 (U-238)	0.818	J X(U)	0.624	1.43	11/03/2021 10:51	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.790		0.207	0.176	10/20/2021 07:56	WG1754722
URANIUM-235	0.0346	J	0.0474	0.0652	10/20/2021 07:56	WG1754722
URANIUM-238	0.998		0.202	0.101	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*80.2*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.08	X	0.289	0.413	11/03/2021 11:53	WG1759843
Bismuth-212	1.40	J X	1.07	1.89	11/03/2021 11:53	WG1759843
Bismuth-214 (Ra-226)	0.991	X	0.235	0.282	11/03/2021 11:53	WG1759843
Lead-212	1.18	X	0.179	0.18	11/03/2021 11:53	WG1759843
Lead-214	1.02	X	0.185	0.263	11/03/2021 11:53	WG1759843
Potassium-40	13.9	X	2.40	1.5	11/03/2021 11:53	WG1759843
Thallium-208	0.340	X	0.103	0.132	11/03/2021 11:53	WG1759843
Uranium-235	0.0650	J X	0.0628	0.114	11/03/2021 11:53	WG1759843
Thorium-234 (U-238)	0.855	J X(U)	0.666	1.48	11/03/2021 11:53	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.928		0.194	0.124	10/20/2021 07:56	WG1754722
URANIUM-235	0.0315	J U	0.0558	0.0833	10/20/2021 07:56	WG1754722
URANIUM-238	0.874		0.176	0.0595	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*84.2*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.25	X	0.311	0.465	11/03/2021 11:56	WG1759843
Bismuth-212	0.478	U X	0.984	1.89	11/03/2021 11:56	WG1759843
Bismuth-214 (Ra-226)	1.07	X	0.231	0.258	11/03/2021 11:56	WG1759843
Lead-212	1.53	X	0.241	0.229	11/03/2021 11:56	WG1759843
Lead-214	1.14	X	0.200	0.217	11/03/2021 11:56	WG1759843
Potassium-40	15.8	X	2.34	1.17	11/03/2021 11:56	WG1759843
Thallium-208	0.441	X	0.106	0.113	11/03/2021 11:56	WG1759843
Uranium-235	0.131	J X	0.0905	0.156	11/03/2021 11:56	WG1759843
Thorium-234 (U-238)	0.408	(U) X	1.20	2.62	11/03/2021 11:56	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	14.3		0.776	0.136	10/20/2021 07:56	WG1754722
URANIUM-235	0.526		0.155	0.0877	10/20/2021 07:56	WG1754722
URANIUM-238	14.6	(X)	0.781	0.1	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*83.7*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.72	X	0.407	0.665	11/03/2021 10:51	WG1759843
Bismuth-212	2.39	X	1.40	2.39	11/03/2021 10:51	WG1759843
Bismuth-214 (Ra-226)	9.70	X	0.846	0.329	11/03/2021 10:51	WG1759843
Lead-212	2.25	X	0.297	0.335	11/03/2021 10:51	WG1759843
Lead-214	11.8	X	0.998	0.381	11/03/2021 10:51	WG1759843
Potassium-40	8.94	X	1.96	2.43	11/03/2021 10:51	WG1759843
Thallium-208	0.561	X	0.131	0.175	11/03/2021 10:51	WG1759843
Uranium-235	0.0293	~~J~~ X	0.683	0.257	11/03/2021 10:51	WG1759843
Thorium-234 (U-238)	-5.20	~~U~~ (X)	3.39	6.43	11/03/2021 10:51	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410531
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}$U by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

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[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.

[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.

[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-16-1300	Soil	L1410531-01
SB-16-0235	Soil	L1410531-02
SS-17-1230	Soil	L1410531-03
SB-17-0102	Soil	L1410531-04
SS-18-1250	Soil	L1410531-05
SB-18-0102	Soil	L1410531-06
SS-19-1310	Soil	L1410531-07
SB-19-0102	Soil	L1410531-08
SB-19-0203	Soil	L1410531-09
SB-DUP-16	Soil	L1410531-10
SS-DUP-17	Soil	L1410531-11

Validation Report By: **Amanda Leigh Dick** **03/08/2022**

(print) **Date**

Amanda Leigh Dick

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **3/10/22**

(print) **Date**

TLRucker

(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SB-16-0235, SB-19-0102, SB-19-0203	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	SS-18-1250, SB-DUP-16	X
11	C6	1	-5.3	2	8.2 – 12.7	SS-19-1310	X
2	P3	1	5.3			SS-16-1300, SS-DUP-17	X
4	P3	1	18.3	1	8.8	SB-17-0102	X
12	P3	1	24.5	1	9.6	SS-17-1230	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detector/geometry has one quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Differences	SDG Samples Affected	Qualifier
1	C6	1	-10.6	SB-16-0235, SB-19-0102, SB-19-0203	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <1 pCi/g was not met for the following samples: SS-16-1300, SS-18-1250, SB-DUP-16, and SS-DUP-17.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-16-1300	Th-234	1.4815	5.18525	1
SS-18-1250	Th-234	0.5595	1.95825	1
SB-DUP-16	Th-234	0.6005	2.10175	1
SS-DUP-17	Th-234	1.696	5.936	1

The following samples had results that exceeded the project action limits: SS-16-1300: Ra-226 γ 3.34 pCi/g, SS-17-1230: Ra-226 γ 15.5 pCi/g, SB-17-0102: Ra-226 γ 19.8 pCi/g, SS-16-1300: Ra-226 γ 3.34 pCi/g, SS-DUP-17: Ra-226 γ 9.70 pCi/g.

No samples exhibited excess uncertainty:

The following samples had negative results with uncertainties smaller than their absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SS-16-1300: Thorium-234 and SS-DUP-17: Thorium-234.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U). The following results are qualified as U: SS-16-1300: Th-234; SS-18-1250: Th-234; SB-DUP-16: Th-234; and SB-DUP-17: Th-234.

Method Blank

Thorium-234 was detected in the Method Blank for the gamma spectrometry analysis. To be conservative, the action level was calculated based on 5X the highest blank concentration. **It is recommended that Th-234 results that are greater than 5x but less than 10x the blank result be qualified as estimated (J) as follows: SS-17-1230 and SB-17-0102. It is also recommended that Th-234 results that are less than 5x the blank result be qualified as non-detect (U) as follows: SB-18-0102, SS-19-1310, SB-19-0102.**

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD.

$$RPD = \left(\frac{|S-D|}{\frac{S+D}{2}} \right) * 100$$

$$NAD = \frac{|S-D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, < 3).

All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been used to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

The initial calibration met project acceptance criteria for all reported analytes.

Continuing Calibration

The continuing calibration met project acceptance criteria for all reported analytes.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was achieved for all radionuclides of interest.

The following samples had results that exceeded the project action limits: SS-17-1230: U-234 α 24.9 pCi/g, U-235 α 1.19 pCi/g, U-238 α 24.9 pCi/g, SB-17-0102: U-234 α 22.0 pCi/g, U-235 α 0.970 pCi/g, U-238 α 22.1 pCi/g, and SS-DUP-17: U-234 α 14.3 pCi/g, U-235 α 0.526 pCi/g, U-238 α 14.6 pCi/g.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty. **It is recommended that sample concentrations less than the L_c are qualified as non-detect (U) as follows:**

Sample-specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SB-18-0102	U-235	0.00432	0.015	0.02475	U
SB-DUP-16	U-235	0.0315	0.021	0.03465	U

Matrix Spike

The percent recoveries for the MS/MSD were within acceptable limits for the alpha spectrometry analysis.

Method Blank

There was no indication of blank contamination in the Method Blank.

Laboratory Control Sample:

The percent recoveries for the LCSs were within acceptable limits for the alpha spectrometry analysis.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD.

$$RPD = \left(\frac{|S-D|}{\frac{S+D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the alpha spectrometry analysis have RPDs and/or NADs (DERS) with acceptable limits (<20%, <3).

All field duplicate results were within a factor of 4 from the original result.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

There was significant trailing in the Uranium-234 and U-238 peaks in samples SS-17-1230, SB-17-0102, SS-19-1310, and SS-DUP-17. The LCS, MS, and MSD also showed some peak tailing. However, there was no peak interference. Therefore, no qualification is required.The following samples had Uranium-235 peak energies outside 40 keV from the theoretical energy: SB-18-0102 and SB-19-0203. Per CENWK guidance, these results were not rejected because they were non-detect. The following samples had Uranium-232 peak energies outside 40 keV from the theoretical energy: SS-17-1230 and SS-19-1310. However, peak identification was not impacted. Therefore, no qualification is required.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement indicating subsampling representativeness problems. **The following sample results are recommended to be qualified as either estimated (J) or unusable (X), depending on the magnitude of the difference, due to incomparable results:**

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SS-16-1300	U-235	0.101	0.027	0.385	0.077	116.87%	3.481	J
SS-17-1230	U-235	1.19	0.088	2.17	0.115	58.33%	6.768	J
SS-18-1250	U-235	0.0309	0.017	0.228	0.04285	152.26%	4.276	J
SS-17-1230	U-238	24.9	0.51	12.3	2.255	67.74%	5.450	J
SS-DUP-17	U-238	14.6	0.3905	-5.2	1.695	421.28%	11.383	X

[1]The U-238 results for gamma were taken from the Th-234 daughter measurement

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410531

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ Tracers recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other: (Radiological)	initial calibration data	Y
	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

Sample DUP-17 has the incorrect collected date of 09/23/2021. According to the COC, the sample was collected on 09/24/2021. However, this discrepancy will not impact the data results.

The calibration documentation are missing for both alpha and gamma analyses. Calibration standard COAs are not found in the package .

A revision was issued by the laboratory with some of the missing items .

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: Amanda Leigh Dick Date: 03/08/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

Page 1 of 1

SDG No: L1410531

Analyte Group: Gamma Spectroscop and IIsotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-16-1300	L1410531-01	Soil	Gamma Spec. & Iso U	
SB-16-0235	L1410531-02	Soil	Gamma Spec. & Iso U	
SS-17-1230	L1410531-03	Soil	Gamma Spec. & Iso U	
SB-17-0102	L1410531-04	Soil	Gamma Spec. & Iso U	
SS-18-1250	L1410531-05	Soil	Gamma Spec. & Iso U	
SB-18-0102	L1410531-06	Soil	Gamma Spec. & Iso U	
SS-19-1310	L1410531-07	Soil	Gamma Spec. & Iso U	
SB-19-0102	L1410531-08	Soil	Gamma Spec. & Iso U	
SB-19-0203	L1410531-09	Soil	Gamma Spec. & Iso U	
SB-DUP-16	L1410531-10	Soil	Gamma Spec. & Iso U	
SS-DUP-17	L1410531-11	Soil	Gamma Spec. & Iso U	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410531

Analysis: Gamma Spectroscopy and Isotopic Uranium

Method: DOE Ga-01-R/901.1 and D3972 U-02

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Sample results qualified as indicated due to U-235/U-238 comparability and detects in the Method Blank

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick Date: 03/08/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks:

Several sample results were above the project action limits. Please see page 4 of this report . The RDL was not met for Th-234 for several samples. Please see calculation sheets.

Th-234 was detected in the Gamma Method Blank. See Blank section of this report.

Several samples had Uranium-235/U-238 results that were incomparable between the two methods used for this SDG .

The following samples had negative results with uncertainties less than the absolute value: SS-DUP-17 and SS-16-1300 .

The alpha spectroscopy spectrum for the Laboratory Control Sample had poor resolution. In addition, the following samples had tailing from the U-234 and U-238 peaks: MS R3724488-3, MSD R3724488-4, SS-17-1230, SB-17-0102, SS-19-1310, and SS-DUP-17. There was no indication that manual integration was performed on these peaks.

The following samples had Uranium-235 peak energies outside of 40 keV of the theoretical peak energy: SB-18-0102 & SB-19-0203. Results were less than the MDA, so no qualification was needed.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: SB-19-0102 was re-analyzed due to the sample position not being under detector. The re-analysis is reported.

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All sample holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	<1 pCi/g	2.28 pCi/g	SS-16-1300
Thorium-234	<1 pCi/g	6.01 pCi/g	SS-16-1300
Potassium-40	<1 pCi/g	1.71 pCi/g	SB-16-0235
Thorium-234	<1 pCi/g	1.61 pCi/g	SB-16-0235
Potassium-40	<1 pCi/g	1.92 pCi/g	SS-17-1230
Thorium-234	<1 pCi/g	4.29 pCi/g	SS-17-1230
Potassium-40	<1 pCi/g	3.21 pCi/g	SB-17-0102
Thorium-234	<1 pCi/g	6.04 pCi/g	SB-17-0102
Bismuth-214 (Ra-226)	0.5 pCi/g	0.501 pCi/g	SB-17-0102
Potassium-40	<1 pCi/g	1.04 pCi/g	SS-18-1250
Thorium-234	<1 pCi/g	2.55 pCi/g	SS-18-1250
Potassium-40	<1 pCi/g	1.23 pCi/g	SB-18-0102
Thorium-234	<1 pCi/g	1.36 pCi/g	SB-18-0102
Thorium-234	<1 pCi/g	1.46 pCi/g	SS-19-1310
Potassium-40	<1 pCi/g	1.32 pCi/g	SB-19-0102
Thorium-234	<1 pCi/g	1.43 pCi/g	SB-19-0102 Cont. on next page

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The following samples had results that exceeded the project action limits:
SS-16-1300: Ra-226 γ 3.34 pCi/g
SS-17-1230: U-234 α 24.9 pCi/g, U-235 α 1.19 pCi/g, U-238 α 24.9 pCi/g, Ra-226 γ 15.5 pCi/g
SB-17-0102: U-234 α 22.0 pCi/g, U-235 α 0.970 pCi/g, U-238 α 22.1 pCi/g, Ra-226 γ 19.8 pCi/g
SS-DUP-17: U-234 α 14.3 pCi/g, U-235 α 0.526 pCi/g, U-238 α 14.6 pCi/g, and Ra-226 γ 9.70 pCi/g

The following samples had a negative result with an uncertainty greater than the absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results:
SS-16-1300 & SS-DUP-17

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations: Continued from previous page

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	<1 pCi/g	1.50 pCi/g	SB-19-0203
Thorium-234	<1 pCi/g	1.48 pCi/g	SB-19-0203
Potassium-40	<1 pCi/g	1.17 pCi/g	SB-DUP-16
Thorium-234	<1 pCi/g	2.62 pCi/g	SB-DUP-16
Potassium-40	<1 pCi/g	2.43 pCi/g	SS-DUP-17
Thorium-234	<1 pCi/g	6.43 pCi/g	SS-DUP-17

Cont. on next page.

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

For concentrations greater than ten times the MDC, the calculation CSU > 0.25*Rs was used to identify excess reported uncertainty. No samples exhibited excess uncertainty

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. Th-234 did not meet the RDL for samples: SS-16-1300, SS-18-1250, SB-DUP-16, & SS-DUP-17. Please see calculation sheet.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations: Continued from previous page.

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

The LC was calculated for samples less than the detection limit. The following samples had results that were less than the LC and were qualified "U".
SS-16-1300: Th-234, SS-18-1250: Th-234, SB-18-0102: U-235, SB-DUP-16: U-235 & Th-234.
SS-DUP-17: Th-234.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: All initial and continuing calibrations met project acceptance criteria.

A background count was performed the same month the samples were counted. The background did not contain high results.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.3%	898.04 keV	Detector 1	< 5%		
-16.4%	136.47 keV	Detector 5	< 5%		
6.5 %	159.00 keV	Detector 5	< 5%		
-5.3%	136.47 keV	Detector 11	< 5%		
5.3%	513.99 keV	Detector 2	< 5%		
18.3%	513.99 keV	Detector 4	< 5%		
24.5%	513.99 keV	Detector 12	< 5%		

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: A long monthly background was performed. No high results were noted.

No documentation of an energy calibration was given. Additionally, there was no indication that a Peak-to-Compton ratio calibration was performed.

Daily source checks were performed for each detector. The FWHM was less than 3 keV for confirmed isotopes. Detector 2 had Co-60 energy difference from the true energy greater than 1.0 keV.

Samples counted on a detector with a delta value greater than 5% and/or a 95% CL (1.96 σ) greater than 8% were qualified "X".

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations: Project samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations: Project samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP
1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: Alpha: MB R3724488-1 Gamma: MB R3725157-3

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
10/19/2021	MB R3724488-1	U-238 α	0.103 pCi/g & 0.103 pCi/g	0.136 pCi/g & 0.103 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			
11/03/2021	MB R3725157-3	Tl-208 γ	0.0607 pCi/g & 0.0498 pCi/g	0.0842 pCi/g & 0.0498 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			
11/03/2021	MB R3725157-3	Th-234 γ	1.85 pCi/g & 1.11 pCi/g	1.80 pCi/g & 1.11 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. See next page.			
11/03/2021	MB R3725157-3	U-235 γ	0.119 pCi/g & 0.0709 pCi/g	0.120 pCi/g & 0.0709 pCi/g
	The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.			

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks: The alpha spectroscopy blank results were non-detect. Additionally, the |Zblank| value was less than 3. No qualification needed. The gamma spectroscopy blank results not listed above were non-detect. No project blanks were associated with this SDG.

Radiochemical Data Review Checklist

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on ~~10X~~ 5x the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations: MB R3725157-3

Radionuclide	Max. Activity Detected	Action Level	Samples Affected
Th-234	1.85 pCi/g	3.7 pCi/g	SS-16-1300: Result < 5X. DVQ: U
			SB-16-0235. Result < 5X. DVQ: U
			SS-17-1230. Result > 5x, <10x. DVQ: J
			SB-17-0102. Result > 5x, <10x. DVQ: J
			SS-18-1250. Result < 5X. DVQ: U
			SB-18-0102. Result < 5X. DVQ: U
			SS-19-1310. Result < 5X. DVQ: U
			SB-19-0102. Result < 5X. DVQ: U
			SB-19-0203. Result < 5X. DVQ: U
			SB-DUP-16. Result < 5X. DVQ: U
			SS-DUP-17. Result < 5X. DVQ: U

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).

4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

Radiochemical Data Review Checklist

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations: None

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: All tracer percent recovery results were within QC limits.

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

Alpha aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: Alpha: LCS R3724488-2
Gamma: LCS R3725157-1 & LCSD R3725157-2

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: All LCS percent recovery results were within QC limits.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: SB-18-0102 (L1410531-06)
MS R3724488-3 & MSD R3724488-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All matrix spike percent recovery results were within QC limits.

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: Alpha: MSD R3724488-4 & DUP R3724488-5
Gamma: LCSD R3725157-2 & DUP R3725157-4
Field DU: SB-DUP-16 & SS-DUP-17

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
U-235 α (DUP R3724488-5)		59.55%	1.085	NAD less than 3. No DVQ.
Ra-226γ (DUP R3725157-4)		22.22%	1.531	NAD less than 3. No DVQ.
Th-234 γ (DUP R3725157-4)		259.00%	2.805	NAD less than 3. No DVQ.
U-235 γ (DUP R3725157-4)		45.16%	0.150	NAD less than 3. No DVQ.

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: All laboratory duplicates either had RPD % results less than 20% or NAD results less than 3. All field duplicate results were within a factor 4 of the original result.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected
All peaks	Poor resolution (Messy Spectrum)	LCS R3724488-2
U-234 & U-238	Significant tailing	MS R3724488-3
U-234 & U-238	Some tailing	MSD R3724488-4
U-234 & U-238	Significant tailing	SS-17-1230
U-234 & U-238	Significant tailing	SB-17-0102
U-232	Some tailing	SS-19-1310
U-234 & U-238	Significant tailing	SS-DUP-17
U-232	Peak less than 40 keV from theoretical energy	LCS R3724488-2.
U-235	Peak less than 40 keV from theoretical energy	SB-18-0102. Result < MDA. No DVQ
U-235	Peak less than 40 keV from theoretical energy	SB-19-0203. Result < MDA. No DVQ
U-232	Peak less than 40 keV from theoretical energy	SS-17-1230
U-232	Peak less than 40 keV from theoretical energy	SS-19-1310

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: The peaks listed above either had poor resolution or tailing. Manual integration is needed for large tailing peaks. There were no interferent peaks in the spectra.
A small amount of noise was seen in the spectra, but not enough to adversely affect the data.

The peaks not listed above were within 40 keV of the theoretical energies.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: Please see below.

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: Each target radionuclide peaks were within 2 keV of the observed standard peak. However, the peak search parameters were set at 3 keV instead of 2 keV. All radionuclides of interest were identified.
There were no overlapping or interferent peaks.

Radiochemical Data Review Checklist

XIII. ~~Tentatively Identified Radionuclides (gamma spectroscopy)~~ Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different subsample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and gamma results are not comparable.	SS-17-1230. DVQ: "J"
U-235	Alpha and gamma results are not comparable	SS-16-1300. DVQ: "J".
U-235	Alpha and gamma results are not comparable	SS-18-1250. DVQ: "J".
U-238		SS-17-1230. DVQ: "J".
U-238		SS-DUP-17. DVQ: "X"

Actions:

1. ~~Qualify all tentatively identified radionuclides as estimated (J).~~
2. ~~If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
3. ~~If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

Please see calculation sheet.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected
D3972 U-02 Isotopic Uranium	Peak resolution/peak tailing	LCS, MS, MSD,
		SS-17-1230
		SB-17-0102
		SS-19-1310
		SS-DUP-17

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: A little noise in alpha spectra did not adversely affect data. However there was significant tailing. All background levels were low. There were no known energy shifts or extraneous peaks.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see attached Calculation Sheets

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see Calculation Sheets.

Radionuclide:	Method:

Remarks: .

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: Data qualified using parameters and guidance from the QAPP, CENWK, and QSM 5.1

Chain of Custody Page 1 of 2

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
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GEO Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Report to: David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description: Staten Island Warehouse

City/State Collected: Staten Island

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project #

Lab Project #

Collected by (print): David Lindsey

Site/Facility ID #

P.O. #

Collected by (signature):

Quote #

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Date Results Needed

Immediately Packed on Ice N ✓ Y ___

Analysis / Container / Preservative: GSPEC-NORM Z1, U-150 NoPres

SDG # L1410640
B230

Acctnum:
Template:
Prelogin:
PM:
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	Remarks	Sample # (lab only)
SS-25-0940	G	Scm	0-0.5	9-27-21	0940	1		-01
SS-22-0935	G	Scm	0-0.5	9-27-21	0935	1		-02
SS-21-1000	G	Scm	0-0.5	9-27-21	1000	1		-03
SS-20-1020	G	Scm	0-0.5	9-27-21	1020	1		-04
SB-MS-24	G	Scm	1-2	9-27-21	1000	1		-06
SS-24-0941	G	Scm	0-0.5	9-27-21	0941	1		-05
SB-24-0102	G	Scm	1-2	9-27-21	1000	1		-06
SB-DUP-23	G	Scm	1-2	9-27-21	1040	1		-07
SB-MSD-24	G	Scm	1-2	9-27-21	1000	1		-06
SB-23-0102	G	Scm	1-2	9-27-21	1040	1		-08

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_________

Remarks:

pH _______ Temp _______

Flow _______ Other _______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No (HCL / MeoH, TBR)
Relinquished by : (Signature)	Date: ~~1615~~ DL 9/27/21	Time: 1615	Received by: (Signature)	A60T 0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 21.5+0=21.5 °C Bottles Received: 12
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

<500 cpm

Billing Information: Accounts Payable 325 Kentucky Ave Kevil KY 42053

GEO Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

GSPEC-NORM 21,V-180 Nopres

Chain of Custody Page 2 of 2

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description: Staten Island Warehouse

City/State Collected: Staten Island

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project #

Lab Project #

SDG # L1410640

Table #

Collected by (print): David Lindsey

Site/Facility ID #

P.O. #

Acctnum:

Template:

Prelogin:

PM:

PB:

Shipped Via:

Collected by (signature): [signature]

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ✓ Y ___

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	Remarks	Sample # (lab only)
SS-23-1014	G	SCM	0-0.5	9-27-21	1014			-09
SS-13-1015	G	SCM	0-0.5	9-27-21	1015			-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeOH TBR
[signature]	9-27-21	1615		
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: A001 °C 21.5+0=21.5 Bottles Received: 12
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.932		0.209	0.141	10/20/2021 07:56	WG1754722
URANIUM-235	0.0669	~~J~~	0.0665	0.0829	10/20/2021 07:56	WG1754722
URANIUM-238	1.14		0.223	0.121	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*76.0*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.671	X	0.209	0.352	11/03/2021 11:57	WG1759843
Bismuth-212	0.597	~~U~~ X	0.760	1.45	11/03/2021 11:57	WG1759843
Bismuth-214 (Ra-226)	1.99	X	0.263	0.201	11/03/2021 11:57	WG1759843
Lead-212	0.543	X	0.140	0.179	11/03/2021 11:57	WG1759843
Lead-214	2.12	X	0.250	0.231	11/03/2021 11:57	WG1759843
Potassium-40	7.58	X	1.54	1.45	11/03/2021 11:57	WG1759843
Thallium-208	0.260	X	0.0669	0.0789	11/03/2021 11:57	WG1759843
Uranium-235	-0.351	(U) X	0.311	0.603	11/03/2021 11:57	WG1759843
Thorium-234 (U-238)	1.70	X(U)	0.908	1.51	11/03/2021 11:57	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.869		0.241	0.22	10/20/2021 07:56	WG1754722
URANIUM-235	0.0179	U	0.0442	0.0745	10/20/2021 07:56	WG1754722
URANIUM-238	0.925		0.226	0.169	10/20/2021 07:56	WG1754722
(T) URANIUM-232	*71.2*			*30.0-110*	*10/20/2021 07:56*	WG1754722

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.737	X	0.299	0.566	11/03/2021 11:51	WG1759843
Bismuth-212	0.509	~~U~~ X	0.956	1.84	11/03/2021 11:51	WG1759843
Bismuth-214 (Ra-226)	1.23	X	0.239	0.25	11/03/2021 11:51	WG1759843
Lead-212	0.814	X	0.175	0.226	11/03/2021 11:51	WG1759843
Lead-214	1.36	X	0.219	0.264	11/03/2021 11:51	WG1759843
Potassium-40	7.55	X	1.77	1.91	11/03/2021 11:51	WG1759843
Thallium-208	0.287	X	0.0906	0.128	11/03/2021 11:51	WG1759843
Uranium-235	0.108	~~J~~ X	0.0837	0.153	11/03/2021 11:51	WG1759843
Thorium-234 (U-238)	-0.0622	(U) X	1.04	2.48	11/03/2021 11:51	WG1759843

Cp Tc Ss Cn Sr Qc Gl Al Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.669		0.185	0.16	10/20/2021 21:27	WG1754725
URANIUM-235	0.0330	~~J~~	0.0522	0.0762	10/20/2021 21:27	WG1754725
URANIUM-238	0.678	J	0.179	0.141	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*71.0*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.486	X	0.134	0.222	11/03/2021 12:04	WG1759843
Bismuth-212	0.519	~~J~~ X	0.425	0.716	11/03/2021 12:04	WG1759843
Bismuth-214 (Ra-226)	0.901	X	0.124	0.128	11/03/2021 12:04	WG1759843
Lead-212	0.669	X	0.0952	0.105	11/03/2021 12:04	WG1759843
Lead-214	0.971	X	0.115	0.118	11/03/2021 12:04	WG1759843
Potassium-40	7.60	X	0.985	0.73	11/03/2021 12:04	WG1759843
Thallium-208	0.199	X	0.0432	0.0531	11/03/2021 12:04	WG1759843
Uranium-235	0.0561	~~J~~ X	0.0469	0.081	11/03/2021 12:04	WG1759843
Thorium-234 (U-238)	0.477	(U) X	0.625	1.34	11/03/2021 12:04	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.04		0.222	0.145	10/20/2021 21:27	WG1754725
URANIUM-235	0.0370	~~J~~	0.0581	0.0848	10/20/2021 21:27	WG1754725
URANIUM-238	0.995	J	0.204	0.0848	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*77.6*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.720	X	0.205	0.328	11/03/2021 11:55	WG1759843
Bismuth-212	0.570	~~U~~ X	0.705	1.33	11/03/2021 11:55	WG1759843
Bismuth-214 (Ra-226)	0.697	X	0.150	0.187	11/03/2021 11:55	WG1759843
Lead-212	0.918	X	0.145	0.168	11/03/2021 11:55	WG1759843
Lead-214	0.828	X	0.138	0.171	11/03/2021 11:55	WG1759843
Potassium-40	10.6	X	1.57	1.12	11/03/2021 11:55	WG1759843
Thallium-208	0.271	X	0.0674	0.0841	11/03/2021 11:55	WG1759843
Uranium-235	0.0753	~~J~~ X	0.0672	0.123	11/03/2021 11:55	WG1759843
Thorium-234 (U-238)	-0.599	(U) X,J	0.983	2.37	11/03/2021 11:55	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.11		0.316	0.188	10/20/2021 21:27	WG1754725
URANIUM-235	0.0692	J	0.0620	0.0697	10/20/2021 21:27	WG1754725
URANIUM-238	2.14	J	0.300	0.108	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*71.3*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.895	X	0.348	0.585	11/03/2021 13:45	WG1759843
Bismuth-212	2.08	~~J~~ X	1.36	2.32	11/03/2021 13:45	WG1759843
Bismuth-214 (Ra-226)	3.91	X	0.487	0.347	11/03/2021 13:45	WG1759843
Lead-212	1.02	X	0.191	0.223	11/03/2021 13:45	WG1759843
Lead-214	4.16	X	0.456	0.332	11/03/2021 13:45	WG1759843
Potassium-40	6.76	X	1.87	1.97	11/03/2021 13:45	WG1759843
Thallium-208	0.329	X	0.117	0.166	11/03/2021 13:45	WG1759843
Uranium-235	0.377	X(J)	0.103	0.154	11/03/2021 13:45	WG1759843
Thorium-234 (U-238)	1.47	~~J~~ X(U)	0.934	1.94	11/03/2021 13:45	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.98		0.288	0.138	10/20/2021 21:27	WG1754725
URANIUM-235	0.105	J	0.0807	0.0923	10/20/2021 21:27	WG1754725
URANIUM-238	2.21	J	0.292	0.0659	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*80.4*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	2.97	X	0.385	0.382	11/03/2021 12:01	WG1759843
Bismuth-212	3.18	X	1.03	1.54	11/03/2021 12:01	WG1759843
Bismuth-214 (Ra-226)	2.64	X	0.309	0.236	11/03/2021 12:01	WG1759843
Lead-212	3.11	X	0.311	0.186	11/03/2021 12:01	WG1759843
Lead-214	2.80	X	0.302	0.216	11/03/2021 12:01	WG1759843
Potassium-40	13.8	X	1.88	1.54	11/03/2021 12:01	WG1759843
Thallium-208	0.773	X	0.118	0.117	11/03/2021 12:01	WG1759843
Uranium-235	0.319	X(J)	0.0884	0.143	11/03/2021 12:01	WG1759843
Thorium-234 (U-238)	2.20	~~J~~ X(U)	1.41	2.7	11/03/2021 12:01	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.05		0.325	0.155	10/20/2021 21:27	WG1754725
URANIUM-235	0.0447	J	0.0684	0.1	10/20/2021 21:27	WG1754725
URANIUM-238	2.54	J	0.352	0.114	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*71.6*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.864	X	0.339	0.597	11/03/2021 13:43	WG1759843
Bismuth-212	0.613	~~U~~ X	1.28	2.52	11/03/2021 13:43	WG1759843
Bismuth-214 (Ra-226)	2.76	X	0.405	0.367	11/03/2021 13:43	WG1759843
Lead-212	0.734	X	0.228	0.343	11/03/2021 13:43	WG1759843
Lead-214	3.54	X	0.419	0.385	11/03/2021 13:43	WG1759843
Potassium-40	7.54	X	1.97	2.21	11/03/2021 13:43	WG1759843
Thallium-208	0.251	X	0.124	0.199	11/03/2021 13:43	WG1759843
Uranium-235	0.391	X(J)	0.143	0.237	11/03/2021 13:43	WG1759843
Thorium-234 (U-238)	-2.13	(U) X,J	2.19	5.17	11/03/2021 13:43	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.94		0.401	0.182	10/20/2021 21:27	WG1754725
URANIUM-235	0.272		0.129	0.107	10/20/2021 21:27	WG1754725
URANIUM-238	2.90	J	0.394	0.156	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*58.7*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.07	X	0.496	0.971	11/03/2021 13:43	WG1759843
Bismuth-212	0.924	~~U~~ X	1.73	3.39	11/03/2021 13:43	WG1759843
Bismuth-214 (Ra-226)	3.85	X	0.560	0.502	11/03/2021 13:43	WG1759843
Lead-212	0.963	X	0.292	0.445	11/03/2021 13:43	WG1759843
Lead-214	4.97	X	0.569	0.418	11/03/2021 13:43	WG1759843
Potassium-40	8.34	X	2.16	1.99	11/03/2021 13:43	WG1759843
Thallium-208	0.351	X	0.158	0.265	11/03/2021 13:43	WG1759843
Uranium-235	0.540	X	0.175	0.27	11/03/2021 13:43	WG1759843
Thorium-234 (U-238)	1.49	(U) X	2.12	4.7	11/03/2021 13:43	WG1759843

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.610		0.209	0.209	10/20/2021 21:27	WG1754725
URANIUM-235	0.0702	~~J~~	0.0630	0.0707	10/20/2021 21:27	WG1754725
URANIUM-238	0.771	J	0.203	0.16	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*76.7*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.592		0.173	0.257	11/03/2021 13:49	WG1759843
Bismuth-212	0.771	~~J~~	0.555	0.982	11/03/2021 13:49	WG1759843
Bismuth-214 (Ra-226)	0.983		0.156	0.148	11/03/2021 13:49	WG1759843
Lead-212	0.663		0.119	0.134	11/03/2021 13:49	WG1759843
Lead-214	1.19		0.157	0.167	11/03/2021 13:49	WG1759843
Potassium-40	8.28		1.40	1.21	11/03/2021 13:49	WG1759843
Thallium-208	0.279		0.0598	0.0635	11/03/2021 13:49	WG1759843
Uranium-235	0.202	~~J~~	0.221	0.391	11/03/2021 13:49	WG1759843
Thorium-234 (U-238)	0.877	~~J~~ U	0.604	1.21	11/03/2021 13:49	WG1759843

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.813		0.199	0.169	10/20/2021 21:27	WG1754725
URANIUM-235	0.0394	J	0.0458	0.0584	10/20/2021 21:27	WG1754725
URANIUM-238	0.866	J	0.190	0.132	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*83.4*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.991	X	0.172	0.229	11/03/2021 12:02	WG1756460
Bismuth-212	1.26	X	0.556	0.861	11/03/2021 12:02	WG1756460
Bismuth-214 (Ra-226)	1.43	X	0.163	0.139	11/03/2021 12:02	WG1756460
Lead-212	1.17	X	0.133	0.123	11/03/2021 12:02	WG1756460
Lead-214	1.51	X	0.156	0.135	11/03/2021 12:02	WG1756460
Potassium-40	12.1	X	1.30	0.8	11/03/2021 12:02	WG1756460
Thallium-208	0.317	X	0.0563	0.0654	11/03/2021 12:02	WG1756460
Uranium-235	0.164	X(J)	0.0627	0.102	11/03/2021 12:02	WG1756460
Thorium-234 (U-238)	0.364	(U) X	0.745	1.7	11/03/2021 12:02	WG1756460

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410640
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.
"J" - Indicates an unusually uncertain or estimated result.
"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-25-0940	Soil	L1410640-01
SS-22-0935	Soil	L1410640-02
SS-21-1000	Soil	L1410640-03
SS-20-1020	Soil	L1410640-04
SS-24-0941	Soil	L1410640-05
SB-24-0102	Soil	L1410640-06
SB-DUP-23	Soil	L1410640-07
SB-23-0102	Soil	L1410640-08
SS-23-1014	Soil	L1410640-09
SS-13-1015	Soil	L1410640-10

Validation Report By: **Amanda Leigh Dick** **03/08/2022**

(print) **Date**

Amanda Leigh Dick

(sign)

Peer Reviewed By: **Thomas. L. Rucker** **03/11/2022**

(print) **Date**

TLRucker

(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SS-24-0941	X
11	C6	1	-5.3	2	8.2 – 12.7	SS-21-1000, SS-13-1015	X
2	P3	1	5.3			SS-20-1020, SB-DUP-23	X
4	P3	1	18.3	1	8.8	SS-22-0935, SB-23-0102	X
12	P3	1	24.5	1	9.6	SB-24-0102	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detector/geometry has one quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	-10.6	SS-24-0941	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples did not meet the RDL project goal of <1 pCi/g: SS-25-0940, SS-22-0935, SS-21-1000, SS-20-1020, SB-DUP-23, SB-23-0102, and SS-13-1015. Please see table below.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-25-0940	U-235	0.1553	0.54355	0.5
SS-22-0935	Th-234	0.5185	1.81475	1
SS-21-1000	Th-234	0.3123	1.09305	1
SS-20-1020	Th-234	0.4917	1.72095	1
SB-DUP-23	Th-234	1.096	3.836	1
SB-23-0102	Th-234	1.0585	3.70475	1
SS-13-1015	Th-234	0.3723	1.30305	1

The following samples had results that exceeded the project action limit: SS-24-0941: Ra-226: 3.91 pCi/g, SB-24-0102: Ra-226: 2.64 pCi/g, SB-DUP-23: Ra-226: 2.76 pCi/g, and SB-23-0102: Ra-226: 3.85 pCi/g.

No samples exhibited excess uncertainty.

The following samples had negative results with uncertainties smaller than their absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SS-25-0940: U-235.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U): SS-25-0940: U-235; SS-22-0935: Th-234; SS-21-1000: Th-234; SS-20-1020: Th-234; SB-DUP-23: Th-234; SB-23-0102: Th-234; and SS-13-1015: Th-234.

Method Blank

Thorium-234 was detected in the Method Blank for the gamma spectrometry analysis. To be conservative, the action level was calculated based on 5X the highest blank concentration. **It is recommended that the following samples with results less than 5X the blank result be qualified as non-detect (U): SS-25-0940, SS-22-0935, SS-21-1000, SS-20-1020, SS-24-0941, SB-24-0102, SB-DUP-23, SB-23-0102, and SS-23-1014.**

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, <3).

All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

The initial calibration met project acceptance criteria.

Continuing Calibration

The continuing calibration met project acceptance criteria.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was met for all radionuclides of interest.

The following sample had a Uranium-235 result above the project action limit: SB-23-0102: 0.272 pCi/g.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample CSU. **It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows:**

Sample-Specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SS-22-0935	U-235	0.0179	0.014	0.0231	U

Matrix Spike

The percent recoveries for the MS/MSD were within acceptable limits for all alpha spectrometry analyses.

Method Blank

There was no indication of blank contamination in the Method Blank.

Laboratory Control Sample:

The percent recoveries were within acceptable limits for LCS R3724488-2. The Uranium-238 percent recovery is outside the lower acceptable limit (75%-125%) for LCS R3725650-2. **It is recommended that the following associated Uranium-238 sample results be qualified as estimated (J): SS-21-1000, SS-20-1020, SS-24-0941, SB-24-0102, SB-DUP-23, SB-23-0102, SS-23-1014, and SS-13-1015.** Please see table below.

Radiochemistry - LCS % Recovery Calculation

Sample ID	Analyte	Found Value (pCi/g)	True Value (pCi/g)	LCS (% Recovery)	Qualifier
L1410640LCS	U-238	3.46	4.74	72.996%	J

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)

U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the alpha spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<20%, <3).

All field duplicate results were within a factor of 4 from the original result.

Sample-Specific Chemical Recovery:

The percent recoveries for tracers were within acceptable limits.

Spectral Analysis:

Sample SS-21-100 exhibited Uranium-232 peak tailing. The following QC samples exhibited Uranium-234 and Uranium-238 peak tailing: LCS R3724488-2, MS R3724488-3, MSD R3724488-4, MS R3725650-3, and MSD R3725650-4. Sample SS-21-1000 also had Uranium-235 peak energy outside 40 keV from the theoretical energy. Per CENWK guidance, these results were not rejected because they were non-detect. The following QC samples also had peak energies outside 40 keV from their theoretical energy: LCS R3724488-2 and MB R3725650-1. However, peak identification was not impacted. Therefore, no qualification is required.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement. **The following sample uranium results (both alpha and gamma) are recommended to be qualified as estimated (J) due to incomparable results:**

Radiochemistry - Data Intercomparion

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SS-24-0941	U-235	0.0692	0.022	0.377	0.0515	137.97%	5.496	J
SB-24-0102	U-235	0.105	0.031	0.319	0.0442	100.94%	3.964	J
SB-DUP-23	U-235	0.0447	0.022	0.391	0.0715	158.96%	4.629	J
SS-13-1015	U-235	0.0394	0.018	0.164	0.03135	122.52%	3.447	J
SS-20-1020	U-238	0.995	0.102	-0.599	0.4915	805.05%	3.175	J
SB-DUP-23	U-238	2.54	0.176	-2.13	1.095	2278.05%	4.211	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410640

Analyte Group: Gamma Spectroscopy and Isotopic Uranium

Sample Matrix: Soil

EDD (Y/N): Y

Disposition of Data Package: N/A

NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ tracer recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other:	initial calibration data	Y
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

The case narrative did not cover project sample IDs vs laboratory sample IDs.
Additionally, it also did not cover each analytical type included in this SDG.
No discrepancies were listed in the case narrative.

The sample result forms were missing the extraction dates and sample matrix.

The calibration documentation are missing for both alpha and gamma analyses .

Calibration standard COAs were missing.

A revision was issued by the laboratory with some of the missing items.

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: Amanda Leigh Dick   Date: 03/06/2022

QA Review By: ____________   Date: ____________

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

Page 1 of 1

SDG No: L1410640

Analyte Group: Gamma Spectroscopy & Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-25-0940	L1410640-01	Soil	Gamma Spec & Iso U	
SS-22-0935	L1410640-02	Soil	Gamma Spec & Iso U	
SS-21-1000	L1410640-03	Soil	Gamma Spec & Iso U	
SS-20-1020	L1410640-04	Soil	Gamma Spec & Iso U	
SS-24-0941	L1410640-05	Soil	Gamma Spec & Iso U	
SB-24-0102	L1410640-06	Soil	Gamma Spec & Iso U	
SB-DUP-23	L1410640-07	Soil	Gamma Spec & Iso U	
SB-23-0102	L1410640-08	Soil	Gamma Spec & Iso U	
SS-23-1014	L1410640-09	Soil	Gamma Spec & Iso U	
SS-13-1015	L1410640-10	Soil	Gamma Spec & Iso U	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410640

Analysis: Gamma Spectroscopy & Isotopic Uranium

Method: DOE Ga-01-R/901.1 and D3972 U-02

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Results qualified as indicated due to detects in the MB and low LCS recoveries, and incomparable results

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick Date: 03/06/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks:

Several samples were qualified for incomparable results between alpha and gamma analyses.

Sample SS-25-0940 had a negative result with an uncertainty smaller than its absolute value.

Several samples did not meet the RDL. Please see page 9 of this report.

Alpha LCS R3725650-2 had an Uranium-238 result (72.9%) that was lower than the project QC limits. The associated sample Uranium-238 results were qualified "J".

Thorium-234 was detected in gamma MB R3725157-3. The associated samples that were detect for Th-234 and with results less than the action limit were qualified "U".

Several alpha spec. analyses either had poor resolution or tailing.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No samples were re-analyzed or diluted.

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	< 1 pCi/g	1.45 pCi/g	SS-25-0940
Thorium-234	< 1 pCi/g	1.51 pCi/g	SS-25-0940
Potassium-40	< 1 pCi/g	1.91 pCi/g	SS-22-0935
Thorium-234	< 1 pCi/g	2.48 pCi/g	SS-22-0935
Thorium-234	< 1 pCi/g	1.34 pCi/g	SS-21-1000
Potassium-40	< 1 pCi/g	1.12 pCi/g	SS-20-1020
Thorium-234	< 1 pCi/g	2.37 pCi/g	SS-20-1020
Potassium-40	< 1 pCi/g	1.97 pCi/g	SS-24-0941
Thorium-234	< 1 pCi/g	1.94 pCi/g	SS-24-0941
Potassium-40	< 1 pCi/g	1.54 pCi/g	SB-24-0102
Thorium-234	< 1 pCi/g	2.70 pCi/g	SB-24-0102
Potassium-40	< 1 pCi/g	2.21 pCi/g	SB-DUP-23
Thorium-234	< 1 pCi/g	5.17 pCi/g	SB-DUP-23
Bismuth-214 (Ra-226)	0.5 pCi/g	0.502 pCi/g	SB-23-0102
Potassium-40	< 1 pCi/g	1.99 pCi/g	SB-23-0102
Thorium-234	< 1 pCi/g	4.70 pCi/g	SB-23-0102

Cont. on next page.

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The following sample had a negative result with an uncertainty smaller than the absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results: SS-25-0940: U-235 γ

The following samples had results that exceeded the project action limit:

SS-24-0941: Ra-226: 3.91 pCi/g
SB-24-0102: Ra-226: 2.64 pCi/g
SB-DUP-23: Ra-226: 2.76 pCi/g
SB-23-0102: U-235: 0.272 pCi/g and Ra-226: 3.85 pCi/g

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	< 1 pCi/g	1.21 pCi/g	SS-23-1014
Thorium-234	< 1 pCi/g	1.21 pCi/g	SS-23-1014
Thorium-234	< 1 pCi/g	1.70 pCi/g	SS-13-1015
Uranium-235 α		LC<Result	SS-25-0940. No DVQ.
Uranium-235 γ		LC>Result	SS-25-0940. DVQ: "U"
Uranium-235 α		LC>Result	SS-22-0935. DVQ: "U"
Uranium-235 γ		LC<Result	SS-22-0935. No DVQ
Thorium-234		LC>Result	SS-22-0935. DVQ: "U"
Uranium-235 α		LC<Result	SS-21-1000. No DVQ
Uranium-235 γ		LC<Result	SS-21-1000. No DVQ
Thorium-234		LC>Result	SS-21-1000. DVQ: "U"
Uranium-235 α		LC<Result	SS-20-1020. No DVQ.
Uranium-235 γ		LC<Result	SS-20-1020. No DVQ.
Thorium-234		LC>Result	SS-20-1020. DVQ: "U"
Uranium-235 α		LC<Result	SS-24-0941. No DVQ.
Thorium-234		LC<Result	SS-24-0941. No DVQ.

Cont. on next page

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: The sample-specific detection limit (LC) was calculated for sample results less than the critical level. Sample concentrations less than the LC were qualified "U". Please see calculation sheet.

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. The following samples had results that did not meet the RDL: SS-25-0940: U-235 γ, SS-22-0935: Th-234, SS-21-1000: Th-234, SS-20-1020: Th-234, SB-DUP-23: Th-234, SB-23-0102: Th-234 & SS-13-1015: Th-234.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Thorium-234		LC<Result	SB-24-0102. No DVQ.
Uranium-235 α		LC<Result	SB-DUP-23. No DVQ.
Thorium-234		LC>Result	SB-DUP-23. DVQ: "U"
Thorium-234		LC>Result	SB-23-0102. DVQ: "U"
Uranium-235 α		LC<Result	SS-23-1014. No DVQ.
Uranium-235 γ		LC<Result	SS-23-1014. No DVQ.
Thorium-234		LC<Result	SS-23-1014. No DVQ.
Uranium-235 α		LC<Result	SS-13-1015. No DVQ.
Thorium-234		LC>Result	SS-13-1015. DVQ: "U"

Cont. on next page.

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

For concentration ten times the MDC, the calculation CSU>0.25*Rs was used to identify excess reported uncertainty. No samples exhibited excess uncertainty.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: The initial and continuing calibrations met project acceptance criteria.

A background count was performed the same month the samples were counted. The background did not contain high results.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Vales

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
Delta Value: 8.2%	159.00 keV	Detector 2	Delta value: < 5%		
Delta Value: 7.6%	392.00 keV	Detector 2	Delta value: < 5%		
Delta Value: 6.3%	898.04 keV	Detector 1	Delta value: < 5%		
Delta Value: 6.5%	159.00 keV	Detector 5	Delta value: < 5%		
Delta Value: 5.3%	513.99 keV	Detector 2	Delta Value: < 5%		
Delta Value: 18.3%	513.99 keV	Detector 4	Delta Value: < 5%		
Delta Value: 24.5%	513.99 keV	Detector 12	Delta Value: < 5%		
Delta value: -7.1%	513.99 keV	Detector 1	Delta Value: < 5%		
Delta value: -6.3%	136.47 keV	Detector 2	Delta Value: < 5%		
Delta value: -12.9%	136.47 keV	Detector 9	Delta Value: < 5%		

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Deviations Cont.: Detector 11: Delta value -5.3% at 136.47 keV, Detector 5: Delta value -16.4% at 136.47 keV

All source checks had passing efficiencies, FHWM, and energies, but a few analytes were not within 10%.

There was no mention of a Peak-to-Compoton Ratio Calibration being performed .

No standard documentation or standard preparation documentation was provided.

Samples counted on detectors with high delta values and/or a 95% CL (1.96 σ) greater than 8% were qualified as "X".

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations: SDG samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations: SDG samples not selected for analysis.

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: Alpha: MB R3724488-1 & MB R3725650-1
Gamma: MB R3725159-2 & MB R3725157-3

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
10/19/2021	MB R3724488-1	U-238 α	0.103 pCi/g & 0.103 pCi/g	0.136 pCi/g & 0.103 pCi/g

The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
11/01/2021	MB R3725159-2	Th-234 γ	1.12 pCi/g & 0.601 pCi/g	1.17 pCi/g & 0.601 pCi/g

The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
11/03/2021	MB R3725157-3	U-235 γ	0.119 pCi/g & 0.0709 pCi/g	0.120 pCi/g & 0.0709 pCi/g

The Blank result subtracted from its uncertainty was less than the MDA. No DVQ.

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
11/03/2021	MB)R3725157-3	Th-234 γ	1.85 pCi/g & 1.11 pCi/g	1.80 pCi/g & 1.11 pCi/g

The Blank result subtracted from its uncertainty was less than the MDA. Please see next page.

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks: The blank results not listed above were below their respective uncertainties and MDAs. Additionally, the |Zblank| value was less than 3.
No project blanks were associated with this SDG.

Radiochemical Data Review Checklist

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

5X
Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations: MB R3725157-3

Radionuclide	Max. Activity Detected	Action Level	Samples Affected
Th-234 γ	1.85 pCi/g	9.25 pCi/g	SS-25-0940: Result < 5X: DVQ: "U"
			SS-25-0940. Result < 5X: DVQ: "U"
			SS-22-0935. Result < 5X: DVQ: "U"
			SS-21-1000. Result < 5X: DVQ: "U"
			SS-20-1020. Result < 5X: DVQ: "U"
			SS-24-0941. Result < 5X: DVQ: "U"
			SB-24-0102. Result < 5X: DVQ: "U"
			SB-DUP-23. Result < 5X: DVQ: "U"
			SB-23-0102. Result < 5X: DVQ: "U"
			SS-23-1014. Result < 5X: DVQ: "U"

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks: Th-234 sample results there were less than the action level were qualified "U" as indicated in the QAPP.

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations: None

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: All tracer recovery results were within project QC limits.

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

Alpha aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications:
Alpha: LCS R3724488-2 & LCS R3725650-2
Gamma: LCS R3725159-1 & LCSD R3725159-3
LCS R3725157-1 & LCSD R3725157-2

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Uranium-238	10/20/21	72.9%	The following samples had U-238 results qualified "J":
			SS-21-1000
			SS-20-1020
			SS-24-0941
			SB-24-0102
			SB-DUP-23
			SB-23-0102
			SS-23-1014
			SS-13-1015

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: The LCS recovery results not listed above were within project QC limits.

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: SB-24-0102
MS R3725650-3 & MSD R3725650-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All matrix spike recovery results were within project QC limits.

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: Alpha: DUP R3724488-5, MSD R3724488-4, DUP R3725650-5, & MSD R3725650-4
Gamma: DUP R3725159-4, LCSD R3725159-3, DUP R3725157-4, & LCSD R3725157-2
Project DUP: SB-DUP-23

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
U-235 α (DUP R3724488-5)		59.55%	1.085	NAD less than 3. No qualification needed.
U-235 α (DUP R3725650-5)		62.62%	0.963	NAD less than 3. No qualification needed.
Ac-228 γ (DUP R3725159-4)		77.40%	0.407	NAD less than 3. No qualification needed.
K-40 γ (DUP R3725159-4)		84.34%	2.915	NAD less than 3. No qualification needed.
Th-234 γ (DUP R3725159-4)		114.30%	0.924	NAD less than 3. No qualification needed.
Ra-226 γ (DUP R3725159-4)		163.42%	3.141	NAD greater than 3. Parent sample is Non-SDG.
Ra-226 γ (DUP R3725157-4)		22.22%	1.531	NAD less than 3. No qualification needed.

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: The duplicate results not listed above had RPD% value less than 20%.
All field duplicate results were within project requirements. Please see calculation sheets.

Radiochemical Data Review Checklist

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-238, U-234, U-232	Poor resolution/tailing	LCS R3724488-2
U-238 & U-234	Tailing	MS R3724488-3
U-238 & U-234	Tailing	MSD R3724488-4
U-238 & U-234	Tailing	MS R3725650-3
U-238 & U-234	Tailing	MSD R3725650-4
U-232	Tailing	SS-21-1000
U-232.	Outside of theoretical energy limit	LCS R3724488-2
U-235	Outside of theoretical energy limit	MB R3725650-1
U-235	Outside of theoretical energy limit	SS-21-1000. Results non-detect. No DVQ.

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: There were no overlapping or interferent peaks. The samples listed above either had poor resolution or tailing. However target peaks were easily distinguishable.

All SDG samples that were detected had radionuclide peaks within 40keV from their theoretical energies.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: Please see below.

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: Each target radionuclide peaks were within 2 keV of the observed standard peak. However, the peak search parameters were set at 3 keV instead of 2 keV. All radionuclides of interest were identified.

There were no interferent or overlapping peaks.

The matrix density was not calculated due to lack of documentation containing sample volume within the sample container and the density of the calibration standard.

Radiochemical Data Review Checklist

XIII. ~~Tentatively Identified Radionuclides (gamma spectroscopy)~~ Sample Aliquot Representativeness

Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak ~~radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~

~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~

~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and gamma results not comparable	SS-24-0941. DVQ: "J".
U-235	Alpha and gamma results not comparable	SB-24-0102. DVQ: "J"
U-235	Alpha and gamma results not comparable	SB-DUP-23: DVQ:"J"
U-235	Alpha and gamma results not comparable	SS-13-1015. DVQ: "J"
U-238	Alpha and gamma results not comparable	SS-20-1020. DVQ: "J"
U-238	Alpha and gamma results not comparable	SB-DUP-23. DVQ: "J"

Actions:

~~1. Qualify all tentatively identified radionuclides as estimated (J).~~

~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~

~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

Please see calculation sheet.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected
D3972 U-02 Isotopic Uranium	Peak resolution/peak tailing	LCS R3724488-2
		MS R3724488-3
		MSD R3724488-4
		MS R3725650-3
		MSD R3725650-4
		SS-21-1000

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: A small amount of noise can be seen in the alpha spectra, but not enough to adversely affect sample results. All background levels were low. There were no known energy shifts or extraneous peaks.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please see calculation sheets.

Radionuclide:	Method:

Remarks: ______________________

Calculation Check:

Radionuclide:	Method:

Remarks: ______________________

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: Data qualified using parameters and guidance from the QAPP, CENWK, and QSM 5.1

Company Name/Address:

Geo Consultants - Kevil, KY

325 Kentucky Ave
Kevil, KY 42053

Billing Information:

Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Email To: lindseyd@geoconsultantscorp.com

Report to: David Lindsey

Project Description: Staten Isl Warehouse, Port Richmond

City/State Collected: Staten Island, New York

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project # FUSRAP

Lab Project #

Collected by (print): David Lindsey

Site/Facility ID #

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ✓ Y ___

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

SDG # L1410673

B231

Acctnum: GEOCONKKY
Template: T195295
Prelogin: P873895
PM: 732 - Donna Eidson
PB:
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21,U-ISO 16ozHDPE-NoPres	Remarks	Sample # (lab only)
SS-08-1400	G	SCM	0-0.5	9-23-21	1400	1	X		-01
SB-08-0102	G	SCM	1-2	9-23-21	1410	1	X		-02
SS-06-0936	G	SCM	0-0.5	9-22-21	0936	1	X		-03
SB-06-0203	G	SCM	2-3	9-22-21	1115	1	X		-04
SB-06-0501	G	SCM	0.5-1	9-22-21	1105	1	X		-05
SS-07-1220	G	SCM	0.5-1	9-22-21	~~1220~~ 0943 DL 9-24-21	1	X		-06
SB-07-0102	G	SCM	1-2	9-22-21	1220	1	X		-07
SB-07-0203	G	SCM	2-3	9-22-21	1225	1	X		-08
SS-DUP-06	G	SCM	0.5-0.5	9/22/21	0936	1	X		-09
		SCM				1	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks: no ice required

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	
[signature]	9-27-21	1430		Trip Blank Received: Yes / No 0 HCL / MeoH TBR
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: AZMC 22.(ct.1=22.7 Bottles Received: 9
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/29/21 Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

<4500 cpm

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.46		0.232	0.0928	10/20/2021 21:27	WG1754725
URANIUM-235	0.0317	J	0.0436	0.06	10/20/2021 21:27	WG1754725
URANIUM-238	1.59	J	0.238	0.0736	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*86.7*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.84	X	0.361	0.514	11/04/2021 09:38	WG1759852
Bismuth-212	1.77	~~J~~ X	1.05	1.78	11/04/2021 09:38	WG1759852
Bismuth-214 (Ra-226)	1.46	X	0.245	0.258	11/04/2021 09:38	WG1759852
Lead-212	1.75	X	0.234	0.229	11/04/2021 09:38	WG1759852
Lead-214	1.58	X	0.227	0.247	11/04/2021 09:38	WG1759852
Potassium-40	11.1	X	1.96	1.85	11/04/2021 09:38	WG1759852
Thallium-208	0.402	X	0.100	0.127	11/04/2021 09:38	WG1759852
Uranium-235	0.192	X(J)	0.0994	0.171	11/04/2021 09:38	WG1759852
Thorium-234 (U-238)	-2.27	(U) X, J	1.72	3.83	11/04/2021 09:38	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.966		0.195	0.14	10/20/2021 21:27	WG1754725
URANIUM-235	0.0518	J	0.0524	0.0652	10/20/2021 21:27	WG1754725
URANIUM-238	1.12	J	0.191	0.0822	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*79.9*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.32	X	0.283	0.376	11/04/2021 09:44	WG1759852
Bismuth-212	1.55	~~J~~ X	0.966	1.59	11/04/2021 09:44	WG1759852
Bismuth-214 (Ra-226)	1.19	X	0.220	0.201	11/04/2021 09:44	WG1759852
Lead-212	1.63	X	0.238	0.185	11/04/2021 09:44	WG1759852
Lead-214	1.34	X	0.213	0.214	11/04/2021 09:44	WG1759852
Potassium-40	11.5	X	1.87	1.18	11/04/2021 09:44	WG1759852
Thallium-208	0.370	X	0.0961	0.113	11/04/2021 09:44	WG1759852
Uranium-235	0.204	X(J)	0.0884	0.144	11/04/2021 09:44	WG1759852
Thorium-234 (U-238)	0.653	(U) X	1.10	2.37	11/04/2021 09:44	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.45		0.256	0.164	10/20/2021 21:27	WG1754725
URANIUM-235	0.0943		0.0727	0.0803	10/20/2021 21:27	WG1754725
URANIUM-238	1.20	J	0.219	0.0917	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*83.4*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.01	X	0.324	0.558	11/04/2021 10:58	WG1759852
Bismuth-212	1.62	~~J~~ X	1.05	1.78	11/04/2021 10:58	WG1759852
Bismuth-214 (Ra-226)	1.31	X	0.255	0.242	11/04/2021 10:58	WG1759852
Lead-212	1.22	X	0.182	0.173	11/04/2021 10:58	WG1759852
Lead-214	1.30	X	0.211	0.266	11/04/2021 10:58	WG1759852
Potassium-40	14.3	X	2.45	1.52	11/04/2021 10:58	WG1759852
Thallium-208	0.396	X	0.114	0.146	11/04/2021 10:58	WG1759852
Uranium-235	0.150	X	0.0721	0.12	11/04/2021 10:58	WG1759852
Thorium-234 (U-238)	1.40	~~J~~ X	0.797	1.63	11/04/2021 10:58	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.54		0.376	0.177	10/20/2021 21:27	WG1754725
URANIUM-235	0.00867	(U) J	0.0946	0.158	10/20/2021 21:27	WG1754725
URANIUM-238	2.60	J	0.367	0.0884	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*57.1*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.08	X	0.292	0.476	11/04/2021 11:04	WG1759852
Bismuth-212	1.42	~~J~~ X	0.976	1.65	11/04/2021 11:04	WG1759852
Bismuth-214 (Ra-226)	3.06	X	0.407	0.247	11/04/2021 11:04	WG1759852
Lead-212	1.41	X	0.237	0.246	11/04/2021 11:04	WG1759852
Lead-214	3.05	X	0.391	0.247	11/04/2021 11:04	WG1759852
Potassium-40	8.60	X	1.70	1.4	11/04/2021 11:04	WG1759852
Thallium-208	0.418	X	0.0990	0.105	11/04/2021 11:04	WG1759852
Uranium-235	0.358	X(J)	0.115	0.176	11/04/2021 11:04	WG1759852
Thorium-234 (U-238)	1.07	(U) X	1.38	2.96	11/04/2021 11:04	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	5.01		0.468	0.19	10/20/2021 21:27	WG1754725
URANIUM-235	0.197	J	0.0998	0.086	10/20/2021 21:27	WG1754725
URANIUM-238	5.05	J	0.462	0.147	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*64.8*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.23	X	0.322	0.491	11/04/2021 11:13	WG1759852
Bismuth-212	2.11	X	1.05	1.65	11/04/2021 11:13	WG1759852
Bismuth-214 (Ra-226)	5.69	X	0.539	0.264	11/04/2021 11:13	WG1759852
Lead-212	1.47	X	0.190	0.179	11/04/2021 11:13	WG1759852
Lead-214	6.02	X	0.550	0.24	11/04/2021 11:13	WG1759852
Potassium-40	10.5	X	1.76	1.6	11/04/2021 11:13	WG1759852
Thallium-208	0.548	X	0.112	0.142	11/04/2021 11:13	WG1759852
Uranium-235	0.620	X(J)	0.106	0.135	11/04/2021 11:13	WG1759852
Thorium-234 (U-238)	3.91	X	1.56	1.95	11/04/2021 11:13	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.719		0.213	0.164	10/20/2021 21:27	WG1754725
URANIUM-235	0.0213	U	0.0810	0.133	10/20/2021 21:27	WG1754725
URANIUM-238	0.810	J	0.205	0.0863	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*60.2*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.439	X	0.192	0.372	11/04/2021 09:47	WG1759852
Bismuth-212	0.830	~~J~~ X	0.665	1.15	11/04/2021 09:47	WG1759852
Bismuth-214 (Ra-226)	0.429	X	0.137	0.198	11/04/2021 09:47	WG1759852
Lead-212	0.481	X	0.112	0.159	11/04/2021 09:47	WG1759852
Lead-214	0.449	X	0.112	0.162	11/04/2021 09:47	WG1759852
Potassium-40	7.48	X	1.41	1.22	11/04/2021 09:47	WG1759852
Thallium-208	0.176	X	0.0642	0.0983	11/04/2021 09:47	WG1759852
Uranium-235	0.0267	(U) X	0.0492	0.0941	11/04/2021 09:47	WG1759852
Thorium-234 (U-238)	-0.101	(U) X	0.679	1.58	11/04/2021 09:47	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.73		0.458	0.207	10/20/2021 21:27	WG1754725
URANIUM-235	0.145	J	0.116	0.124	10/20/2021 21:27	WG1754725
URANIUM-238	2.73	J	0.452	0.173	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*47.1*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.27	X	0.196	0.261	11/04/2021 11:19	WG1759852
Bismuth-212	1.85	X	0.618	0.905	11/04/2021 11:19	WG1759852
Bismuth-214 (Ra-226)	2.86	X	0.254	0.144	11/04/2021 11:19	WG1759852
Lead-212	1.64	X	0.165	0.139	11/04/2021 11:19	WG1759852
Lead-214	2.96	X	0.257	0.152	11/04/2021 11:19	WG1759852
Potassium-40	10.8	X	1.20	0.802	11/04/2021 11:19	WG1759852
Thallium-208	0.412	X	0.0647	0.0736	11/04/2021 11:19	WG1759852
Uranium-235	0.296	X(J)	0.0745	0.115	11/04/2021 11:19	WG1759852
Thorium-234 (U-238)	1.88	~~J~~ X	1.09	1.95	11/04/2021 11:19	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.40		0.259	0.141	10/20/2021 21:27	WG1754725
URANIUM-235	0.0400	~~J~~	0.0622	0.0908	10/20/2021 21:27	WG1754725
URANIUM-238	1.48	J	0.260	0.114	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*79.5*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.837	X	0.270	0.457	11/04/2021 10:57	WG1759852
Bismuth-212	1.53	X	0.920	1.51	11/04/2021 10:57	WG1759852
Bismuth-214 (Ra-226)	1.33	X	0.229	0.195	11/04/2021 10:57	WG1759852
Lead-212	0.890	X	0.155	0.17	11/04/2021 10:57	WG1759852
Lead-214	1.15	X	0.188	0.25	11/04/2021 10:57	WG1759852
Potassium-40	9.30	X	2.00	2.06	11/04/2021 10:57	WG1759852
Thallium-208	0.226	X	0.0868	0.13	11/04/2021 10:57	WG1759852
Uranium-235	0.0878	(U) X	0.290	0.53	11/04/2021 10:57	WG1759852
Thorium-234 (U-238)	1.52	~~J~~ X	0.839	1.55	11/04/2021 10:57	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.77		0.367	0.173	10/20/2021 21:27	WG1754725
URANIUM-235	0.0417	J	0.0786	0.118	10/20/2021 21:27	WG1754725
URANIUM-238	3.02	J	0.376	0.145	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*73.0*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.986	X	0.323	0.519	11/04/2021 10:59	WG1759852
Bismuth-212	1.33	~~J~~ X	1.14	2.04	11/04/2021 10:59	WG1759852
Bismuth-214 (Ra-226)	2.08	X	0.321	0.305	11/04/2021 10:59	WG1759852
Lead-212	1.21	X	0.225	0.28	11/04/2021 10:59	WG1759852
Lead-214	2.41	X	0.312	0.296	11/04/2021 10:59	WG1759852
Potassium-40	7.90	X	1.86	2.02	11/04/2021 10:59	WG1759852
Thallium-208	0.294	X	0.115	0.176	11/04/2021 10:59	WG1759852
Uranium-235	0.263	X(J)	0.117	0.198	11/04/2021 10:59	WG1759852
Thorium-234 (U-238)	-2.35	(U) X	2.07	4.62	11/04/2021 10:59	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

14

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410673
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (soil)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

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[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.

[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.

[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SS-08-1400	Soil	L1410673-01
SB-08-0102	Soil	L1410673-02
SS-06-0936	Soil	L1410673-03
SB-06-0203	Soil	L1410673-04
SB-06-0501	Soil	L1410673-05
SS-07-1220	Soil	L1410673-06
SB-07-0102	Soil	L1410673-07
SB-07-0203	Soil	L1410673-08
SS-DUP-06	Soil	L1410673-09

Validation Report By: **Amanda Leigh Dick** **03/04/2022**
(print) **Date**

Amanda Leigh Dick
(sign)

Peer Reviewed By: **Thomas L. Rucker** **03/10/2022**
(print) **Date**

TLRucker
(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SS-06-0936	X
5	C6	2	-16.4-6.5	9	8.8-10.6	SB-08-0102, SB-06-0203	X
10	C6	1	24.1			SB-06-0501	X
11	C6	1	-5.3	2	8.2 – 12.7	SB-07-0102	X
2	P3	1	5.3			SS-08-1400, SS-DUP-06	X
4	P3	1	18.3	1	8.8	SS-07-1220	X
9	P3	1	12.7			SB-07-0203	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detectors/geometries have one or more quantified peak outside of the 10% limit for the calibration verification check source: Detector 1 (Am-241) and Detector 2 (Am-241). Please see table below.

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	10.8	SS-06-0936	X
2	P3	1	10.2	SS-08-1400, SS-DUP-06	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples did not meet the RDL project goal of <1 pCi/g for Th-234: SS-08-1400, SB-08-0102, SB-06-0203, SS-07-1220, and SS-DUP-06. Please see table below.

Samples That Did Not Meet The RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SS-08-1400	Th-234	0.858	3.003	1
SB-08-0102	Th-234	0.549	1.9215	1
SB-06-0203	Th-234	0.689	2.4115	1
SS-07-1220	Th-234	0.33945	1.18808	1
SS-DUP-06	Th-234	1.0355	3.62425	1

The Bi-214 (Ra-226) result (5.69 pCi/g) is greater than the project action limit in SB-06-0501.

No sample results exhibited excess uncertainty.

The following samples had negative results with uncertainties smaller than their absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SS-08-1400: Thorium-234 and SS-DUP-06: Thorium-234.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U). The following results are qualified as U: SS-08-1400 Th-234, SB-08-0102: Th-234, SB-06-0203: Th-234, SS-07-1220: U-235 and Th-234, SB-07-0203: U-235, and SS-DUP-06: Th-234.

<u>Method Blank</u>

There was no indication of blank contamination for the gamma spectrometry analysis.

<u>Laboratory Control Sample</u>:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

<u>Duplicate Analysis</u>:

The duplicate results were evaluated by calculation of the RPD and NAD.

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (< 25%,< 3).

All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been use to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the alpha spectrometry analyses.

Initial Calibration

All initial calibration criteria met project acceptance criteria.

Continuing Calibration

All continuing calibration criteria met project acceptance criteria.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was met for all radionuclides of interest for all samples.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty. **It is recommended that sample concentrations less than the L_c be qualified as non-detect (U) as follows: SB-06-0203 and SS-07-1220. The following results are qualified as U:**

Sample-specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SB-06-0203	U-235	0.00867	0.022	0.0363	U
SS-07-1220	U-235	0.0213	0.021	0.03465	U

<u>Matrix Spike</u>

A non-SDG sample was used as a matrix spike. The percent recoveries were within acceptable limits.

<u>Method Blank</u>

There was no indication of blank contamination for the alpha spectrometry analysis.

<u>Laboratory Control Sample</u>:

The Uranium-238 percent recovery for the LCS R3725650-2 was below the lower acceptable limit (75%-125%). **All alpha Uranium-238 results associated with this LCS are recommended to be qualified as estimated (J): SS-08-1400, SB-08-0102, SS-06-0936, SB-06-0203, SB-06-0501, SS-07-1220, SB-07-0102, SB-07-0203, and SS-DUP-06.** Please see table below.

Radiochemistry - LCS % Recovery Calculation

Sample ID	Analyte	Found Value (pCi/g)	True Value (pCi/g)	LCS (% Recovery)	Qualifier
LCS R3725650-3	U-238	3.45	4.74	72.785%	J

<u>Duplicate Analysis</u>:

$$RPD = \left(\frac{|S-D|}{\frac{S+D}{2}} \right) * 100$$

$$NAD = \frac{|S-D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The RPDs and the NADs (DERs) are within acceptable limits (<20%, < 3) for the duplicate analyses for all alpha spectrometry analyses.

All field duplicate results were within a factor of 4 from the original result.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

No spectral interferences were observed in all of the alpha spectrometry analyses.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement. **The following sample results are recommended to be qualified as estimated (J) due to incomparable results:**

Radiochemistry - Data Intercomparion

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	Uncert. (pCi/g)	Result (pCi/g)	Uncert. (pCi/g)			
SS-08-1400	U-235	0.0317	0.018	1.92	0.0497	193.50%	35.723	J
SB-08-0102	U-235	0.0518	0.02	0.204	0.0442	119.00%	3.137	J
SB-06-0203	U-235	0.00867	0.022	0.358	0.0575	190.54%	5.674	J
SB-06-0501	U-235	0.197	0.032	0.62	0.053	103.55%	6.832	J
SB-07-0102	U-235	0.145	0.027	0.296	0.03726	68.48%	3.282	J
SS-DUP-06	U-235	0.0417	0.025	0.263	0.0583	145.26%	3.489	J
SS-08-1400	U-238	1.59	0.119	-2.27	0.86	-1135.29%	4.446	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410673

Analyte Group: Gamma Spectroscopy and Isotopic Uranium
Sample Matrix: Soil
EDD (Y/N): Y

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ Tracer recovery results (e.g., org. form II)		Y
Check for LCS results (e.g., org. form III, inorg. form XII)		Y
Check for method blank results (e.g., org. form IV, inorg. form III)		Y
Check for MS/MSD results (e.g., inorg. form V)		Y
Check for laboratory duplicate results (e.g., inorg. form VI)		Y
Check for Method Calibration and Run Documentation		
organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other: (Radiological)	initial calibration data	Y
	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

The calibration documentation are missing for both alpha and gamma analyses. Calibration standard COAs are not found in the package .

The laboratory issued a revision with some of the missing information. .

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR # Item

Reviewed By: Amanda Leigh Dick Date: 03/04/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

Page 1 of 1

SDG No: L1410673

Analyte Group: Gamma Spectroscopy and Isotopic Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SS-08-1400	L1410673-01	Soil	Gamma Spec. and Isotopic Uranium	
SB-08-0102	L1410673-02	Soil	Gamma Spec. and Isotopic Uranium	
SS-06-0936	L1410673-03	Soil	Gamma Spec. and Isotopic Uranium	
SB-06-0203	L1410673-04	Soil	Gamma Spec. and Isotopic Uranium	
SB-06-0501	L1410673-05	Soil	Gamma Spec. and Isotopic Uranium	
SS-07-1220	L1410673-06	Soil	Gamma Spec. and Isotopic Uranium	
SB-07-0102	L1410673-07	Soil	Gamma Spec. and Isotopic Uranium	
SB-07-0203	L1410673-08	Soil	Gamma Spec. and Isotopic Uranium	
SS-DUP-06	L1410673-09	Soil	Gamma Spec. and Isotopic Uranium	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410673

Analysis: Gamma Spectroscopy and Isotopic Uranium

Method: DOE Ga-01-R/901.1 & D3972 U-02

Laboratory: Pace Analytical

Matrix: Soil

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Samples qualified as indicated due to LCS recoveries, reporting levels, and incomparable results.

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick Date: 03/04/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: The LCS Uranium-238 percent recovery result (72.9%) was outside the lower limit of project QC requirements (75%-125%). All SDG samples qualified Uranium-238 results with "J".

The Bi-214 (Ra-226) result is greater than the project action limit in SB-06-0501.

The RDL was not met for Thorium-234 in samples: SS-08-1400, SB-08-0102, SB-06-0203, SS-07-1220, SB-07-0203, & SS-DUP-06.

The U-235 and/or U-238 results were not comparable between the alpha and gamma analyses for several samples . Results were qualified as "J"

The following samples had negative results with uncertainties smaller than their absolute value: SS-DUP-06 & SS-08-1400.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No sample results were re-analyzed or diluted.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks: All holding times were met and the samples were properly preserved.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Potassium-40	<1pCi/g	1.85pCi/g	SS-08-1400. No DVQ.
Thorium-234 (U-238)	<1pCi/g	3.83 pCi/g	SS-08-1400. No DVQ.
Potassium-40	<1pCi/g	1.18 pCi/g	SB-08-0102. No DVQ.
Thorium-234 (U-238)	<1pCi/g	2.37 pCi/g	SB-08-0102. No DVQ.
Potassium-40	<1pCi/g	1.52 pCi/g	SS-06-0936. No DVQ.
Thorium-234 (U-238)	<1pCi/g	1.63 pCi/g	SS-06-0936. No DVQ.
Potassium-40	<1pCi/g	1.4 pCi/g	SB-06-0203. No DVQ.
Thorium-234 (U-238)	<1pCi/g	2.96 pCi/g	SB-06-0203. No DVQ.
Potassium-40	<1pCi/g	1.16 pCi/g	SB-06-0501. No DVQ.
Thorium-234 (U-238)	<1pCi/g	1.95 pCi/g	SB-06-0501. No DVQ.
Potassium-40	<1pCi/g	1.22 pCi/g	SS-07-1220. No DVQ.
Thorium-234 (U-238)	<1pCi/g	1.58 pCi/g	SS-07-1220. No DVQ.
Thorium-234 (U-238)	<1pCi/g	1.95 pCi/g	SB-07-0102. No DVQ.
Potassium-40	<1pCi/g	2.06 pCi/g	SB-07-0203. No DVQ.
Thorium-234 (U-238)	<1pCi/g	1.55 pCi/g	SB.07-0203.No DVQ.
Potassium-40	<1pCi/g	1.86 pCi/g	SS-DUP-06. No DVQ.

Cont. on next page.

Actions: **SEE CENWK 4.1.3.3a and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. ~~If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
3. ~~If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
4. ~~If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks: The Bi-214 (Ra-226) result (5.69 pCi/g) is greater than the project action limit in SB-06-0501.

For concentrations greater than ten times the MDC, the calculation CSU > 0.25*Rs was used to indentify excess reported uncertainty. No samples exhibited excess uncertainty.

The following samples had negative results with uncertainties smaller than their absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SS-08-1400: Thorium-234 and SS-DUP-06: Thorium-234.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Thorium-234 (U-238)	< 1 pCi/g	4.62 pCi/g	SS-DUP-06. No DVQ.
Uranium-235 α		LC<Result	SS-08-1400. No DVQ.
Thorium-234 (U-238)		LC>Result	SS-08-1400. DVQ "U".
Uranium-235 α		LC<Result	SB-08-0102. No DVQ.
Thorium-234 (U-238)		LC>Result	SB-08-0102. DVQ "U".
Thorium-234 (U-238)		LC<Result.	SS-06-0936. No DVQ.
Uranium-235 α		LC>Result	SB-06-0203. DVQ "U".
Thorium-234 (U-238)		LC>Result	SB-06-0203. DVQ "U".
Uranium-235 α		LC>Result	SS-07-1220. DVQ "U".
Uranium-235 γ		LC>Result	SS-07-1220. DVQ "U".
Thorium-234 (U-238)		LC>Result	SS-07-1220. DVQ "U".
Uranium-235 α		LC<Result	SB-07-0203. No DVQ
Uranium-235 γ		LC>Result	SB-07-0203. DVQ "U".
Thorium-234 (U-238)		LC<Result	SB-07-0203. No DVQ
Uranium-235 α		LC<Result	SS-DUP-06. No DVQ.
Thorium-234 (U-238)		LC>Result	SS-DUP-06. DVQ "U".

Actions: **SEE CENWK 4.1.3 and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: The sample-specific detection limit (LC) was calculated for sample results less than the critical level. Sample concentrations less than the LC were qualified "U". Please see calculation sheet.

For results that were less than the critical level, the calculation k * CSU</=RDL was used to determine whether the RDL has been met. The following samples had results that did not meet the RDL: SS-08-1400: Th-234, SB-08-0102: Th-234, SB-06-0203: Th-234, SS-07-1220: Th-234, and SS-DUP-06: Th-234.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

SEE CENWK 4.1.3 and QAPP FOR CRITERIA

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Uranium-235 α		Result<MDA	SS-08-1440. DVQ: "U".
Uranium-235 α		Result<MDA	SB-08-0102. DVQ: "U".
Thorium-234 (U-238)		Result<MDA	SS-06-0936. DVQ: "U".
Thorium-234 (U-238)		Result<MDA	SB-07-0102. DVQ: "U"
Uranium-235 α		Result<MDA	SB-07-0203. DVQ: "U"
Thorium-234 (U-238)		Result<MDA	SB-07-0203. DVQ: "U"
Uranium-235 α		Result<MDA	SS-DUP-06. DVQ: "U"

Actions: **SEE CENWK 4.1.3 and QAPP FOR CRITERIA**

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks: The results listed above were greater than their respective uncertainties, but less than the MDA. The original lab qualifier was changed from a "J" to "U" to keep in compliance with the guidance.

SEE CENWK 4.3.1.2.1 and QAPP FOR CRITERIA

V.A1. Calibration Alpha Spectroscopy

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

SEE CENWK 4.3.1.2.2 and QAPP FOR CRITERIA

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency. Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: SEE CENWK 4.3.1.2 and QAPP FOR CRITERIA

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: An energy and efficiency calibration was performed for each detector. All calibrations met project acceptance criteria.

V.B1. Calibration Gamma Spectroscopy **SEE CENWK 4.3.1.1.1 and QAPP FOR CRITERIA**

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy **SEE CENWK 4.3.1.1.2 and QAPP FOR CRITERIA**

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.3%	898.04 keV	Detector 1	< 5%		
-16.4%	136.47 keV	Detector 5	< 5%		
6.5%	159.00 keV	Detector 5	< 5%		
24.1%	513.99 keV	Detector 10	< 5%		
-5.3%	136.47 keV	Detector 11	< 5%		
5.3%	513.99 keV	Detector 2	< 5%		
18.3%	513.99 keV	Detector 4	< 5%		
12.7%	513.99 keV	Detector 9	< 5%		
24.5%	513.99 keV	Detector 12	< 5%		

Actions: **SEE CENWK 4.3.1.1 and QAPP FOR CRITERIA**

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

A long monthly background was performed. No high results were noted.
An initial efficiency curve was performed, but no standard documentation was provided.
Samples counted on detector with high delta values or or a 95% CL (1.96 σ) greater than 8%: were qualified as X .
Daily source checks were performed for each detector. The FWHM was less than 3 keV for confirmed isotopes. Detector 2 had Co-60 energy difference from the true energy greater than 1.0 keV.

Radiochemical Data Review Checklist

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: **SEE CENWK 4.3.1.4 and QAPP FOR CRITERIA**

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: KPA N/A FOR THIS SDG

V.D1. Calibration Gas Proportional Counters (GrossAB) **SEE CENWK 4.3.1.3.1 and QAPP FOR CRITERIA**

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters **SEE CENWK 4.3.1.3.1 and QAPP FOR CRITERIA**

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: **SEE CENWK 4.3.1.3 and QAPP FOR CRITERIA**

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: GPC N/A FOR THIS SDG

VI. Blanks **SEE CENWK 4.2.1 and QAPP FOR CRITERIA**

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks: Alpha: MB R3725650-1. Gamma: MB R3725727-3

Date	Lab ID #	Radionulcide	Result and Error pCi/g	MDA Result and Error pCi/g
11/04/2021	MB R3725727-3	Bi-214 (Ra-226)	0.0976 and 0.0950	0.181 and 0.0950
The Blank result subtracted from its uncertainty was less than the MDA. No DVQ per QAPP.				
10/20/2021	MB R3725650-1	U-238	0.0641 and 0.0967	0.137 and 0.0967
The Blank result subtracted from its uncertainty was less than the MDA. No DVQ per QAPP.				

Associated Project Blanks (e.g., equipment rinsates, etc.) N/A

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks: All blank results were less than the MDA. No qualification needed per QAPP. There were no project blanks associated with this SDG. Additionally, the |Zblank| value was less than 3.

VI. Blanks (continued)

SEE CENWK 4.2.1 and QAPP FOR CRITERIA

Calculate action levels based on 10X the highest blank concentration. **SEE CENWK 4.2.1.3 and QAPP FOR CRITERIA**

Deviations: Please see previous page.

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: **SEE CENWK 4.2.1 and QAPP FOR CRITERIA**

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).

4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

.

VII. Sample-Specific Carrier or Tracer Recovery **SEE CENWK 4.1.2 and QAPP FOR CRITERIA**

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations: None

Radionuclide	Sample ID	%R	Action Taken

Actions: **SEE CENWK 4.1.2 and QAPP FOR CRITERIA**

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: All tracer recovery results were within project QC limits.

VIII. Laboratory Control Sample Information **SEE CENWK 4.2.2 and QAPP FOR CRITERIA**

General LCS Criteria:
percent recovery (%R)

Alpha aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications: Alpha: LCS R3725650-2
Gamma: LCS R3725727-1 and LCSD R3725727-4

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Uranium-238	10/20/2021	72.9%	All alpha U-238 results qualified J.

Actions: **SEE CENWK 4.2.2 and QAPP FOR CRITERIA**

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks: All gamma LCS/LCSD recovery results were within QC limits. The alpha LCS result for Uranium-234 was within QC limits as well.

Radiochemical Data Review Checklist

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

SEE CENWK 4.2.3 and QAPP FOR CRITERIA

Project Sample(s) Spiked: Non-SDG sample was spiked (L1410640-06)
MS R3725650-3 & MSD R3725650-4

Deviations: None

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied

Actions: **SEE CENWK 4.2.3 and QAPP FOR CRITERIA**

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: All matrix spike recovery results were within project QC limits.

Radiochemical Data Review Checklist

X. Duplicate Sample or Matrix Spike Duplicate Analysis **SEE CENWK 4.2.4, 4.2.5 and QAPP FOR CRITERIA**

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: Alpha: DUP R3725650-5 & MSD R3725650-4
Gamma: DUP R3725727-2 & LCSD R3725727-4
Field DU: SS-DUP-06 L1410673-09

Deviations: DUP R372

Radionuclide	DER	RPD	NAD RER	Samples Affected
U-235 (DUP R3725650-5)		62.38%	0.347	NAD less than 3. No DVQ.
Th-234 (U-238) γ (DUP R3725727-2)		53.57%	0.451	NAD less than 3. No DVQ.
Ac-228 γ (DUP R3725727-2)		27.32%	0.794	NAD less than 3. No DVQ.

Actions: **SEE CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP FOR CRITERIA**

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks: All field duplicate results were within project requirements. Please see calculation sheets. The RPD results not listed above were within project requirements. The CENWK guidance states that the RPD results must be within 35% or the NAD result must be less than 1.96 for soil duplicate analyses.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

SEE CENWK 4.1.8, 4.1.9.2 and QAPP FOR CRITERIA

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations: None.

Radionuclide	Deficiency	Samples Affected

Actions: **SEE CENWK 4.1.8, 4.1.9.2 and QAPP FOR CRITERIA**

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: There were no overlapping peaks in the spectra. There was a small amount of background noise, but nothing that would interfere with sample results. All radionuclide peaks were within their region of interest. No manual integration was noted.

All detected radionuclide peaks of interest were within 40keV from their theoretical energies.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density **SEE CENWK 4.1.9, 4.1.7 and QAPP FOR CRITERIA**

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: None.

Radionuclide	Deficiency	Samples Affected

Actions: **SEE CENWK 4.1.9, 4.1.7 and QAPP FOR CRITERIA**

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks: The peak search algorithm was set at 3.0, not the required 2 keV for all SDG samples.

All identified radionuclide energies were less than 2 keV from the theoretical energy.

All project radionuclides of interest met identification criteria.

The energy spectra did not contain overlapping or interferent peaks.

XIII. ~~Tentatively Identified Radionuclides (gamma spectroscopy)~~ Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	alpha and gamma results not comparable.	SS-18-1400. DVQ: "J"
U-235	alpha and gamma results not comparable.	SB-08-0102. DVQ: "J"
U-235	alpha and gamma results not comparable.	SB-06-0203. DVQ: "J"
U-235	alpha and gamma results not comparable.	SB-06-0501. DVQ: "J"
U-235	alpha and gamma results not comparable.	SB-07-0102. DVQ: "J"
U-235	alpha and gamma results not comparable.	SS-DUP-06. DVQ: "J"
U-238	alpha and gamma results not comparable.	SS-08-1400. DVQ "J"

Actions:

1. ~~Qualify all tentatively identified radionuclides as estimated (J).~~
2. ~~If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
3. ~~If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~

If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "R", depending on the magnitude of the uncertainty.

Remarks:

See calculation sheets.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) **SEE CENWK and QAPP**

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations: None

Radionuclide/Method	Deficiency	Samples Affected

Actions: **SEE CENWK and QAPP**

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks: There were no obvious system performance discrepancies. The spectra was free of peak tailing and/or splitting and the resolution was clear.

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: N/A for Level 3 Validation.

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XV. Analyte Quant Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: N/A for Level 3 Validation

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: SDG sample results were qualified per QAPP and CENWK guidance.

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 1 of 2

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Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

Report to: **David Lindsey**

Email To: lindseyd@geoconsultantscorp.com

Project Description: **Staten Isl Warehouse, Port Richmond**

City/State Collected: Staten Island

Please Circle: PT MT CT ET

Phone: **270-462-3882**

Client Project # **FUSRAP**

Lab Project #

Site/Facility ID #

P.O. #

Collected by (print): David Lindsey

Collected by (signature):

Immediately Packed on Ice N ✓ Y ___

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

SDG # L1410682
B232

Acctnum: **GEOCONKKY**
Template: **T195295**
Prelogin: **P873895**
PM: **732 - Donna Eidson**
PB:
Shipped Via: **FedEX Ground**

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	GSPEC-NORM21, U-ISO 16ozHDPE-NoPres	Remarks	Sample # (lab only)
SD-01-0813	G	SCM	Surface 0-0	9-27-21	0813	1	X		-01
SD-02-0810	G	SCM	Surface	9-27-21	0810	1	X		-02
SD-03-0815	G	SCM	Surface	9-27-21	0815	1	X		-03
SD-04-0910	G	SCM	Surface	9-27-21	0910	1	X		-04
SD-05-0800	G	SCM	Surface	9-27-21	0800	1	X		-05
SD-06-0754	G	SCM	Surface	9-27-21	0754	1	X		-06
SD-07-0758	G	SCM	Surface	9-27-21	0758	1	X		-07
SD-08-0805	G	SCM	Surface	9-27-21	0805	1	X		-08
SD-09-0750	G	SCM	Surface	9-27-21	0750	1	X		-09
SD-10-0816	G	SCM	Surface	9-27-21	0816	1	X		-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:no ice required

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: NP Y N
COC Signed/Accurate: Y N
Bottles arrive intact: Y N
Correct bottles used: Y N
Sufficient volume sent: Y N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
	9-27-21	16:10		0	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: ~~A7 68~~ -.2 °C 21.1 ~~20.9~~ Bottles Received: 13	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21 Time: 1015	Hold: Condition: NCF / OK

4500CPM

GEO Consultants – Kevil – KY 325 Kentucky Ave Kevil KY 42053	Billing Information: Accounts payable 325 Kentucky Ave Kevil KY 42053	Pres Chk
Report to: David Lindsey	Email To: lindseyd@geoconsultantscorp.com	
Project Description: Staten Island Warehouse, Port Richmond	City/State Collected:	Please Circle: PT MT CT ET
Phone:	Client Project #	Lab Project #
Collected by (print):	Site/Facility ID #	P.O. #
Collected by (signature): Immediately Packed on Ice N ____ Y ____	*Rush?* (Lab MUST Be Notified) ___ Same Day ___ Five Day ___ Next Day ___ 5 Day (Rad Only) ___ Two Day ___ 10 Day (Rad Only) ___ Three Day	Quote # Date Results Needed

Analysis / Container / Preservative: GSPEC – NORM21, U-ISO No Pres

Chain of Custody Page 2 of 2

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

SDG # L1410682
Table #
Acctnum:
Template:
Prelogin:
PM:
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	GSPEC – NORM21, U-ISO No Pres	Remarks	Sample # (lab only)
SD-MS	Grab	SCM	Surface	9-27-21	0910	1			-04
SD-MS-DUP	Grab	SCM	Surface	9-27-21	0910	1			-04
SD-~~X~~DUP-02	Grab	SCM	Surface	9-27-21	0810	1			-11

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP __Y __N
COC Signed/Accurate: __Y __N
Bottles arrive intact: __Y __N
Correct bottles used: __Y __N
Sufficient volume sent: __Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: __Y __N

Relinquished by : (Signature)	Date: 9-27-21	Time: 1610	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	AT BP 0 Temp: -.2 °C 21.1 20.9	Bottles Received: 13
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/29/21	Time: 1015

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.66		0.347	0.166	10/20/2021 21:27	WG1754725
URANIUM-235	0.167		0.103	0.11	10/20/2021 21:27	WG1754725
URANIUM-238	3.09	J	0.361	0.0993	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*70.0*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.02	X	0.259	0.416	11/04/2021 11:00	WG1759852
Bismuth-212	1.34	~~J~~ X	0.816	1.38	11/04/2021 11:00	WG1759852
Bismuth-214 (Ra-226)	2.03	X	0.270	0.215	11/04/2021 11:00	WG1759852
Lead-212	1.15	X	0.176	0.197	11/04/2021 11:00	WG1759852
Lead-214	2.34	X	0.264	0.211	11/04/2021 11:00	WG1759852
Potassium-40	10.5	X	1.69	1.27	11/04/2021 11:00	WG1759852
Thallium-208	0.356	X	0.0884	0.119	11/04/2021 11:00	WG1759852
Uranium-235	0.233	X	0.0784	0.133	11/04/2021 11:00	WG1759852
Thorium-234 (U-238)	0.819	(U) X, J	1.04	2.23	11/04/2021 11:00	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.618		0.187	0.184	10/20/2021 21:27	WG1754725
URANIUM-235	0.0291	J (U)	0.0470	0.0686	10/20/2021 21:27	WG1754725
URANIUM-238	0.686	J	0.164	0.112	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*89.1*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.09	X	0.296	0.462	11/04/2021 12:08	WG1759852
Bismuth-212	2.22	X	1.02	1.5	11/04/2021 12:08	WG1759852
Bismuth-214 (Ra-226)	0.972	X	0.222	0.278	11/04/2021 12:08	WG1759852
Lead-212	1.18	X	0.175	0.174	11/04/2021 12:08	WG1759852
Lead-214	1.01	X	0.174	0.241	11/04/2021 12:08	WG1759852
Potassium-40	17.1	X	2.61	1.53	11/04/2021 12:08	WG1759852
Thallium-208	0.397	X	0.107	0.138	11/04/2021 12:08	WG1759852
Uranium-235	0.151	X(J)	0.0645	0.108	11/04/2021 12:08	WG1759852
Thorium-234 (U-238)	1.48	X	0.785	1.43	11/04/2021 12:08	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

7

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.18		0.295	0.193	10/20/2021 21:27	WG1754725
URANIUM-235	0.0455	J (U)	0.0838	0.121	10/20/2021 21:27	WG1754725
URANIUM-238	2.18	J	0.276	0.125	10/20/2021 21:27	WG1754725
(T) URANIUM-232	*80.1*			*30.0-110*	*10/20/2021 21:27*	WG1754725

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.917	X	0.245	0.375	11/04/2021 12:10	WG1759852
Bismuth-212	0.918	~~J~~ X	0.784	1.38	11/04/2021 12:10	WG1759852
Bismuth-214 (Ra-226)	1.50	X	0.242	0.215	11/04/2021 12:10	WG1759852
Lead-212	0.922	X	0.169	0.186	11/04/2021 12:10	WG1759852
Lead-214	1.59	X	0.229	0.182	11/04/2021 12:10	WG1759852
Potassium-40	8.58	X	1.58	1.27	11/04/2021 12:10	WG1759852
Thallium-208	0.232	X	0.0773	0.104	11/04/2021 12:10	WG1759852
Uranium-235	0.218	X(J)	0.0867	0.14	11/04/2021 12:10	WG1759852
Thorium-234 (U-238)	1.59	~~J~~ X	1.17	2.08	11/04/2021 12:10	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.887		0.186	0.102	10/21/2021 17:06	WG1754727
URANIUM-235	0.0599	J	0.0543	0.061	10/21/2021 17:06	WG1754727
URANIUM-238	0.850		0.179	0.0854	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*95.7*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.10	X	0.323	0.528	11/04/2021 14:46	WG1759852
Bismuth-212	1.28	J X	1.18	2.12	11/04/2021 14:46	WG1759852
Bismuth-214 (Ra-226)	1.16	X	0.263	0.319	11/04/2021 14:46	WG1759852
Lead-212	1.49	X	0.214	0.193	11/04/2021 14:46	WG1759852
Lead-214	1.56	X	0.240	0.289	11/04/2021 14:46	WG1759852
Potassium-40	13.3	X	2.46	1.53	11/04/2021 14:46	WG1759852
Thallium-208	0.497	X	0.125	0.144	11/04/2021 14:46	WG1759852
Uranium-235	0.114	J X	0.0794	0.14	11/04/2021 14:46	WG1759852
Thorium-234 (U-238)	1.13	J X	0.793	1.75	11/04/2021 14:46	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.16		0.315	0.14	10/21/2021 17:06	WG1754727
URANIUM-235	0.0286	U	0.0578	0.0902	10/21/2021 17:06	WG1754727
URANIUM-238	1.69		0.276	0.114	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*79.1*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.13	X	0.314	0.495	11/04/2021 14:53	WG1759852
Bismuth-212	1.80	J X	1.11	1.87	11/04/2021 14:53	WG1759852
Bismuth-214 (Ra-226)	1.35	X	0.253	0.247	11/04/2021 14:53	WG1759852
Lead-212	1.48	X	0.241	0.222	11/04/2021 14:53	WG1759852
Lead-214	1.37	X	0.230	0.255	11/04/2021 14:53	WG1759852
Potassium-40	12.4	X	2.07	1.2	11/04/2021 14:53	WG1759852
Thallium-208	0.387	X	0.104	0.121	11/04/2021 14:53	WG1759852
Uranium-235	0.168	J X	0.103	0.175	11/04/2021 14:53	WG1759852
Thorium-234 (U-238)	1.69	J X	1.45	2.67	11/04/2021 14:53	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	2.81		0.346	0.153	10/21/2021 17:06	WG1754727
URANIUM-235	0.0877	J	0.0828	0.105	10/21/2021 17:06	WG1754727
URANIUM-238	3.02		0.353	0.128	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*81.8*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.29	X	0.197	0.226	11/04/2021 11:20	WG1759852
Bismuth-212	1.05	~~J~~ X	0.588	1.05	11/04/2021 11:20	WG1759852
Bismuth-214 (Ra-226)	2.57	X	0.259	0.139	11/04/2021 11:20	WG1759852
Lead-212	1.22	X	0.141	0.122	11/04/2021 11:20	WG1759852
Lead-214	2.47	X	0.247	0.152	11/04/2021 11:20	WG1759852
Potassium-40	10.3	X	1.25	0.87	11/04/2021 11:20	WG1759852
Thallium-208	0.364	X	0.0637	0.0712	11/04/2021 11:20	WG1759852
Uranium-235	0.250	X(J)	0.0635	0.103	11/04/2021 11:20	WG1759852
Thorium-234 (U-238)	1.91	X	0.994	1.67	11/04/2021 11:20	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.83		0.267	0.14	10/21/2021 17:06	WG1754727
URANIUM-235	0.104	J	0.0795	0.0926	10/21/2021 17:06	WG1754727
URANIUM-238	2.39	J	0.292	0.0839	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*82.0*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.947	X	0.244	0.419	11/04/2021 12:08	WG1759852
Bismuth-212	1.77	X	0.797	1.23	11/04/2021 12:08	WG1759852
Bismuth-214 (Ra-226)	1.90	X	0.251	0.201	11/04/2021 12:08	WG1759852
Lead-212	1.16	X	0.171	0.193	11/04/2021 12:08	WG1759852
Lead-214	1.98	X	0.234	0.224	11/04/2021 12:08	WG1759852
Potassium-40	10.2	X	1.62	1.35	11/04/2021 12:08	WG1759852
Thallium-208	0.336	X	0.0839	0.112	11/04/2021 12:08	WG1759852
Uranium-235	0.308	X(J)	0.0878	0.137	11/04/2021 12:08	WG1759852
Thorium-234 (U-238)	-0.710	(U) X, J	1.26	3.05	11/04/2021 12:08	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.24		0.230	0.177	10/21/2021 17:06	WG1754727
URANIUM-235	0.102		0.0660	0.0661	10/21/2021 17:06	WG1754727
URANIUM-238	1.67		0.237	0.108	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*87.1*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	1.35	X	0.308	0.446	11/04/2021 12:11	WG1759852
Bismuth-212	0.841	J X	0.959	1.79	11/04/2021 12:11	WG1759852
Bismuth-214 (Ra-226)	1.04	X	0.217	0.264	11/04/2021 12:11	WG1759852
Lead-212	1.09	X	0.185	0.227	11/04/2021 12:11	WG1759852
Lead-214	1.37	X	0.206	0.217	11/04/2021 12:11	WG1759852
Potassium-40	12.7	X	2.04	1.63	11/04/2021 12:11	WG1759852
Thallium-208	0.389	X	0.0967	0.126	11/04/2021 12:11	WG1759852
Uranium-235	0.150	X	0.0784	0.139	11/04/2021 12:11	WG1759852
Thorium-234 (U-238)	1.24	J X	1.12	2.29	11/04/2021 12:11	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.995		0.223	0.196	10/21/2021 17:06	WG1754727
URANIUM-235	0.0208	U	0.0799	0.122	10/21/2021 17:06	WG1754727
URANIUM-238	1.22		0.215	0.127	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*78.1*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.809	X	0.251	0.417	11/04/2021 12:12	WG1759852
Bismuth-212	0.740	~~J~~ X	0.733	1.4	11/04/2021 12:12	WG1759852
Bismuth-214 (Ra-226)	0.956	X	0.178	0.172	11/04/2021 12:12	WG1759852
Lead-212	1.03	X	0.151	0.143	11/04/2021 12:12	WG1759852
Lead-214	0.939	X	0.160	0.226	11/04/2021 12:12	WG1759852
Potassium-40	8.81	X	1.91	2.17	11/04/2021 12:12	WG1759852
Thallium-208	0.244	X	0.0750	0.102	11/04/2021 12:12	WG1759852
Uranium-235	0.106	(U) X	0.257	0.467	11/04/2021 12:12	WG1759852
Thorium-234 (U-238)	0.654	~~U~~ X	0.601	1.47	11/04/2021 12:12	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	1.56		0.278	0.193	10/21/2021 17:06	WG1754727
URANIUM-235	0.0674	~~J~~	0.0729	0.0953	10/21/2021 17:06	WG1754727
URANIUM-238	1.57	J	0.259	0.122	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*71.4*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.836	X	0.245	0.386	11/04/2021 14:47	WG1759852
Bismuth-212	1.49	X	0.883	1.47	11/04/2021 14:47	WG1759852
Bismuth-214 (Ra-226)	1.32	X	0.225	0.243	11/04/2021 14:47	WG1759852
Lead-212	0.935	X	0.168	0.212	11/04/2021 14:47	WG1759852
Lead-214	1.39	X	0.199	0.218	11/04/2021 14:47	WG1759852
Potassium-40	8.05	X	1.56	1.51	11/04/2021 14:47	WG1759852
Thallium-208	0.208	X	0.0795	0.121	11/04/2021 14:47	WG1759852
Uranium-235	0.110	~~J~~ X	0.0821	0.148	11/04/2021 14:47	WG1759852
Thorium-234 (U-238)	-2.52	(U) X, J	1.60	3.21	11/04/2021 14:47	WG1759852

Radiochemistry by Method D3972 U-02

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
URANIUM-234	0.881		0.200	0.11	10/21/2021 17:06	WG1754727
URANIUM-235	0.0275	J U	0.0471	0.071	10/21/2021 17:06	WG1754727
URANIUM-238	0.913		0.199	0.087	10/21/2021 17:06	WG1754727
(T) URANIUM-232	*75.3*			*30.0-110*	*10/21/2021 17:06*	WG1754727

Radiochemistry by Method DOE Ga-01-R/901.1 (21 day)

Analyte	Result pCi/g	Qualifier	Uncertainty +/-	MDA pCi/g	Analysis Date date / time	Batch
Actinium-228 (Ra-228)	0.902	X	0.389	0.738	11/04/2021 14:49	WG1759852
Bismuth-212	1.51	J X	1.43	2.59	11/04/2021 14:49	WG1759852
Bismuth-214 (Ra-226)	1.01	X	0.287	0.4	11/04/2021 14:49	WG1759852
Lead-212	1.38	X	0.250	0.311	11/04/2021 14:49	WG1759852
Lead-214	1.19	X	0.238	0.332	11/04/2021 14:49	WG1759852
Potassium-40	16.0	X	2.76	1.95	11/04/2021 14:49	WG1759852
Thallium-208	0.340	X	0.127	0.201	11/04/2021 14:49	WG1759852
Uranium-235	0.159	J X	0.105	0.189	11/04/2021 14:49	WG1759852
Thorium-234 (U-238)	0.805	(U) X	1.50	3.32	11/04/2021 14:49	WG1759852

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Leidos Radiological Analytical Data Validation

Event Name: Staten Island Warehouse FUSRAP Site
SDG Number: L1410682
Laboratory: Pace Analytical
Analysis: Gamma Spec/Iso U (sediment)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. The requested analyses include: $^{234/235/238}U$ by alpha spectrometry (Method D3972 U-02); ^{226}Ra (^{214}Pb, ^{214}Bi), ^{234}Th, ^{228}Ac, ^{40}K, and ^{235}U by gamma spectrometry (Method DOE Ga-01-R/901.1 (21 day)). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)
Data Intercomparison

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

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[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September, 2021.

[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.

[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February, 2018.

Sample Name Cross-Reference

Project Sample Name	Matrix	Lab Sample Name
SD-01-0813	Sediment	L1410682-01
SD-02-0810	Sediment	L1410682-02
SD-03-0815	Sediment	L1410682-03
SD-04-0910	Sediment	L1410682-04
SD-05-0800	Sediment	L1410682-05
SD-06-0754	Sediment	L1410682-06
SD-07-0758	Sediment	L1410682-07
SD-08-0805	Sediment	L1410682-08
SD-09-0750	Sediment	L1410682-09
SD-10-0816	Sediment	L1410682-10
SD-DUP-02	Sediment	L1410682-11

Validation Report By: **Amanda Leigh Dick** **03/0/8/2022**
(print) **Date**

Amanda Leigh Dick
(sign)

Peer Reviewed By: **Thomas L. Rucker** **3/11/2022**
(print) **Date**

TLRucker
(sign)

1.0 GAMMA SPECTROMETRY ANALYSIS

Holding Time and Preservation

All holding times and preservation requirements were met for the gamma spectrometry analysis.

Initial Calibration

For gamma spectrometry, the CENWK states that if the efficiency calibration delta values (difference between the measured and the calibration curve efficiency) are greater than 5% for any one radionuclide, the calibration shall be deemed unusable. The QAPP further states that the 95% CL of fitted function over range shall be ≤ 8%. The following gamma spectrometer detectors/geometries had one or more radionuclides with delta values greater than 5% and or a 95% CL (1.96 σ) greater than 8%:

Initial Calibration

Detector	Geometry	# Energy Peaks	Delta %	# Energy Peaks	95% CL	SDG Samples Affected	Qualifier
1	C6	1	6.3			SD-02-0810, SD-04-0910	X
5	C6	2	-16.4-6.5	9	8.8 – 14.7	SD-03-0815, SD-05-0800	X
2	P3	1	5.3			SD-07-0758, SD-10-0816	X
4	P3	1	18.3	1	8.8	SD-01-0813, SD-08-0805, SD-DUP-02	X
9	P3	1	12.7			SD-09-0750	X
12	P3	1	24.5	1	9.6	SD-06-0754	X

Based on the CENWK any samples counted on detector with Delta% greater than 5% should be qualified as unusable (X). However, this parameter was not listed in the QAPP. The QAPP parameter, 95% CL of the fitted curve, does not have guidance on how to qualify results outside its limits. It is likely that both of these parameter deficiencies are due to the calibration being performed with less than the minimum 10,000 net counts in each peak in at least six calibration peaks that bracket the range of use as is specified in the DoD Quality Systems Manuel (QSM). The raw counts for the calibration were not provided, but this is evidenced by the uncertainty reported for the peaks. This means there is greater than normal uncertainty in the results due to an uncertain bias from calibration. The samples counted on theses detectors/geometries have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Continuing Calibration

For gamma spectrometry, the CENWK states that if the activity of each radioisotope in the calibration standard is not within 10% relative of the true, decay corrected activity, the calibration shall be deemed unusable. The QAPP also sets a limit of 10% relative to the true value. The following detectors/geometries have one or more quantified peak outside of the 10% limit for the calibration verification check source:

Continuing Calibration

Detector	Geometry	# Energy Peaks	% Difference	SDG Samples Affected	Qualifier
1	C6	1	10.80%	SD-02-0810, SD-04-0910	X
2	P3	1	10.20%	SD-07-0758, SD-10-0816	X

Based on the CENWK any samples counted on detector with check source value of greater than 10% should be qualified as unusable (X). It is likely that this parameter's deficiencies are due to the calibration verification being performed with less than the minimum 10,000 net counts in each peak as is specified in the CENWK as the raw net counts for all peaks were less than the 10,000 net counts for all peaks and all detectors. This means there is greater than normal uncertainty in the results due to an uncertain bias from the calibration verification. These samples have been qualified as unusable (X) based on the CENWK guidance. However, it is recommended that the project consider these results as estimated and potentially usable for the project during Data Usability Assessment, due to the fact that the added uncertainty is only marginally outside the limits for a minimal number of radionuclide energies and only marginally greater than would normally be allowed.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The following samples did not achieve the RDL project goal of <1 pCi/g for Th-234: SD-01-0813, SD-07-0758, SD-10-0816, and SD-DUP-02.

Samples That Did Not Meet the RDL

Sample ID	Analyte	CSU (pCi/g)	3.5*CSU	RDL (pCi/g)
SD-01-0813	Th-234	0.5215	1.82525	1
SD-07-0758	Th-234	0.628	2.198	1
SD-10-0816	Th-234	0.8	2.8	1
SD-DUP-02	Th-234	0.7505	2.62675	1

The Ra-226 result was greater than the project action limit in the following sample: SD-06-0754: 2.57 pCi/g,

No sample results exhibited excess uncertainty.

The following sample had a negative result with an uncertainty smaller than its absolute value. The CENWK states these results need to be rejected. However, since these results are likely being influenced by a slight negative bias and may still be useful, professional judgment was used to qualify results. SD-10-0816: Thorium-234.

It is recommended that sample concentrations less than the L_c be qualified as non-detect (U). The following samples are qualified as U: SD-01-0813: Th-234; SD-07-0758: Th-234, SD-09-0750: U-235; SD-10-0816: Th-234; and SD-DUP-02: Th-234.

Method Blank

There was no indication of blank contamination for the gamma spectrometry analysis.

Laboratory Control Sample:

The percent recoveries for the laboratory control samples (LCSs) were within acceptable limits.

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S-D|}{\frac{S+D}{2}} \right) * 100$$

$$NAD = \frac{|S-D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the gamma spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<25%, <3).

All field duplicate results were within a factor of 4 from the original result.

Identification and Quantification:

The following target radionuclides: ^{228}Ac, ^{226}Ra, ^{40}K, ^{234}Th, and ^{235}U in the samples were reported. The energies of the radionuclides were less than 2 keV from their theoretical energies.

The laboratory used a peak search sensitivity factor of 3. When the peak search sensitivity factor is set at a value greater than 2.3, the peak search report will not report peaks as low as the MDA. Therefore, there is a greater than 5% chance that concentrations greater than the reported MDA will not appear in the peak search. However, the List Isotope Activities report calculates the net activities for the target analytes and this list has been used to report all target analyte activities. Therefore, the only impact is that small but detected non-target analytes may not have been reported.

2.0 ALPHA SPECTROMETRY

Holding Time and Preservation

All holding times and preservation requirements were met for the alpha spectrometry analyses.

Initial Calibration

The initial calibration met project acceptance criteria.

Continuing Calibration

The continuing calibration met project acceptance criteria.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The project RDL goal of <0.5 pCi/g was met for all radionuclides of interest.

All samples had results less than the project action limits.

No sample results exhibited excess uncertainty.

The sample-specific critical level (L_c) was calculated as 1.65 times the sample uncertainty**.** **It is recommended that sample concentrations less than the L_c be qualified as non-detect (U). The following results were qualified as U:.**

Sample-specific Critical Level (L_C)

Sample ID	Analyte	Result (pCi/g)	CSU (pCi/g)	L_C (pCi/g)	Qualifier
SD-02-0810	U-235	0.0291	0.019	0.03135	U
SD-03-0815	U-235	0.0455	0.029	0.04785	U
SD-05-0800	U-235	0.0286	0.02	0.033	U
SD-09-0750	U-235	0.0208	0.026	0.0429	U
SD-DUP-02	U-235	0.0275	0.017	0.02805	U

Matrix Spike

The percent recoveries were within acceptable limits.

Method Blank

There was no indication of blank contamination for the alpha spectrometry analysis.

Laboratory Control Sample:

The Uranium-238 percent recoveries was lower than the acceptable limits (75%-125%) for LCS R3725650-2 (See table below). **It is recommended that the U-238 results for the associated samples by qualified as estimated (J). The following samples were qualified J: SD-01-0813, SD-02-0810, and SD-03-0815**.

Radiochemistry - LCS % Recovery Calculation

Sample ID	Analyte	Found Value (pCi/g)	True Value (pCi/g)	LCS (% Recovery)	Qualifier
(LCS) R3725650-2	U-238	3.46	4.74	72.996%	J

Duplicate Analysis:

The duplicate results were evaluated by calculation of the RPD and NAD (DER).

$$RPD = \left(\frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where: S = Parent Sample Result
D = Field Split/Duplicate Parent Sample Result
U_S = Parent Sample CSU (1 sigma)
U_D = Field Split/Duplicate Parent Sample CSU (1 sigma)

The duplicates for the alpha spectrometry analysis have RPDs and/or NADs (DERs) with acceptable limits (<20%, <3).

All field duplicate results were within a factor of 4 from the original result.

Sample-Specific Chemical Recovery:

The tracer recoveries were within acceptable limits.

Spectral Analysis:

No spectral interferences were observed in all of the alpha spectrometry analyses.

Quantification:

No quantification issues were observed.

3.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

In comparing the uranium results from alpha spectrometry analysis to the uranium results from gamma spectrometry, several samples were not in agreement. **It is recommended that the following sample results (both alpha and gamma) be qualified as estimated (J) due to incomparable results: SD-02-0810, SD-03-0815, SD-06-0754, and SD-07-0758.**

Radiochemistry - Data Intercomparison

Sample ID	Analyte	Alpha		Gamma		RPD%	DER	Qualifier
		Result (pCi/g)	CSU (pCi/g)	Result (pCi/g)	CSU (pCi/g)			
SD-02-0810	U-235	0.0291	0.019	0.151	0.03225	135.37%	3.257	J
SD-03-0815	U-235	0.0455	0.029	0.218	0.04335	130.93%	3.307	J
SD-06-0754	U-235	0.0877	0.031	0.25	0.03175	96.12%	3.658	J
SD-07-0758	U-235	0.104	0.031	0.308	0.0439	99.03%	3.796	J
SD-01-0813	U-238	3.09	0.1805	0.819	0.52	116.19%	4.126	J
SD-07-0758	U-238	2.39	0.146	-0.71	0.63	369.05%	4.794	J
SD-10-0816	U-238	1.57	0.1295	-2.52	0.8	-861.05%	5.047	J

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410682

Analyte Group: **Iso Uranium and Gamma Spec**
Sample Matrix: Sediment
EDD (Y/N):

Disposition of Data Package: N/A
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y
On each Result Form check:	
SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for ~~surrogate~~ Tracer recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other: (Radiological)	initial calibration data	Y
	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

Calibration Standard COAs were not found in the package.
The calibration documentation are missing for both alpha and gamma analyses.

The gamma duplicate (DUP R3725727-2) MDA results are missing in the EDD and raw data. However, the MDA is not needed for duplicate calculations or validation requirements.

The laboratory issued a revision with some of the missing items.

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR # Item

Reviewed By: Amanda Leigh Dick & CMJ Date: 03/08/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site — Page ___ of ___

SDG No: L1410682 — **Analyte Group:** **Radiological**

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
SD-01-0813	L1410682-01	Sed	Iso. U, Gamma Spec	
SD-02-0810	L1410682-02	Sed	Iso. U, Gamma Spec	
SD-03-0815	L1410682-03	Sed	Iso. U, Gamma Spec	
SD-04-0910	L1410682-04	Sed	Iso. U, Gamma Spec	
SD-05-0800	L1410682-05	Sed	Iso. U, Gamma Spec	
SD-06-0754	L1410682-06	Sed	Iso. U, Gamma Spec	
SD-07-0758	L1410682-07	Sed	Iso. U, Gamma Spec	
SD-08-0805	L1410682-08	Sed	Iso. U, Gamma Spec	
SD-09-0750	L1410682-09	Sed	Iso. U, Gamma Spec	
SD-10-0816	L1410682-10	Sed	Iso. U, Gamma Spec	
SD-DUP-02	L1410682-11	Sed	Iso. U, Gamma Spec	

Comments:

Sediment

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1410682

Analysis: **Isotopic U and Gamma Specrometry**

Method:

Laboratory: Pace Analytical

Matrix: Sediment

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Results qualified as indicated due to LCS recoveries and incomparable results.

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: Amanda Leigh Dick & CMJ Date: 03/08/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks:

The Uranium-238 percent recoveries was lower than the acceptable limits for LCS R3725650-2. The associated samples are qualified as estimated (J): SD-01-0813, SD-02-0810, and SD-03-0815.

Samples that counted on gamma detectors with high delta values and/or a 95% CL (1.96 σ) greater than 8% were qualified: "X".

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks: No samples were re-analyzed or diluted.

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks:
No Issues.

Radiochemical Data Review Checklist

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
U-234	0.5 pCi/g	0.102 - 0.193	No Issues
U-235	0.5 pCi/g	0.061 - 0.122	No Issues
U238	0.5 pCi/g	0.0839 - 0.128	No Issues
K-40	<1 pCi/g	0.87 - 2.17	
Ra-226	0.5 pCi/g	0.139 - 0.4	No issues
Ac-228	<1 pCi/g	0.226 - 0.738	No issues
Th-234	<1 pCi/g	1.43 - 3.32	

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks:

K-40 results for these samples exceeded the MDA. Samples
SD-01-0813, SD-02-0810, SD-03-0815, SD-04-0910, SD-05-0800, SD-07-0758, SD-08-0805, SD-09-0750,
SD-10-0816, SD-DUP-02

Th-234 results for these samples exceeded the MDA. Samples
SD-01-0813, SD-02-0810, SD-03-0815, SD-04-0910, SD-05-0800, SD-07-0758, SD-07-0758, SD-08-0805, ,
SD-09-0750, SD-10-0816, SD-DUP-02

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: None

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: No issues.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: Delta Values

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value
6.3%	898.04 keV	1	< 5%		
-16.4%	136.47 keV	5	< 5%		
6.5%	159.00 keV	5	< 5%		
24.1%	513.99 keV	10	< 5%		
-5.3%	136.47 keV	11	< 5%		
5.3%	513.99 keV	2	< 5%		
18.3%	513.99 keV	4	< 5%		
12.7%	513.99 keV	9	< 5%		
24.5%	513.99 keV	12	< 5%		

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Samples counted on detectors with high delta values and/or a 95% CL (1.96 σ) greater than 8% were qualified: "X:.

Daily source checks were performed on each detector. Detectors 1 and 2 had %D values greater than 10%.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Not Applicable.

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks: Not Applicable.

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks:

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks:

None of the Method blanks or samples meet the requirements to qualified the samples for Isotopic Uranium.

None of the Method blanks or samples meet the requirements to qualified the samples for gamma spectrometry analysis..

VI. Blanks (continued)

see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration.

see CENWK 4.2.1.3 and QAPP

Deviations:

Radionuclide	Max. Activity Detected	Action Level	Samples Affected
Bi214 (Ra-226)	0.0976+/_ 0.0950	U	Gamma Spec Method Blank

Actions:

see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken
U-232	L1410682-01	70	No Issues
U-232	L1410682-02	89.1	No Issues
U-232	L1410682-03	80.1	No Issues
U-232	L1410682-04	95.7	No Issues
U-232	L1410682-05	79.1	No Issues
U-232	L1410682-06	81.8	No Issues
U-232	L1410682-07	82	No Issues
U-232	L1410682-08	87.1	No Issues
U-232	L1410682-09	78.1	No Issues
U-232	L1410682-10	71.4	No Issues
U-232	L1410682-11	75.3	No Issues

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks: No Issues

Radiochemical Data Review Checklist

VIII. Laboratory Control Sample Information

see CENWK 4.2.2 and QAPP

General LCS Criteria:
percent recovery (%R)

	aqueous	solid
Alpha	80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications:

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
U-238		72.996%	SD-01-0813 DVQ: J
			SD-02-0810 DVQ: J
			SD-03-0815 DVQ: J

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
Alpha (Solid)	<50% ~~<40%~~	50-74% ~~40-69%~~	126-150% ~~131-160%~~	>150% ~~>160%~~
	R	J	J	R

Remarks:

Radiochemical Data Review Checklist

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: SD-04-0910

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
MS			
U-234	21-Oct	105%	
U-238	21-Oct	105%	
MSD			
U-234	21-Oct	110%	
U-238	21-Oct	112%	

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch
see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: No Issuses.

U-238 recovery for MS is 105% and MSD is 110%

U-234 recovery for MS is 105% and MSD is 112%

Radiochemical Data Review Checklist

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: DUP R3725650-5 & DUP R3726763-5
DUP R3725727-2

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks:

L1410682.04

U-238 recovery for MS is 105% and MSD is 112%. The RPD for U-238 is 5.33%.

U-234 recovery for MS is 105% and MSD is 110%. The RPD for U-234 is 5.33%.

L1410640-06

U-238 recovery for MS is 98.6% and MSD is 101%. The RPD for U-238 is 2.08%.

U-234 recovery for MS is 97.9% and MSD is 101%. The RPD for U-234 is 2.74%.

All laboratory and field duplicate RDP/NAD results met acceptance criteria.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No issues.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues. Gamma Spectrometer system identified and calculated the the amount of the of the identified radionuclides as expected.

Radiochemical Data Review Checklist

XIII. ~~Tentatively Identified Radionuclides (gamma spectroscopy)~~ Sample Aliquot Representativeness

~~Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy. Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status. Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.~~
~~All peaks greater than 3X the background standard deviation must be identified and quantified.~~
~~The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical. Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination. Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).~~ Results from different but comparable analytical techniques from different sub-sample aliquots of the same sample shall be compared for consistency.

Deviations:

Radionuclide	Deficiency	Samples Affected
U-235	Alpha and Gamma results not comparable.	SD-02-0810. DVQ: "J"
U-235	Alpha and Gamma results not comparable.	SD-03-0815. DVQ: "J"
U-235	Alpha and Gamma results not comparable.	SD-06-0754. DVQ: "J"
U-235	Alpha and Gamma results not comparable.	SD-07-0758. DVQ: "J"
U-238	Alpha and Gamma results not comparable.	SD-01-0813. DVQ: "J"
U-238	Alpha and Gamma results not comparable.	SD-07-0758: DVQ: "J"
U-238	Alpha and Gamma results not comparable.	SD-10-0816. DVQ: "J"

Actions:
~~1. Qualify all tentatively identified radionuclides as estimated (J).~~
~~2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.~~
~~3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).~~ If the results do not agree within the reported uncertainty of measurement, results shall be qualified as "J" or "X", depending on the magnitude of the uncertainty.

Remarks:

Please see calculation sheet.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks:

No Issuses.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check: Please See Calculation Sheets.

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:
Formula has a "CF" code which means Correction Factor.
The Correction Factor is not in the data package.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:
Formula has a "CF" code which means Correction Factor.
The Correction Factor is not in the data package.

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks: SDG sample results were qualified per QAPP and CENWK guidance.

Company Name/Address:
Geo Consultants - Kevil, KY
325 Kentucky Ave
Kevil, KY 42053

Billing Information:
Accounts Payable
325 Kentucky Ave
Kevil, KY 42053

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

Pace Analytical®

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

Report to:
David Lindsey

Email To: lindseyd@geoconsultantscorp.com

Project Description:
Staten Isl Warehouse, Port Richmond

City/State Collected:

Please Circle: PT MT CT ET

Phone: 270-462-3882

Client Project # FUSRAP

Lab Project #

Collected by (print): Ben Hodges

Site/Facility ID #

P.O. #

Collected by (Signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N___ Y___

SDG # L1411184
B017

Acctnum: GEOCONKKY
Template: T195315
Prelogin: P873897
PM: 732 - Donna Eidson
PB: BF 9/17/21
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	KPA-U 500mlHDPE-HNO3	RA-226 1L-HDPE-Add HNO3	RA-228 1L-HDPE-Add HNO3								Remarks	Sample # (lab only)
Pres Chk							✓2	✓2	✓2									
GW-06-1205	G	NPW		9/27/21	1205	3	X	X	X									-01
GW-09-1210	G	NPW		9/27/21	1210	3	X	X	X									-02
GW-07-1215	G	NPW		9/27/21	1215	3	X	X	X									-03
GW-10-1220	G	NPW		9/27/21	1220	3	X	X	X									-04
		NPW				3	X	X	X									
		NPW				3	X	X	X									
		NPW				3	X	X	X									
		NPW				3	X	X	X									
						3	X	X	X									

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other______

Remarks: no ice is required
Please use split for field blank (GW-06) if possible

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP __Y __N
COC Signed/Accurate: __Y __N
Bottles arrive intact: __Y __N
Correct bottles used: __Y __N
Sufficient volume sent: __Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: __Y __N

Relinquished by : (Signature) Date: 9/27/21 Time: 1800 Received by: (Signature)

Relinquished by : (Signature) Date: Time: Received by: (Signature)

Trip Blank Received: Yes / No
HCL / MeoH
TBR

Relinquished by : (Signature) Date: Time: Received for lab by: (Signature)

Temp: A201 0 °C 21.4+0=21.4
Bottles Received: 12

Date: 9/30/21 Time: 9:15

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	-54.6	(U) J	66.0	126	10/20/2021 11:54	WG1757645
GROSS BETA	125	J	75.6	96.1	10/20/2021 11:54	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.0171	U	0.439	0.811	10/26/2021 15:15	WG1757745
(T) Barium	*96.6*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*95.1*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty +/-	RDL mg/l	Analysis Date date / time	Batch
Uranium	0.00755			0.00100	10/21/2021 13:41	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	2.55		0.624	0.194	10/08/2021 17:39	WG1750907
(T) Barium-133	*99.6*			*30.0-143*	*10/08/2021 17:39*	WG1750907

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	548	J	214	223	10/20/2021 11:54	WG1757645
GROSS BETA	787	J	175	200	10/20/2021 11:54	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.447	~~J~~	0.402	0.729	10/26/2021 15:15	WG1757745
(T) Barium	*95.3*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*100*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty +/-	RDL mg/l	Analysis Date date / time	Batch
Uranium	ND	U		0.00100	10/21/2021 13:43	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	1.95		0.549	0.174	10/08/2021 17:39	WG1750907
(T) Barium-133	*99.3*			*30.0-143*	*10/08/2021 17:39*	WG1750907

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	663	J	239	234	10/20/2021 11:54	WG1757645
GROSS BETA	803	J	150	165	10/20/2021 11:54	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	1.01		0.425	0.758	10/26/2021 15:15	WG1757745
(T) Barium	*87.6*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*95.1*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty +/-	RDL mg/l	Analysis Date date / time	Batch
Uranium	0.152			0.00100	10/21/2021 13:48	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	2.76		0.630	0.163	10/08/2021 17:39	WG1750907
(T) Barium-133	*101*			*30.0-143*	*10/08/2021 17:39*	WG1750907

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	40.1	J	60.5	85.7	10/20/2021 11:55	WG1757645
GROSS BETA	198	J	77.6	95.2	10/20/2021 11:55	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	5.83		0.931	1.56	10/26/2021 15:15	WG1757745
(T) Barium	*93.1*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*96.6*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty +/-	RDL mg/l	Analysis Date date / time	Batch
Uranium	0.0120			0.00100	10/21/2021 13:50	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.576		0.319	0.196	10/08/2021 17:39	WG1750907
(T) Barium-133	*96.5*			*30.0-143*	*10/08/2021 17:39*	WG1750907

Radiological Analytical Data Verification
Comments on Data for Case Number L1411184

Event Name:	Staten Island Warehouse FUSRAP Site
SDG Number:	L1411184
Laboratory:	Pace Analytical
Analysis:	Gross Alpha/Beta, Ra-228, Uranium, Ra-226 (ground water)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 4 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. This statement of work (SOW) contained four ground water samples for radiological analysis. The requested analyses include gross alpha/gross beta by gas proportional counting (Method EPA 900/9310), ^{228}Ra (Method EPA 904/9320), Total Uranium (ASTM D5174/D5174M), and ^{226}Ra (Method SM-7500-RA-B M). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

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[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September 2021.

[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.

[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February 2018.

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

Client Identification	Laboratory Identification
GW-06-1205	L1411184-01
GW-09-1210	L1411184-02
GW-07-1215	L1411184-03
GW-10-1220	L1411184-04

Validation Report By: **C. Martin Johnson** **03/13/2022**

(print) **Date**

C. Martin Johnson, Jr.

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/16/2022**

(print) **Date**

TLRucker

(sign)

1.0 GROSS ALPHA AND GROSS BETA ANALYSIS

The laboratory reported the following Gross Alpha and Gross Beta analyses results in the samples.

Holding Time and Preservation

All holding times and preservation requirements were met for the gross alpha and beta analyses.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_C) was calculated as 1.65 CSU. **It is recommended that sample concentrations less than the L_c include were qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/L)	CSU (pCi/L)	L_C (pCi/L)	Qualifier
GW-06-1205	Gross Alpha	-54.6	33.0	54.2	U

Lc = 1.645 * CSU

Method Blank Analysis

The Gross alpha, Gross Beta samples results did not show any method blank contamination for the Gross Alpha and Gross Beta analyses.

Duplicate Analyses

Review of the duplicate for the Gross Alpha and Gross Beta analysis was performed and the Gross Alpha analysis was within limits with a duplicate RPD and NAD (DER) of 15.7% and 0.0665. The Gross Beta analysis was outside of the limits with a duplicate RPD of 66.8% but NAD was within limits at 0.972. Therefore, no qualification of results is necessary.

Laboratory Control Samples

The laboratory control samples for the Gross Alpha and Gross Beta had recoveries of 93.2% and 120%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Gross Alpha and Gross Beta were not within the recovery limits of 80.0%. to 120% for water matrix. The MS recovery was 129% for Gross Alpha and 125% for Gross Beta. **Therefore, it recommended all Gross Alpha and Gross Beta results be qualified as estimated (J).**

Calculations

Ten percent of the results were recalculated. No issues were observed.

2.0 Ra-228 ANALYSIS

The laboratory reported the following Ra-228 by Gas Proportional Counter analyses to get the Ra-228 results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_c) was calculated as 1.65 CSU**. It is recommended that sample concentrations less than the L_c include be qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/L)	CSU (pCi/L)	L_C (pCi/L)	Qualifier
GW-06-1205	Ra-228	-0.0171	0.22	0.36	U

Lc = 1.645 * CSU

Method Blank Analysis

The Ra-228 results did not show any method blank contamination in the method blank for the analyses of Ra-228.

Duplicate Analyses

The evaluation of duplicates for the Ra-228 analysis was perform and the analysis was within limits with a duplicate NAD of 0.213. Therefore, no qualification is required.

Laboratory Control Samples

The laboratory control samples for the Ra-228 analysis had recoveries of 103%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Ra-228 is within the recovery limits of 70.0%. to 130%. The recoveries are 114% and 107%. Therefore, no qualification of the Ra-228 results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

3.0 URANIUM ANALYSIS

The laboratory reported the following Uranium analysis by KPA analyses to get the uranium results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Method Blank Analysis

The uranium results did not show any method blank contamination in the method blank for the analyses of uranium.

Duplicate Analyses

The duplicate for the uranium analysis was performed and the analysis showed non-detects for both the original samples and the duplicate samples. No qualification of the data due to duplicate samples.

Laboratory Control Samples

The laboratory control samples for the uranium analysis had recoveries of 112%. Therefore, no qualification of the samples due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the uranium analysis had 110% recovery for the original sample and 112% recovery for the matrix spike duplicate. The recovery limits were 75.0 to 125%. The recovery limits of 70.0%. to 125% were required. Therefore, no qualification of the uranium results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

4.0 Ra-226 ANALYSIS

The laboratory reported the following Ra-226 by Alpha Spectrometry analyses to get the Ra-226 results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_c) was calculated as 1.65 CSU**.** No results were less than the $L_{c.}$ Therefore, no undetected qualifiers are required.

The Ra-226 results analysis results do not meet the RDLs.

Method Blank Analysis

The Ra-226 results did not show any method blank contamination in the method blank for the analyses of Ra-226.

Duplicate Analyses

The duplicate for the Ra-226 analysis was perform and the analysis was within limits with a duplicate NAD of 0.213. Therefore, no qualification required for the Ra-226 data.

Laboratory Control Samples

The laboratory control samples for the Ra-226 analysis had recoveries of 102%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Ra-226 is within the recovery limits of 70.0%. to 130%. The recoveries are 92.1% and 97.7%. Therefore, no qualification of the Ra-226 results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1411184

Analyte Group: Gross Alpha/Beta; Ra-226,Ra228,Uranium
Sample Matrix: Ground Water
EDD (Y/N): Y

Disposition of Data Package: Finished
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for surrogate recovery results (e.g., org. form II)	Y
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y

Check for Method Calibration and Run Documentation

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other:	initial calibration data	Y
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

None

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR # Item

Reviewed By: C. Martin Johnson, Jr. Date: 3/13/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1411184

Analyte Group: Gross Alpha/Beta; Ra-226,Ra228,Uranium

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
GW-06-1205	L1411184-01	W	Gross Alpha/Beta; Ra-226,Ra228,Uranium	
GW-09-1210	L1411184-02	W	Gross Alpha/Beta; Ra-226,Ra228,Uranium	
GW-07-1215	L1411184-03	W	Gross Alpha/Beta; Ra-226,Ra228,Uranium	
GW-10-1220	L1411184-04	W	Gross Alpha/Beta; Ra-226,Ra228,Uranium	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1411184

Analysis: Gross Alpha/Beta; Ra-226,Ra228,Uranium

Method:

Laboratory: Pace Analytical

Matrix: Ground Water

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: C. Martin Johnson, Jr. Date: 3/13/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks:

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks:

No isssues.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks:

All holding times were met by the laboratory.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Gross A		126 pCi/L	
Gross B		96.1 pCi/L	
Ra-226		0.194 pCi/L	
Ra-228		0.811 pCi/L	
KPA Uranium		0.001 mg/L	

Actions: see CENWK 4.1.3.3a and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
~~2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.~~
~~3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).~~
~~4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).~~

Remarks:

No issues.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No issues.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

Not Used.

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No issues.

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No Deficiencies.

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks:

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
20-Oct-21		Gross Alpha	0.165 +/- 0.473	
20-Oct-21		Gross Beta	-0.314 +/- 1.21	
26-Oct-21		Ra-228	-0.151 +/- 0.246	
21-Oct-21		Uranium	U	
8-Oct-21		Ra-226	0.00799 +/- 0.0350	

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error

Remarks:

No issues.

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations:

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

No isssues.

VII. Sample-Specific Carrier or Tracer Recovery

see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks:

No issues.

Radiochemical Data Review Checklist

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

Gross Alpha

General LCS Criteria:
percent recovery (%R)

aqueous	solid
80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications:

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Gross Alpjha	20-Oct-21	93.20%	No qualification
Gross Beta	20-Oct-21	120%	No qualification
Ra-228	26-Oct-21	103%	No qualification
Uranium	21-Oct-21	112%	No qualification
Ra-226	26-Oct-21	102%	No qualification

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks:

No issues.

Radiochemical Data Review Checklist

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: ______

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Gross Alpha	20-Oct-21	129%	J - estimated
Gross Beta	20-Oct-21	125%	J - estimated
Ra-228	26-Oct-21	114%	No Qualification
Uranium	21-Oct-21	110%	No Qualification
Ra-226	26-Oct-21	92.10%	No Qualification

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch

see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks:

All Ground water samples qualified as estimated for Gross alpha and Gross beta analyses.

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: ______________________

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
Gross Alpha		5.46%		No qualification
Gross Beta		1.44%		No qualification
Ra-228		6.27%		No qualification
Uranium		0.97%		No qualification
Ra-226		5.90%		No qualification

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP
1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks:

No qualification of samples due to MS MSD recoveries.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No issues.

XIII. Tentatively Identified Radionuclides (gamma spectroscopy) N/A

Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions:
1. Qualify all tentatively identified radionuclides as estimated (J).
2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).

Remarks:

No issues.

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks:

No issues.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide: Ra-226	Method: L1411184-04

$$\text{Ra-226} = \frac{13-(0.001\text{x}150)-0}{150 \text{ x } 0.965 \text{ x } 0.25 \text{ x } 0.278 \text{ x } 2.22}$$

$$\text{Ra-226} = \frac{12.85 \text{ Counts}}{22.3335}$$

Ra-226 = 0.575 pCi/L

13 Counts
0.15 Counts bkd
150 minutes
0.965 Tracer Recovery
0.250 ml Sample Aliquot
2.22 coversion factor

Remarks:

Calculation Check:

Radionuclide: Ra-226 Uncertainy	Method:

$$\text{Ra-226 Error} = \frac{1.96 \text{ x}(\text{SQRT}(((13/150)/150) + (0.001/150)))}{(0.278 \text{ x } 0.25 \text{ x } 0.965 \text{ x } 2.22)}$$

$$\text{Ra-226 Error} = \frac{4.7384}{0.14889}$$

Ra-226 Error = 0.318

Remarks:

No issues with the calculations.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:
Not Applicable	

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks:

The gross alpha and gross beta results for samples GW-06-1205, GW-09-1210, Gw--07-1215, and GW-10-1220 should be qualified as estimated (J).

	Billing Information:
Geo Consultants Corp 325 Kentucky Ave Kevil KY 42053	Accounts Payable 325 Kentucky Ave Kevil, KY 42053
Report to: David Lindsey	Email To: lindseyd@geoconsultantscorp.com
Project Description: Staten Island	City/State Collected: Staten Island NY — Please Circle: PT MT CT ET
Phone: 270 462-3882	Client Project # — Lab Project #
Collected by (print): Ben Hooks	Site/Facility ID # — P.O. #
Collected by (signature): [signature]	Rush? (Lab MUST Be Notified) ___ Same Day ___ Five Day ___ Next Day ___ 5 Day (Rad Only) ___ Two Day ___ 10 Day (Rad Only) ___ Three Day — Quote # — Date Results Needed
Immediately Packed on Ice N ___ Y ___	

Analysis / Container / Preservative

Pres Chk: NZ | NZ | NZ

Chain of Custody Page ___ of ___

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SDG # L1411187

B018

Acctnum:
Template:
Prelogin:
PM:
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	KPA-U	RA-226	RA-228	Remarks	Sample # (lab only)
EQ-SD-1410	Comp	W	Surface	9-27-21	1410	3					-01
EQ-SB-1520	Comp	W	~~4-6~~ Surface	9-27-21	1520	✓					-02

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: ✓Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeOH TBR	
[signature]	9-27-21	1830		0	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: ~~Ambt~~ 21.3+.1=21.4 — Bottles Received: 6	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/30/21 Time: 9:15	Hold: — Condition: NCF / OK

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	-0.0607	(U) J	0.498	0.814	10/20/2021 11:55	WG1757645
GROSS BETA	0.125	(U) J	1.43	1.94	10/20/2021 11:55	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.256	U	0.296	0.562	10/26/2021 15:15	WG1757745
(T) Barium	*98.7*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*97.2*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty + / -	RDL mg/l	Analysis Date date / time	Batch
Uranium	ND	U		0.00100	10/21/2021 13:52	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.0348	U	0.0860	0.179	10/26/2021 22:26	WG1750910
(T) Barium-133	*97.0*			*30.0-143*	*10/26/2021 22:26*	WG1750910

Radiochemistry by Method 900

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
GROSS ALPHA	0.110	(U) J	0.572	0.883	10/20/2021 11:55	WG1757645
GROSS BETA	-1.54	(U) J	1.49	2.11	10/20/2021 11:55	WG1757645

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.575	U	0.291	0.562	10/26/2021 15:15	WG1757745
(T) Barium	*99.1*			*62.0-143*	*10/26/2021 15:15*	WG1757745
(T) Yttrium	*95.3*			*79.0-136*	*10/26/2021 15:15*	WG1757745

Radiochemistry by Method D5174

Analyte	Result mg/l	Qualifier	Uncertainty +/-	RDL mg/l	Analysis Date date / time	Batch
Uranium	ND	U		0.00100	10/21/2021 14:00	WG1760063

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.468		0.300	0.258	10/26/2021 22:26	WG1750910
(T) Barium-133	*93.4*			*30.0-143*	*10/26/2021 22:26*	WG1750910

Radiological Analytical Data Verification
Comments on Data for Case Number L1411187

Event Name:	Staten Island Warehouse FUSRAP Site
SDG Number:	L1411187
Laboratory:	Pace Analytical
Analysis:	Gross Alpha/Beta, Ra-228, Uranium, Ra-226 (ground water)

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The data validation was performed against the Quality Assurance / Quality Control Limits established in the Quality Assurance Project Plan (QAPP)[1] and in accordance with guidance from the Kansas City District Data Quality Evaluation Guidance[2] (CENWK) referenced in the QAPP and the Stage 3 guidelines provide in the DoD General Data Validation Guidelines[3]. It was based on the information and documentation supplied by the associated laboratory and project requirements. This statement of work (SOW) contained two equipment blank samples for radiological analysis. The requested analyses include gross alpha/gross beta by gas proportional counting (Method EPA 900/9310), ^{228}Ra (Method EPA 904/9320), Total Uranium (ASTM D5174/D5174M), and ^{226}Ra (Method SM-7500-RA-B M). The general criteria used to assess the analytical integrity of the data were based on an examination of the following, as applicable:

Case Narrative
Analytical Holding Times and Preservation
Method Calibration/Calibration Verification
Method Blanks
Background Checks
Analytical Tracer Recoveries
MS/MSD Recoveries and Differences
LCS/LCSD Recoveries and Differences
Laboratory Duplicates/Replicates
Re-analysis and Secondary Dilution
Minimum Detectable Activities (MDAs)
Reporting Levels
Chemical/Spectroscopic Separation
Specificity (alpha spectroscopy)
Project Duplicates and Splits
Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

[1] QAPP: "Final Uniform Federal Policy-Quality Assurance Project Plan Supplemental Site Inspection Staten Island Warehouse FUSRAP Site Port Richmond, Staten Island, New York, GEO Consultants Corporation, September 2021.
[2] CENWK: "Radionuclide Data Quality Evaluation Guidance" U.S. Army Corps of Engineers, Kansas City District, September 2017.
[3] "General Data Validation Guidelines" Department of Defense, Environmental Data Quality Workgroup, February 2018.

Definition of Data Validation Qualifiers:

"U" - Indicates a normal, non-detected (< critical value) result.

"J" - Indicates an unusually uncertain or estimated result.

"X" -The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but the exclusion of the data is recommended. The problems (quantitative or qualitative) are severe; data may still be usable depending upon the intended use of the data and reason for data rejection.

Client Identification	Laboratory Identification
EQ-SD-1410	L1411187-01
EQ-SB-1520	L1411187-02

Validation Report By: **C. Martin Johnson** **03/13/2022**

(print) **Date**

C. Martin Johnson, Jr.

(sign)

Peer Reviewed By: **Thomas L. Rucker, Ph.D.** **03/15/2022**

(print) **Date**

TLRucker

(sign)

1.0 GROSS ALPHA AND GROSS BETA ANALYSIS

The laboratory reported the following Gross Alpha and Gross Beta results.

Holding Time and Preservation

All holding times and preservation requirements were met for the gross alpha and beta analyses.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_c) was calculated as 1.65 CSU. **It is recommended that sample concentrations less than the L_c include be qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/L)	CSU (pCi/L)	L_C (pCi/L)	Qualifier
EQ-SD-1410	Gross Alpha	0.498	0.407	0.6695	U
EQ-SB-1520	Gross Alpha	0.572	0.4415	0.7263	U
EQ-SD-1410	Gross Beta	1.43	0.715	1.18	U
EQ-SB-1520	Gross Beta	-1.54	0.745	1.23	U

Lc = 1.645 * CSU

Method Blank Analysis

The Gross alpha, Gross Beta samples results did not show any method blank contamination for the Gross Alpha and Gross Beta analyses.

Duplicate Analyses

Review of the duplicate for the Gross Alpha and Gross Beta analysis was performed and the Gross Alpha analysis was within limits with a duplicate RPD and NAD (DER) of 15.7% and 0.0665. The Gross Beta analysis was outside of the limits with a duplicate RPD of 66.8% but NAD was within limits at 0.972. Therefore, no qualification of results is necessary.

Laboratory Control Samples

The laboratory control samples for the Gross Alpha and Gross Beta had recoveries of 93.2% and 120%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Gross Alpha and Gross Beta were not within the recovery limits of 80.0%. to 120% for water matrix. The MS recovery was 129% for Gross Alpha and 125% for Gross Beta. **Therefore, it recommended all Gross Alpha and Gross Beta results be qualified as estimated (J).**

2.0 Ra-228 ANALYSIS

The laboratory reported the following Ra-228 analysis by Gas Proportional Counter to get the Ra-228 results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_C) was calculated as 1.65 CSU**. It is recommended that sample concentrations less than the L_c include be qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/L)	CSU (pCi/L)	L_C (pCi/L)	Qualifier
EQ-SD-1410	Ra-228	-0.256	0.148	0.244	U
EQ-SB-1520	Ra-228	-0.575	0.146	0.239	U

Lc = 1.645 * CSU

Method Blank Analysis

The Ra-228 results did not show any method blank contamination in the method blank for the analyses of Ra-228.

Duplicate Analyses

The evaluation of duplicates for the Ra-228 analysis was performed and the analysis was within limits with a duplicate NAD of 0.213. Therefore, no qualification is required.

Laboratory Control Samples

The laboratory control samples for the Ra-228 analysis had a recovery of 103%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Ra-228 is within the recovery limits of 70.0%. to 130%. The recoveries are 114% and 107%. Therefore, no qualification of the Ra-228 results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

3.0 URANIUM ANALYSIS

The laboratory reported the following Uranium analysis by KPA to get the uranium results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The total uranium results were reported as non-detected (ND). **Therefore, all results were qualified as non-detect (U).**

Method Blank Analysis

The uranium results did not show any method blank contamination in the method blank for the analyses of uranium.

Duplicate Analyses

The duplicate for the uranium analysis was performed and the analysis showed non-detects for both the original samples and the duplicate samples. No qualification of the data due to duplicate samples is required.

Laboratory Control Samples

The laboratory control sample for the uranium analysis had a recovery of 112%. Therefore, no qualification of the samples due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the uranium analysis had 110% recovery for the original sample and 112% recovery for the matrix spike duplicate. The recovery limits were 75.0 to 125%. The recovery limits of 70.0% to 125% were required. Therefore, no qualification of the uranium results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

4.0 Ra-226 ANALYSIS

The laboratory reported the following Ra-226 analysis by Alpha Spectrometry to get the Ra-226 results.

Initial Calibration

There were no problems observed in the initial calibration.

Continuing Calibration

There were no problems observed in the continuing calibration.

Minimum Detectable Activities (MDAs)/ Reporting Levels

The sample-specific critical level (L_c) was calculated as 1.65 CSU**. . It is recommended that sample concentrations less than the L_c include be qualified as non-detect (U).** Please see table below.

Non-detected Results

Sample ID	Analyte	Result (pCi/L)	CSU (pCi/L)	L_C (pCi/L)	Qualifier
EQ-SD-1410	Ra-226	0.0348	0.0430	0.711	U

Lc = 1.645 * CSU

Method Blank Analysis

The Ra-226 results did not show any method blank contamination in the method blank for the analyses of Ra-226.

The Ra-226 results analysis results do not meet the RDLs.

Duplicate Analyses

The duplicate for the Ra-226 analysis was performed and the analysis was within limits with a duplicate NAD of 0.213. Therefore, no qualification is required for the Ra-226 data.

Laboratory Control Samples

The laboratory control samples for the Ra-226 analysis had a recovery of 102%. Therefore, no qualification of the sample due to laboratory control samples is required.

Matrix Spike Samples

The matrix spike samples for the Ra-226 is within the recovery limits of 70.0%. to 130%. The recoveries are 92.1% and 97.7%. Therefore, no qualification of the Ra-226 results is required.

Calculations

Ten percent of the results were recalculated. No issues were observed.

LEIDOS
Laboratory Data Verification Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1411187

Analyte Group: Equipment Rinsate Blanks
Sample Matrix: Non -Potable Water
EDD (Y/N): Y

Disposition of Data Package:
NCR No. (if applicable): N/A

1. Case Narrative

Read SDG Case Narrative	Y
Check Laboratory sample ID vs. Project sample ID lists	Y
Check that discussion covers each analytical type included in the SDG	Y
Check for identified nonconforming items (e.g., missed holding times, etc.)	Y

2. Chain-of-Custody (COC)

Check COC sample collection, shipping, and receiving dates	Y
Check that COC signature blocks are complete	Y
Check COC project sample IDs vs. Lab IDs and Result Form IDs	Y
Match COC requested analyses with Case Narrative and with data package content (Result Forms)	Y

3. Analytical Results Form

Verify that a Result Form is present for each sample and analysis	Y

On each Result Form check:

SDG No.	Y
Sample ID	Y
Lab ID	Y
Date Collected	Y
Date Extracted	Y
Date Analyzed	Y
Result Matrix	Y
Result Units	Y

4. Project Verification

Check project analyte list vs. analytes reported	Y
Check project requested methods vs. analytical methods performed	Y
Check analyte reporting levels vs. project reporting level goals	Y

5. Analytical Quality Control Information

Check for surrogate recovery results (e.g., org. form II)	
Check for LCS results (e.g., org. form III, inorg. form XII)	Y
Check for method blank results (e.g., org. form IV, inorg. form III)	Y
Check for MS/MSD results (e.g., inorg. form V)	Y
Check for laboratory duplicate results (e.g., inorg. form VI)	Y
Check for Method Calibration and Run Documentation	Y

organic:	instrument performance check	N/A
	initial calibration data	N/A
	continuing calibration data	N/A
	internal standard areas	N/A
	internal standard retention times	N/A
	sample clean-up documentation	N/A
	(org. forms V through X)	
metal:	initial calibration data	N/A
	continuing calibration data	N/A
	method detection limits	N/A
	method linear range	N/A
	sample run sequence	N/A
	(inorg. forms II, IV, and VIII through XIV)	
other:	initial calibration data	Y
(Radiological)	continuing calibration data	Y
	method detection limits	Y
	sample run sequence	Y

6. Incorrect Information

Identify missing items or incorrect information (i.e., missing forms, unsigned forms, incorrect sample IDs, etc.)

Contact the laboratory or project personnel to obtain missing information or correct information

Document corrections below:

None

7. Nonconforming Items

Document all nonconforming items that can not be resolved above in a Non-Conformance Report (NCR), complete form, file, and follow-up

NCR #	Item

Reviewed By: C. Martin Johnson, Jr. Date: 3/13/2022

QA Review By: Date:

LEIDOS
Laboratory Data Package Detail Form

Project: Staten Island Warehouse FUSRAP Site

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SDG No: L1411187

Analyte Group: **GrossA,B; Ra-226,Ra228,Uranium**

Field Sample ID	Lab ID #	Matrix	Analysis	Notes:
EQ-SD-1410	L1411187-01	W	GrossA,B; Ra-226,Ra228,Uranium	
EQ-SB-1520	L1411187-02	W	GrossA,B; Ra-226,Ra228,Uranium	

Comments:

LEIDOS
Radiochemical Data Review Checklist

Project: Staten Island Warehouse FUSRAP Site

SDG No: L1411187

Analysis: GrossA,B; Ra-226,Ra228,Uranium

Method:

Laboratory: Pace Analytical

Matrix: Water

The above data package has been reviewed and the analytical quality control/quality assurance performance data have been summarized. The general criteria used to assess the analytical integrityof the data were based on an examination of the following:

Case Narrative	Chemical and/or Tracer Recoveries
Analytical Holding Times	Matrix Spike Results
Sample Preservation	Duplicate Error Ratios and RPDs
Method Calibration	LCS Recoveries
Method and Project Blanks	Re-analysis and Secondary Dilution

Overall Remarks: CENWK, QSM 5.3; see QAPP for specific requirements

Results qualified as indicated due to MS/MSD recoveries.

Definition of Qualifiers:

"U", not detected at the associated level
~~"UJ", not detected and associated value estimated~~ N/A
"J", associated value estimated
"R", associated value unusable or analyte identity unfounded
"=", compound properly identified and value positive

Reviewed by: C. Martin Johnson, Jr. Date: 3/13/2022

QA Reviewed by: Date:

I. Case Narrative

Verify direct statements made within the Laboratory Case Narrative (note discrepancies).

Remarks: Samples qualified due to high MS/MSD recoveries.

II. Re-analysis and Secondary Dilutions

Verify that re-analysis and secondary dilutions were performed and reported as necessary. Determine appropriate results to report.

Remarks:

No isssues.

Radiochemical Data Review Checklist

III. Holding Times and Preservation

General analytical holding time for radionuclides is 6 months
Water samples require preservation with nitric acid to pH <2, for dissolved radionuclide determination
Radioactive iodine holding time is 7 days
Consideration must always be given to the individual radionuclide half-life

Deviations: None

Sample #	Radionuclide:	Date Collected	Date Analyzed	Action

Actions:
1. If holding times are exceeded *, all results are qualified as estimated (J/UJ) *or improperly preserved
2. If holding times are exceeded by more than 2X, reviewer may qualify non-detected results as unusable (R)

Remarks:

All holding times were met by the laboratory.

IV. Minimum Detectable Activities (MDAs)/ Reporting Levels

see CENWK 4.1.3 and QAPP

Verify MDAs with project requested reporting levels for all radionuclides
Compare reported activities and uncertainties with reported MDAs

Deviations:

Radionuclide	Project Reporting Level Goal	MDA Achieved	Samples Affected
Gross A		0.883	
Gross B		2.11	
Ra-226		0.258	
Ra-228		0.532	
KPA Uranium		0.001	

Actions: see CENWK 4.1.3 and QAPP

1. Document all radionuclide determinations that do not meet project reporting level goals.
2. If the reported value with its uncertainty encompass the project reporting level goal, they are equivalent.
3. If the sample result is negative and its absolute value exceeds the MDA, qualify the result as estimated (UJ).
4. If the sample result is negative and its absolute value exceeds 2X the MDA, qualify the result (R).

Remarks:

No issues.

V.A1. Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Initial energy calibration must be demonstrated for each detector.
Resolution (FWHM) must be demonstrated for each detector.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.A2.Continuing Calibration Alpha Spectroscopy

see CENWK 4.3.1.2.2 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed weekly or bi-weekly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.2 and QAPP

1. If the initial calibration efficiencies, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No issues.

V.B1. Calibration Gamma Spectroscopy see CENWK 4.3.1.1.1 and QAPP

Initial efficiency calibration must be demonstrated on each detector for each geometry.
Initial energy calibration must be demonstrated on each detector for each geometry.
Resolution (FWHM) must be demonstrated for each detector for each geometry.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.B2.Continuing Calibration Gamma Spectroscopy see CENWK 4.3.1.1.2 and QAPP

Continuing calibration efficiency verification must be performed for each detector at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Continuing energy calibration must be demonstrated to be within 10% of the initial calibration.
Continuing FWHM must be demonstrated to be within 10% of the initial FWHM.
A long background count for each detector must be performed monthly.
Pulser counts and demonstration of FWHM for each detector must be demonstrated daily.

Deviations: N/A

Deficiency	IS Affected	Area Detectors Affected	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.1 and QAPP

1. If the initial calibration efficiency, energy, resolution, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency, energy, or FWHM are not acceptable, qualify all affected results as estimated (J).
3. If background counts or pulser counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

N/A

V.C1. Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.1 and QAPP

Initial quench curves must be demonstrated for each radionuclide.
Initial calibration must be demonstrated for each radionuclide.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.C2. Continuing Calibration ~~Liquid Scintillation Counters~~ Kinetic Phosphorescence Analysis

see CENWK 4.3.1.4.2 and QAPP

Continuing calibration efficiency verification must be performed afor each radionuclide.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Standards linear regression curve must be performed daily and documentation provided.
Control charts for tritium and carbon-14 chi square and figure of merit values should be documented.
A background count for each radionuclide window must be provided.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.4 and QAPP

1. If the initial calibration quench curve or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or control charts are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No issues.

V.D1. Calibration Gas Proportional Counters (GrossAB) see CENWK 4.3.1.3.1 and QAPP

Initial efficiency calibration must be demonstrated for each detector.
Absorption curve must be demonstrated for each detector.
Plateau curve performance check must be demonstrated for each detector.
Data used to determine alpha and beta cross-talk must be demonstrated.
Standards must be traceable and documentation must be provided.
Standard preparation (dilutions, calculations, etc.) documentation must be provided.

V.D2.Continuing Calibration Gas Proportional Counters see CENWK 4.3.1.3.1 and QAPP

Continuing calibration efficiency verification must be performed at least quarterly.
Continuing calibration efficiency must be demonstrated to be within 10% of the initial efficiency.
Cross-talk value for each detector must be documented.
Background count for each detector must be performed daily.

Deviations:

Deficiency	IS Affected	Area Detectors Affect	Acceptable Range	RT Samples Affected	Std. RT Value

Actions: see CENWK 4.3.1.3 and QAPP

1. If the initial calibration absorption curve, plateau curve, % cross-talk, or standard information is not acceptable, qualify all affected results as estimated (J).
2. If the continuing calibration efficiency or percent cross-talk are not acceptable, qualify all affected results as estimated (J).
3. If background counts are not acceptable, qualify the affected data as estimated (J).

Remarks:

No Deficiencies.

VI. Blanks

see CENWK 4.2.1 and QAPP

Review associated laboratory and project blank samples. List documented contamination below:

If the blank result is less than the associated uncertainty (error), no qualification will be warranted.
If the blank result is greater than its associated uncertainty, but less than the MDA, then no qualification will be warrented.
If the blank result is greater than the associated uncertainty and greater than the MDA, then qualification of sample results may be appropriate.

Laboratory Method Blanks:

Date	Lab ID #	Radionulcide	Result and Error	MDA Result and Error
20-Oct-21		Gross Alpha	0.165 +/- 0.473	
20-Oct-21		Gross Beta	-0.314 +/- 1.21	
26-Oct-21		Ra-228	-0.151 +/- 0.246	
21-Oct-21		Uranium	U	
26-Oct-21		Ra-226	-0.000464 +/- 0.0260	

Associated Project Blanks (e.g., equipment rinsates, etc.)

Date	Lab ID #	Radionuclide	Result and Error	MDA Result and Error
20-Oct-21	EQ-SD-1410	Groos Alpha	-0.0607 +- 0.498	
	EQ-SD-1410	Gross Beta	0.125 +/- 1.43	
	EQ-SD-1410	Ra-228	-0.256 +/- 0296	
	EQ-SD-1410	Uranium	ND	
	EQ-SD-1410	Ra-226	0.0348 +/- 0.0860	

Remarks:

No issues.

VI. Blanks (continued) see CENWK 4.2.1 and QAPP

Calculate action levels based on 10X the highest blank concentration. see CENWK 4.2.1.3 and QAPP

Deviations:

Radionuclide	Max. Activity Detected	Action Level	Samples Affected

Actions: see CENWK 4.2.1 and QAPP

1. If the blank result falls outside criteria, qualify associated sample results that are less than 10X the blank value as estimated (J).

Example:	Blank Result	Uncert.	MDA or	Normalized absolute difference	Qualification
acceptable	0.3	0.45	0.5	>2.58	none
acceptable	0.3	0.25	0.5	1.96 to 2.58	J
outside criteria	0.3	0.25	0.2	<1.96	J

2. If the absolute sample result is less than the MDA and the uncertainty is less than the result, qualify as non-detect (U).
3. If the absolute sample results is less than the MDA and the uncertainty is greater than the result, qualify as non-detect value uncertain (UJ).
4. If the sample result is greater than the MDA and the uncertainty is 50-100% of the result, qualify the data as estimated (J).
5. If the sample result is greater than the MDA and the uncertainty is greater than 100% of the result, qualify the data as rejected (R).
4. If the sample result is negative, and its absolute value exceeds 2X the MDA, qualify the data as rejected (R).

Remarks:

No isssues.

VII. Sample-Specific Carrier or Tracer Recovery see CENWK 4.1.2 and QAPP

Sample-specific recoveries must be within limits as demonstrated by the applicable analytical procedures.
Generally, recoveries of 30-110% are considered acceptable.
Documentation of traceable tracer solutions (NIST) and dilution documentation must be provided.
Spot check sample-specific carrier or tracer recovery calculations.

Deviations:

Radionuclide	Sample ID	%R	Action Taken

Actions: see CENWK 4.1.2 and QAPP

1. If recovery is between 30-110%, no qualification is necessary.
2. If recovery is between 20 ~~10~~-30%, qualify the data as estimated (J).
3. If recovery is between 110-120~~150~~%, qualify the data as estimated (J).
4. If recovery is less than 20 ~~10%,~~ qualify the data as rejected (R).
5. If recovery if greater than 120 ~~150%,~~ qualify the data as rejected (R).

outside lab limits but within 20-120%: J if corrective actions taken, otherwise R

Remarks:

No issues.

VIII. Laboratory Control Sample Information see CENWK 4.2.2 and QAPP

Gross Alpha

General LCS Criteria:

percent recovery (%R)	aqueous	solid
	80-120	~~70-130~~ 75-125

Gamma, GPC, KPA: 80-120

Laboratory LCS Identifications:

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Gross Alpjha	20-Oct-21	93.20%	No qualification
Gross Beta	20-Oct-21	120%	No qualification
Ra-228	26-Oct-21	103%	No qualification
Uranium	21-Oct-21	112%	No qualification
Ra-226	26-Oct-21	105%	No qualification

Actions: see CENWK 4.2.2 and QAPP

Alpha (Aqueous) and Gamma, GPC, KPA	<50%	50-79%	121-150%	>150%
	R	J	J	R
	<50%	50-74%	126-150%	>150%
Alpha (Solid)	~~<40%~~	~~40-69%~~	~~131-160%~~	~~>160%~~
	R	J	J	R

Remarks:

Radiochemical Data Review Checklist

IX. Matrix Spike Information

General MS Criteria:
percent recovery (%R)

Aqueous	Solid
50-120	40-130

see CENWK 4.2.3 and QAPP

Project Sample(s) Spiked: ______

Deviations:

Radionuclide	Date	%R	Samples Affected/Qualifiers Applied
Gross Alpha	20-Oct-21	129%	J - estimated
Gross Beta	20-Oct-21	125%	J - estimated
Ra-228	26-Oct-21	114%	No Qualification
Uranium	21-Oct-21	110%	No Qualification
Ra-226	26-Oct-21	75.40%	No Qualification

Actions: see CENWK 4.2.3 and QAPP

	<20%	20-49%	121-160%	~~>160%~~ >150%
Aqueous	R	J	J	~~use professional judgement~~ R

all samples in batch

see CENWK 4.2.3 and QAPP

	<10%	10-39%	131-160%	~~>160%~~ >150%
Solid	R	J	J	~~use professional judgement~~ R

Remarks: ______

X. Duplicate Sample or Matrix Spike Duplicate Analysis see CENWK 4.2.4, 4.2.5 and QAPP

Identify the method utilized to evaluate duplicate analyses; duplicate error ration (DER), relative percent difference (RPD), or relative error ratio (RER).
Duplicate actions should apply to all samples associated with the duplicate pair.

Duplicate Sample Identification: ______________________

Deviations:

Radionuclide	DER	RPD	RER	Samples Affected
Gross Alpha		5.46%		No qualification
Gross Beta		1.44%		No qualification
Ra-228		6.27%		No qualification
Uranium		0.97%		No qualification
Ra-226		1.76%		No qualification

Actions: see CENWK 4.2.4 (lab dup) 4.2.5 (field dup) and QAPP

1. If both sample and duplicate activities are within 2X the MDA comparison is acceptable.
2. If the DER is greater than 1.00, qualify the data as estimated (J).
3. If the RPD is greater than 50% qualify the data as estimated (J).
4. If one sample is <MDA and the other sample is >2X the MDA, qualify the data as estimated (J).

Remarks:

No qualification of samples due to RPD/NAD results.

XI. Chemical/Spectroscopic Separation Specificity (alpha spectroscopy)

see CENWK 4.1.8, 4.1.9.2 and QAPP

Each alpha isotopic peak should be clear and free of interference from other energy peaks.
Each isotopic energy peak should be evaluated for peak shape (i.e., tailing, splitting, etc.)
The observed energy peak(s) for the radionuclide of interest must be confirmed as acceptable to theoretical.

Deviations:

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.8, 4.1.9.2 and QAPP

1. If the energy of the radionuclide peak of interest is more than 40~~100~~keV from the theoretical energy, qualify the results as rejected (R).
2. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
3. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

No Issues.

XII. Target Radionuclide Spectroscopic Identification (gamma spectroscopy)

also Matrix Density see CENWK 4.1.9, 4.1.7 and QAPP

Each sample target radionuclide energy must be within 2 keV of the observed standard peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
At least 50% of the total gamma abundance must be accounted for by the quantified radionuclides.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: N/A

Radionuclide	Deficiency	Samples Affected

Actions: see CENWK 4.1.9, 4.1.7 and QAPP

1. For target radionuclides that are not detected, qualify the results as described in section VI.
2. For target radionuclides that are detected but fail to meet identification crtieria, use professional judgement to qualify the data as estimated (J).
3. If the energy of the radionuclide peak of interest is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
4. If the energy spectra contains any overlapping or interferent peaks that can not be resolved from the target peak, qualify the data as rejected (R).
5. If results have not been properly corrected for distinquishable interfering radionuclide peaks, qualify the data as rejected (R).

Remarks:

N/A

XIII. Tentatively Identified Radionuclides (gamma spectroscopy) N/A

Each sample tentatively identified radionuclide energy must be within 2 keV of the theoretical peak energy.
Multiple peak radionuclides must exhibit the appropriate peak energies and proportional status.
Tentatively identified radionuclide gamma spectra must match the radionuclide's library spectra.
All peaks greater than 3X the background standard deviation must be identified and quantified.
The observed energy peak(s) for radionuclides of interest must be confirmed as acceptable to theoretical.
Judgments of this data should include: half-life consistencies; sample set consistencies; lab contamination.
Radionuclide values must be consistent with related radionuclides (e.g., parent daughter relationships).

Deviations: N/A

Radionuclide	Deficiency	Samples Affected

Actions:
1. Qualify all tentatively identified radionuclides as estimated (J).
2. If the energy of the tentatively identified radionuclide peak is more than 2 keV from the theoretical energy, use professional judgement to qualify the data.
3. If the reviewer judges anything regarding the identifcation of the tentatively identified radilnuclide as suspect, qualify the data as rejected (R).

Remarks:

N/A

XIV. Evaluate System Performance (alpha spec, gamma spec, etc.)

also Background (4.3.2) see CENWK and QAPP

Examples of system performance indicators:

Abrupt, discreet shifts in background or detector response.
High background levels.
Energy calibration shifts.
Extraneous peaks.
Loss of resolution.
Peak tailing or splitting.

Deviations:

Radionuclide/Method	Deficiency	Samples Affected

Actions: see CENWK and QAPP

1. Based on the instrument performance indicators, the data reviewer must use professional judgement ot qualify the data.

Remarks:

No issues.

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:

Remarks: ______________________

Calculation Check:

Radionuclide:	Method:

Remarks: ______________________

XV. Analyte Quanti Radiochemical Data Review Checklist

Original data information should fall within the established calibration range for the analytical run.
Confirm appropriate instrument and manual peak integration.
Confirm calculation of reported results for at least 10% of the data set.

Calculation Check:

Radionuclide:	Method:
Not Applicable	

Remarks:

Calculation Check:

Radionuclide:	Method:

Remarks:

XVI. Overall Assessment of Data

It is appropriate for the data reviewer to make professional judgements and express concerns regarding the validity of the data, overall. This is particularly appropriate when there are several citeria outside the desired specifications. The additive nature of these factors may present data that needs to be further qualified beyond each individual qualification. The reviewer should summarize these concerns.

Actions:

1. Qualified data must be accompanied by all individual reason codes related to the qualification assigned.
2. If the sample result has been qualified for multiple reasons, the reviewer will use professional judgement to determine if multiple estimations warrants rejection (R).

Remarks:

The data in this data package has no issues that will cause qualification of the data.

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APPENDIX C

LABORATORY DATA PACKAGES

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APPENDIX D

ELECTRONIC DATA DELIVERABLES

(electronic copy only)

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APPENDIX E

GIS DATA

(electronic – included in Final version only)

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APPENDIX F

BORING LOGS

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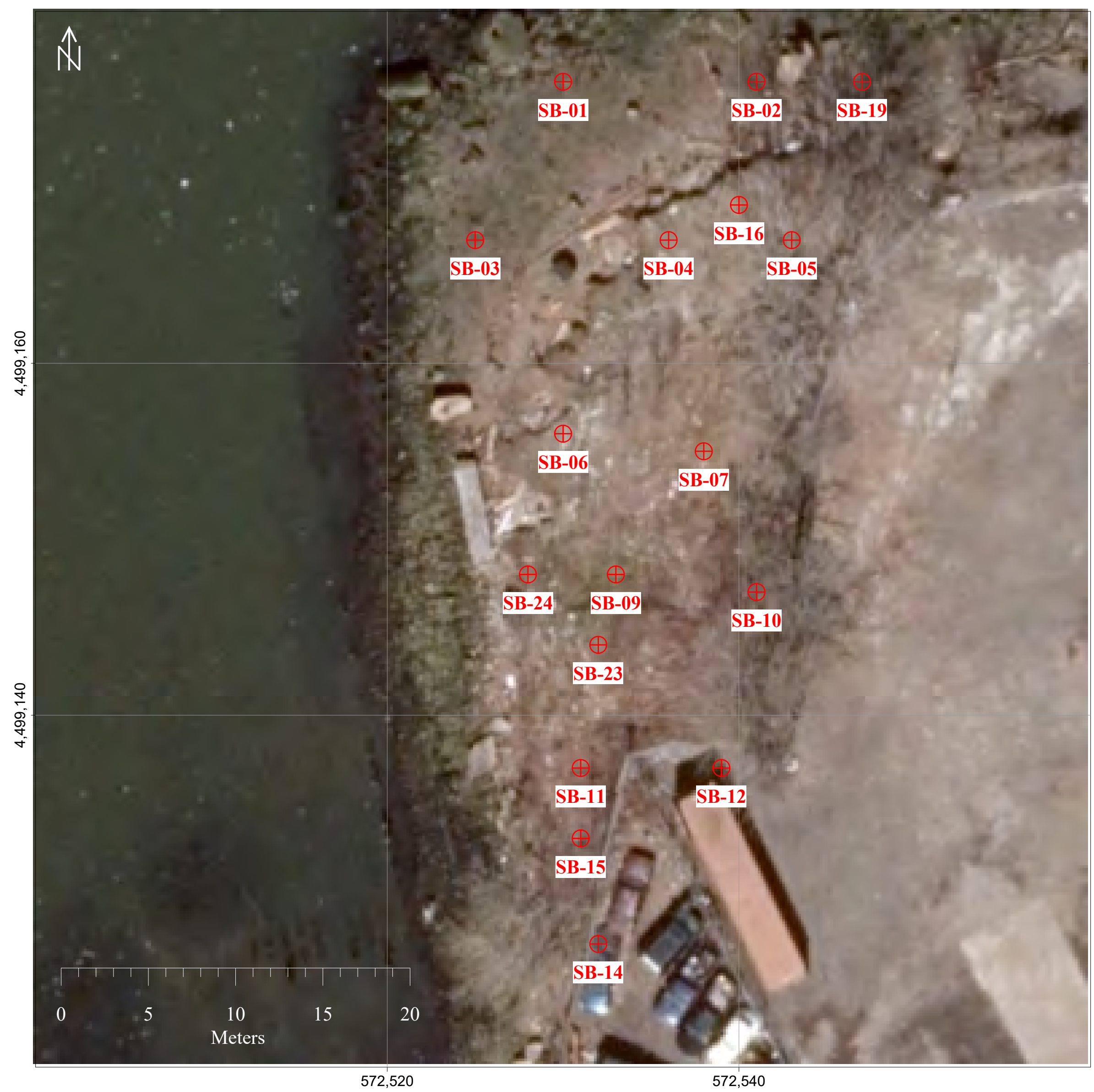
HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-01**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572530, Easting: 4499176 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 0.8 feet amsl (NAD83)	
	10. DATE STARTED: 9/24/2021	11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 2.6 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 2.4 feet bgs	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 2.6 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 100% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-01

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	SAND, coarse- to fine-grained, silty, with fine-grained gravel; with cobbles at surface; brown to gray; moist to wet; loose	SAND	0-2.6 (Rec:100 %)	PID: 0 Gamma: 4203	SS-01
0.2					PID: 0 Gamma: 3966	SB-01 (0.5-1.0)
	1	- dark gray to black, with silt			PID: 0 Gamma: 3758	SB-01 (1.0-2.0)
-0.8						
	2	- medium dense				
		- wet at 2.4'				
-1.8						

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-02**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572541, Easting: 4499176 (UTM Zone 18N)
	9. SURFACE ELEVATION: 2.6 feet amsl (NAD83)
	10. DATE STARTED: 9/24/2021 — 11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 2.1 feet	15. DEPTH GROUNDWATER ENCOUNTERD:
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 2.1 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBRED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 100% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG		HOLE NUMBER: SB-02
PROJECT: Staten Island Warehouse	INSPECTOR: Benjamin Hooks, GEO Consultants Corporation	

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
2.5	0	SAND, coarse- to fine-grained, silty, with fine-grained gravel; with cobbles; brown to dark gray; moist; medium dense	SAND	0-2.1 (Rec:100 %)	PID: 0 Gamma: 4194	SS-02
					PID: 0 Gamma: 4178	SB-02 (0.5-1.0)
1.5	1	CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY		PID: 0 Gamma: 4245	SB-02 (1.0-2.0)
0.5	2	- Refusal at 2.1' - rock or concrete				

HTRW DRILLING LOG

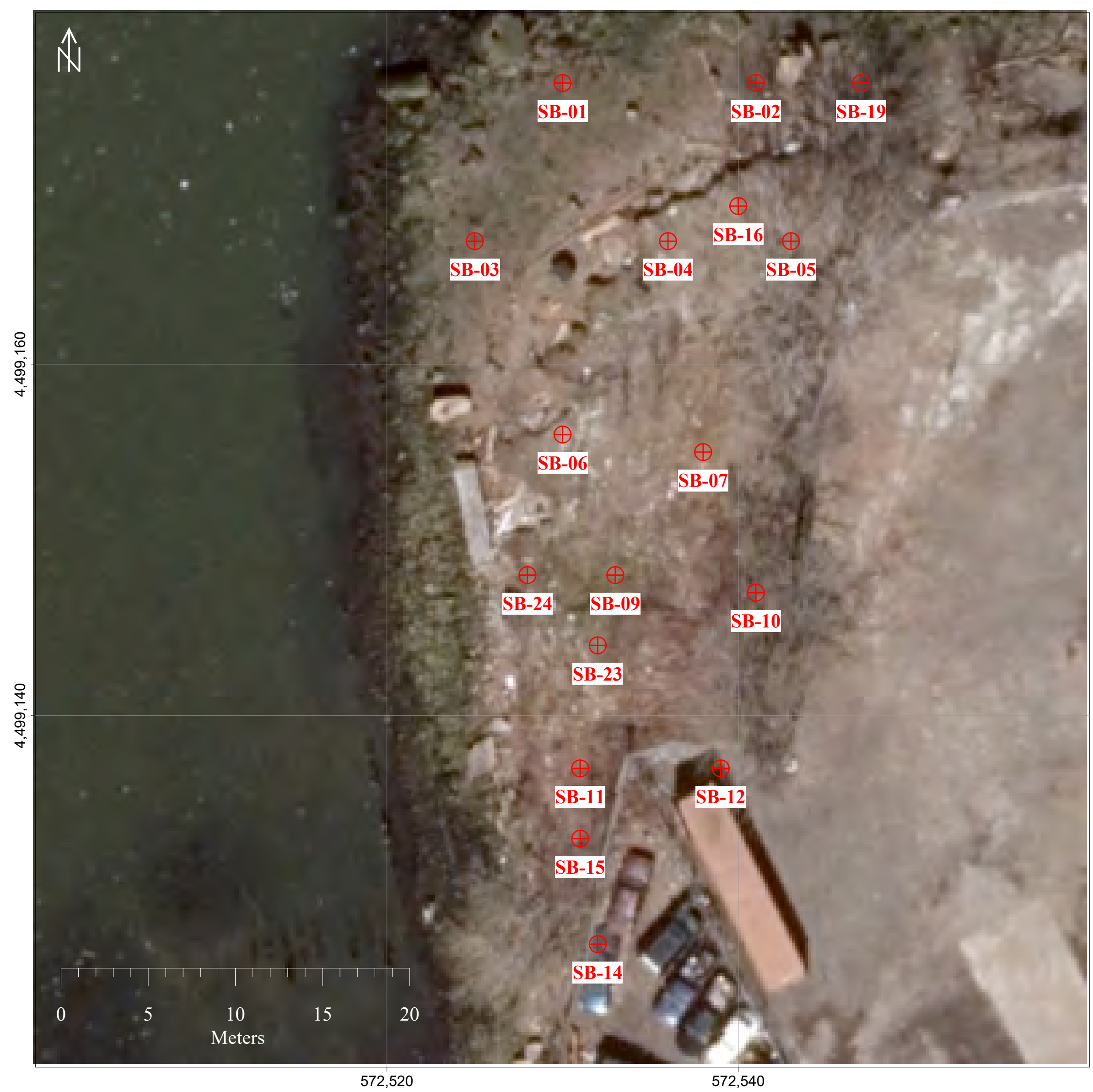
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-03**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572525, Easting: 4499167 (UTM Zone 18N)
	9. SURFACE ELEVATION: 1.5 feet amsl (NAD83)
	10. DATE STARTED: 9/24/2021 — 11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 1.5 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 1.5 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 1.5 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 100% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-03

PROJECT: Staten Island Warehouse | INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	SAND, coarse- to fine-graind, silty, with fine-grained gravel; dark gray to reddish-gray; wet; loose	SAND	0-1.5 (Rec:100 %)	PID: 0 Gamma: 4530	SS-03
1		CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY		PID: 0 Gamma: 4290	SB-03 (0.5-1.0)
	1				PID: 0 Gamma: 4070	SB-03 (1.0-1.5)
0		- saturated at 1.5'				

HTRW DRILLING LOG

DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-04**	
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR: AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" split spoon	8. HOLE LOCATION: Northing: 572536, Easting: 4499167 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 5.4 feet amsl (NAD83)	
	10. DATE STARTED: 9/22/2021	11. DATE COMPLETED: 9/22/2021
12. OVERBURDEN THICKNESS: 6.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 5.5 feet bgs	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 6.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBTED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 27% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-04

PROJECT: Staten Island Warehouse | INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
5.2	0	TOPSOIL, silt; dark gray to brown; moist; soft; with roots	TOPSOIL	0-2 (Rec:40%) SPT Blows: 6-7-7-10 (N = 16)	PID: 0 Gamma: 4520	SS-04
4.2	1	SAND, coarse- to fine-graind, silty, with fine-grained gravel; dark gray to dark brown; dry to moist; loose to medium dense	SAND		PID: 0 Gamma: 6841	SB-04 (1.0-2.0)
3.2	2	- rock in cutting shoe (no recovery)		2-4 (Rec:0%) SPT Blows: 4-2-1-1 (N = 3)		
2.2	3					
1.2	4	CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY	4-6 (Rec:40%) SPT Blows: 1-1-1-1 (N = 2)	PID: 0 Gamma: 6608	SB-04 (4.0-6.0)
0.2	5	- wet at 5.5'				
	6					

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-05**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 5' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572543, Easting: 4499167 (UTM Zone 18N)
	9. SURFACE ELEVATION: 6.9 feet amsl (NAD83)
	10. DATE STARTED: 9/22/2021 — 11. DATE COMPLETED: 9/22/2021
12. OVERBURDEN THICKNESS: 10.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 6 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 10.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 36% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-05

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
6.5	0	TOPSOIL, silt; dark gray to brown; moist; soft; with roots	TOPSOIL	0-5 (Rec:44%)	PID: 0 Gamma: 4614	SS-05
5.5, 4.5, 3.5	1, 2, 3	SAND, coarse- to fine-graind, silty, with fine-grained gravel; gray to dark brown; dry to moist; loose - brick fragments	SAND		PID: 0 Gamma: 7679	SB-05 (0.5-5.0)
2.5	4	CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY			
1.5	5			5-10 (Rec:28%)	PID: 0 Gamma: 7274	SB-05 (5.0-6.0)
0.5, -0.5, -1.5	6, 7, 8	- rock in cutting shoe (no recovery)				

HTRW DRILLING LOG							HOLE NUMBER: SB-05
PROJECT: Staten Island Warehouse		INSPECTOR: Benjamin Hooks, GEO Consultants Corporation					
ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)	
		- hard drilling (rock)					
	9						
-2.5							
	10						

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: SB-06
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" split spoon	8. HOLE LOCATION: Northing: 572530, Easting: 4499156 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 6.4 feet amsl (NAD83)	
	10. DATE STARTED: 9/22/2021	11. DATE COMPLETED: 9/22/2021
12. OVERBURDEN THICKNESS: 6.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 4 feet bgs	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 6.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES:	DISTRURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:	n/a
	(0.0-2.0), (2.0-5.0)			

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		47% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-06

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
6.4	0	TOPSOIL, silt; dark brown; moist; soft; with roots	TOPSOIL	0-2 (Rec:65%) SPT Blows: 6-8-9-12 (N = 19)	PID: 0 Gamma: 4306	SS-06
		SAND, coarse- to fine-graind, silty, with fine-grained gravel; reddish-brown to dark brown; moist; loose	SAND			
5.4	1				PID: 0 Gamma: 7847	SB-06 (0.5-2.0)
4.4	2			2-4 (Rec:55%) SPT Blows: 4-6-8-8 (N = 15)	PID: 0 Gamma: 6872	SB-06 (2.0-3.0)
		CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY			
3.4	3					
		GRAVEL, fine-grained, with coarse-grained sand, silt; dark brown to gray, saturated, loose	GRAVEL			
2.4	4			4-6 (Rec:20%) SPT Blows: 2-1-1-2 (N = 3)		
1.4	5					
	6					

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-07**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" split spoon; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572538, Easting: 4499155 (UTM Zone 18N)
	9. SURFACE ELEVATION: 7.6 feet amsl (NAD83)
	10. DATE STARTED: 9/22/2021 11. DATE COMPLETED: 9/22/2021
12. OVERBURDEN THICKNESS: 6.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 4.5 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 6.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 43% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-07

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
7.2	0	SAND, coarse- to fine-graind, silty, with fine-grained gravel; reddish-brown to dark brown; dry to moist; loose to medium dense	SAND	0-2 (Rec:55%) SPT Blows: 1-8-8-9 (N = 17)	PID: 0 Gamma: 4120	SS-07
6.2	1				PID: 0 Gamma: 6256	SB-07 (1.0-2.0)
5.2	2	- brick fragment		2-4 (Rec:50%) SPT Blows: 17-10-9-17 (N = 18)	PID: 0 Gamma: 6914	SB-07 (2.0-3.0)
4.2	3					
3.2	4	- with coarse gravel; saturated		4-6 (Rec:25%) SPT Blows: 13-45-14-10 (N = 37)		
2.2	5					
	6					

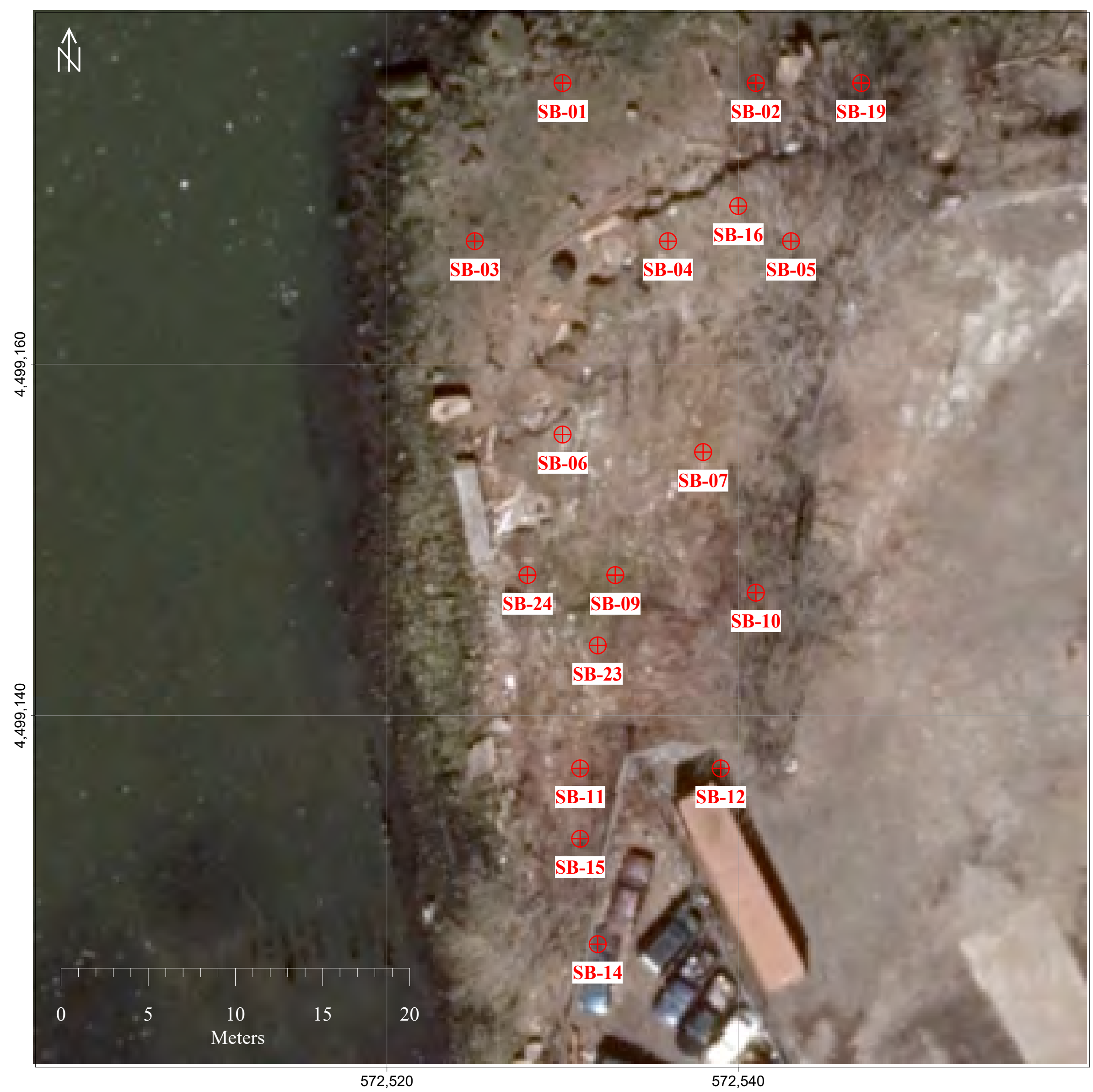
HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-09**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572533, Easting: 4499148 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 6.7 feet amsl (NAD83)	
	10. DATE STARTED: 9/23/2021	11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 8.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 6.5 feet bgs	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 8.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 35% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-09

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	TOPSOIL, silt, with sand; dark brown; moist; soft; with roots	TOPSOIL	0-4 (Rec:43%)	PID: 0 Gamma: 7348	SS-09
6.4		SAND, coarse- to fine-graind, silty, with fine-grained gravel; reddish-brown to dark brown; dry to moist; loose to medium dense	SAND			
	1				PID: 0 Gamma: 7312	SB-09 (0.5-1.7)
5.4						
	2					
4.4						
	3					
3.4						
	4			4-8 (Rec:28%)		
2.4						
	5				PID: 0 Gamma: 7164	SB-09 (5.0-6.0)
1.4						
	6					
0.4		- wet				
	7					
-0.6						
	8					

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-10**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572541, Easting: 4499147 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 7.4 feet amsl (NAD83)	
	10. DATE STARTED: 9/23/2021	11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 12.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 6 feet bgs	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 12.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES:	DISTRUBRED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
	(0.0-4.0), (4.0-8.0)		n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		26% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-10

PROJECT: Staten Island Warehouse | INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	TOPSOIL, silt; dark brown; moist; soft; with roots	TOPSOIL	0-4 (Rec:43%)	PID: 0 Gamma: 6780	SS-10
7		SAND, coarse- to fine-graind, silty, with fine-grained gravel; dark gray to dark brown; moist; medium dense	SAND		PID: 0 Gamma: 6320	SB-10 (0.5-2.0)
6	1					
		GRAVEL, fine-grained, silty, with sand; reddish-brown; moist to wet; soft to very soft	GRAVEL			
5	2					
4	3					
3	4			4-8 (Rec:30%)	PID: 0 Gamma: 6114	SB-10 (4.0-6.5)
2	5					
1	6	- wet				
		- with coarse gravel				
0	7					
-1	8	- with coarse gravel, saturated				

HTRW DRILLING LOG		HOLE NUMBER: SB-10
PROJECT: Staten Island Warehouse	INSPECTOR: Benjamin Hooks, GEO Consultants Corporation	

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF- ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	9	- rock in cutting shoe (poor recovery)				
-2						
	10			8-12 (Rec:5%)		
-3						
	11					
-4						
	12					

HTRW DRILLING LOG

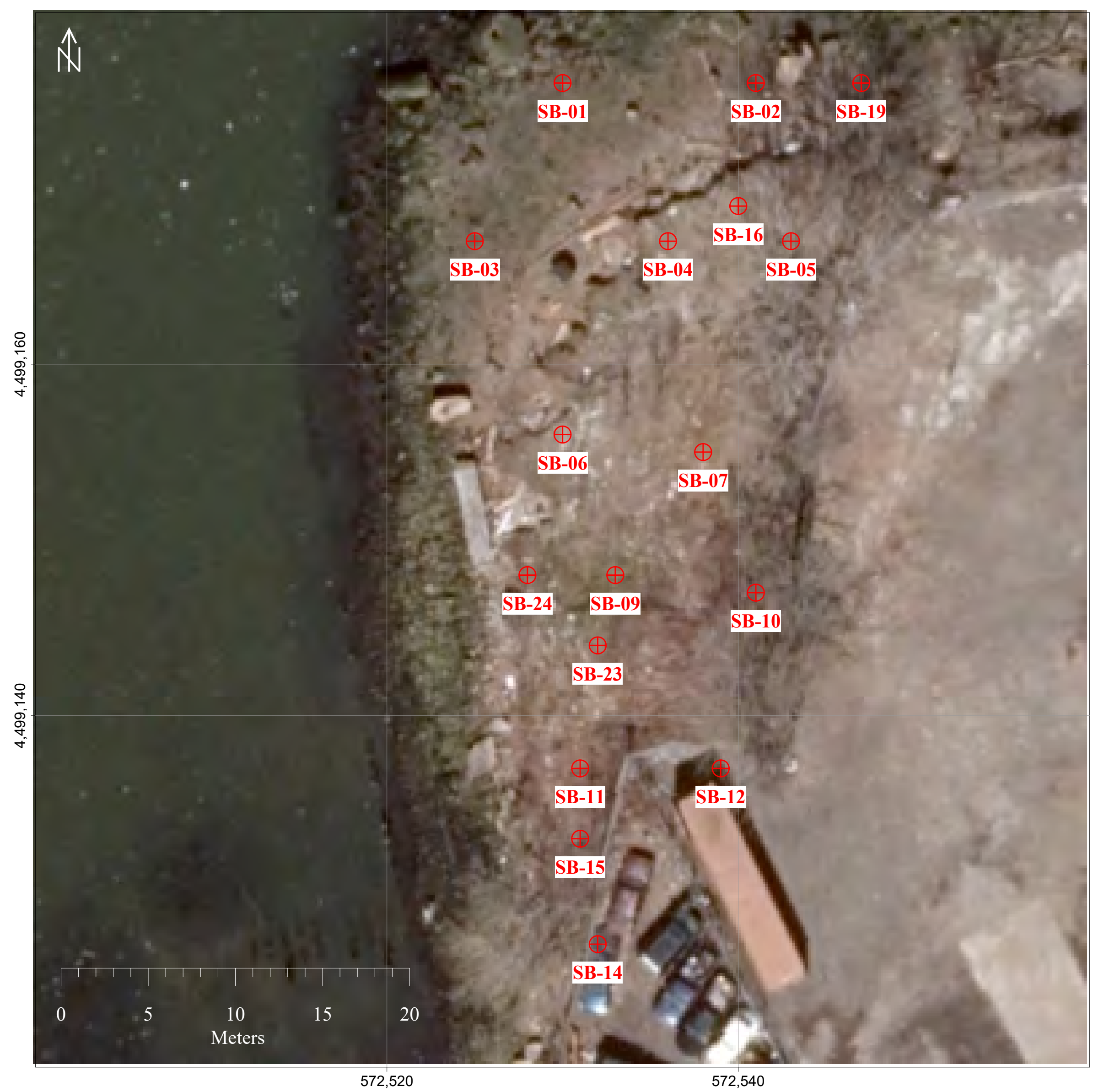
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-11**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572531, Easting: 4499137 (UTM Zone 18N)
	9. SURFACE ELEVATION: 10.2 feet amsl (NAD83)
	10. DATE STARTED: 9/23/2021 — 11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 15.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 9.8 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		40% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-11

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
10	0	CONCRETE	CONCRETE	0-4 (Rec:33%)	PID: 0 Gamma: 4314	SS-11
9, 8, 7	1, 2, 3	DENSE GRADED AGGREGATE (quarry stone; limestone gravel)	DGA			
6, 5, 4, 3	4, 5, 6, 7	SAND, coarse- to fine-graind, silty, with fine-grained gravel; dark gray to dark brown; dry to moist; loose to medium dense	SAND	4-8 (Rec:45%)	PID: 0 Gamma: 4524	SB-11 (4.0-5.0)
					PID: 0 Gamma: 4431	SB-11 (5.0-6.0)
2	8	CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY			

HTRW DRILLING LOG

HOLE NUMBER: SB-11

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
		- with gravel; soft to very soft				
	9					
1						
		- wet				
	10			8-12 (Rec:43%)		
0						
	11					
-1						
	12					

HTRW DRILLING LOG

DISTRICT: USACE, Kansas City District

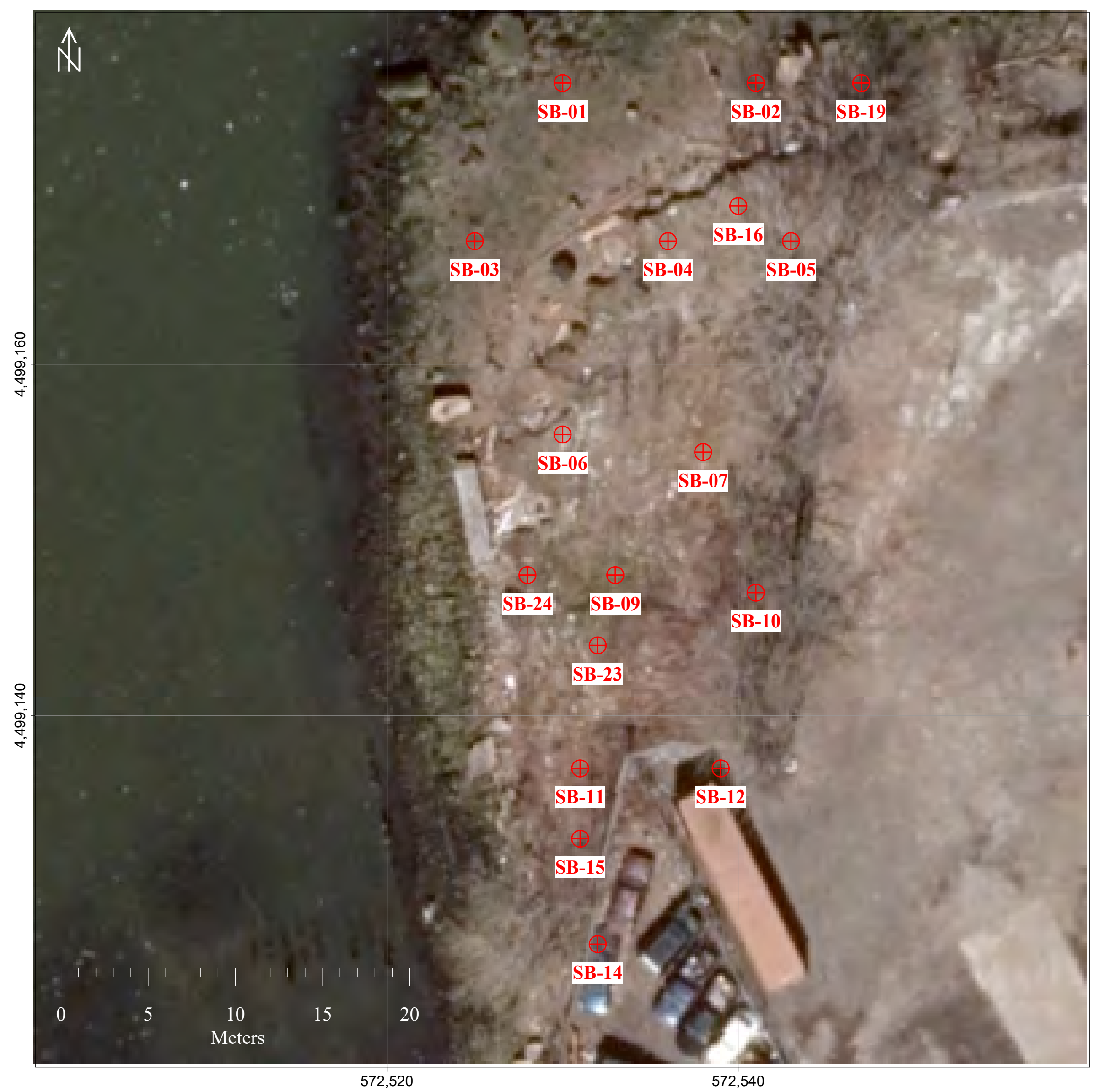
HOLE NUMBER: **SB-12**

1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR: AARCO Environmental Services
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572539, Easting: 4499137 (UTM Zone 18N)
	9. SURFACE ELEVATION: 10 feet amsl (NAD83)
	10. DATE STARTED: 9/23/2021 — 11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 15.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 8 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES:	DISTRUBRED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
	(6.0-8.0), (11.0-12.0)		n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		68% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-12

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
10	0	CONCRETE	CONCRETE	0-4 (Rec:65%)	PID: 0 Gamma: 5925	SS-12
		DENSE GRADED AGGREGATE (quarry stone; limestone gravel)	DGA			
9	1					
		SAND, coarse- to fine-graind, with fine-grained gravel, silty and clayey; dark gray to dark brown; dry to moist; loose to medium dense	SAND			
8	2	- brick fragment				
7	3	- wood fragment; with sand			PID: 0 Gamma: 4929	SB-12 (3.0-4.0)
6	4			4-8 (Rec:80%)		
5	5					
4	6				PID: 0 Gamma: 4959	SB-12 (6.0-8.0)
3	7	- with gravel				
2	8	- wet				

HTRW DRILLING LOG

HTRW DRILLING LOG	HOLE NUMBER: SB-12
PROJECT: Staten Island Warehouse	INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
1	9					
0	10			8-12 (Rec:60%)		
-1	11	CLAY, low plasticity, silty, with sand, trace gravel; brownish-red; moist; firm to stiff	CLAY			
-2	12					

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-14**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572532, Easting: 4499127 (UTM Zone 18N)
	9. SURFACE ELEVATION: 8.8 feet amsl (NAD83)
	10. DATE STARTED: 9/23/2021 / 11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 15.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 9 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES:	DISTRUBRED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
	(4.0-6.0), (8.0-12.0)		n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		54% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-14

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	CONCRETE	CONCRETE	0-4 (Rec:68%)	PID: 0 Gamma: 4215	SS-14
8	1	DENSE GRADED AGGREGATE (quarry stone; limestone gravel)	DGA			
7	2	SAND, coarse- to fine-graind, with fine-grained gravel, silt; dark gray to dark brown; dry to moist; loose to medium dense	SAND			
6	3				PID: 0 Gamma: 4547	SB-14 (2.5-4.0)
5	4			4-8 (Rec:60%)		
4	5					
3	6					
2	7				PID: 0 Gamma: 4482	SB-14 (6.0-8.0)
1	8	CLAY, low plasticity, with silt, sand, trace gravel; reddish-brown; moist; firm to soft	CLAY			

HTRW DRILLING LOG

HOLE NUMBER: SB-14	
PROJECT: Staten Island Warehouse	INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
0	9	- wet				
-1	10			8-12 (Rec:35%)		
-2	11					
-3	12					

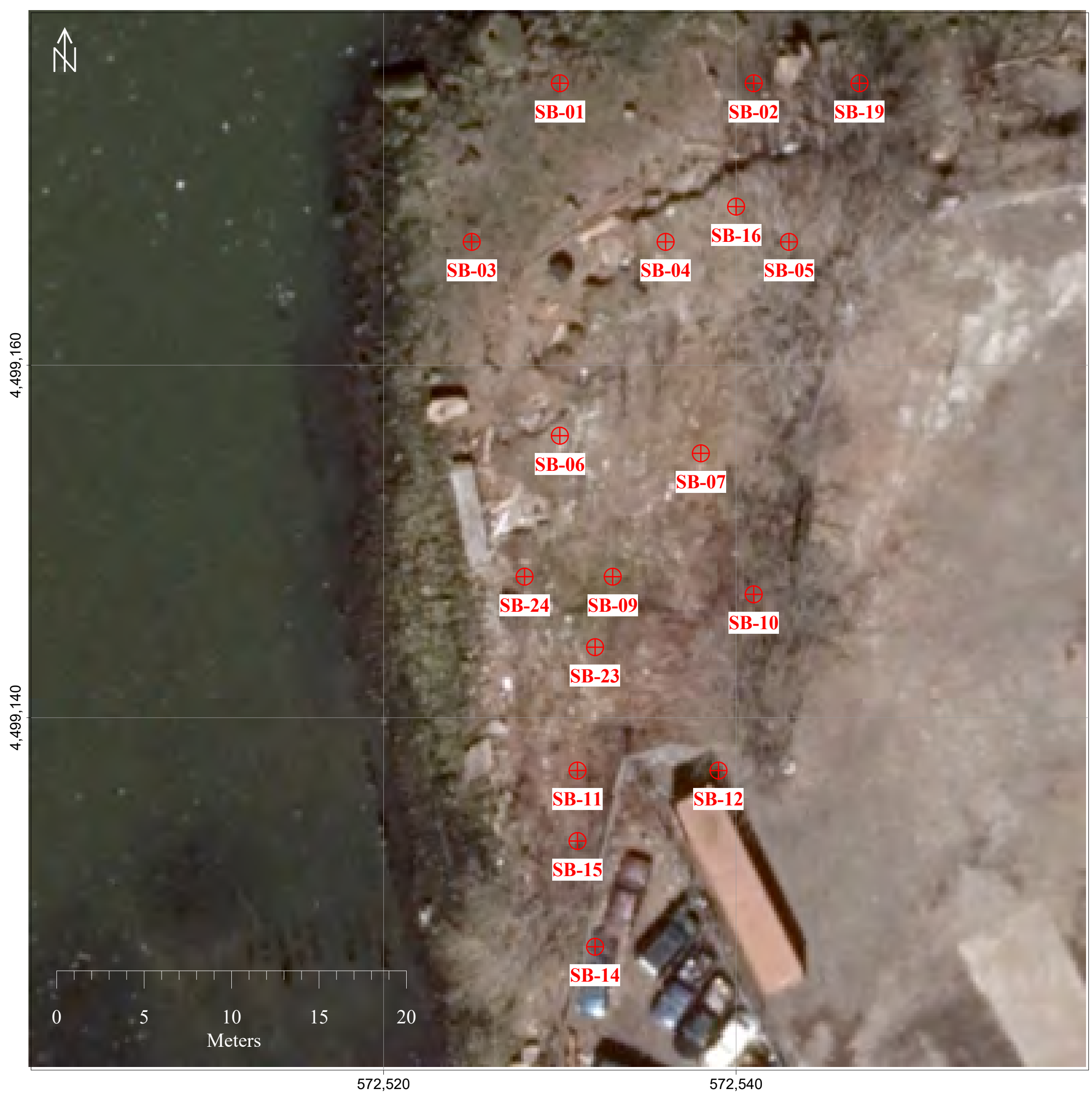
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-15**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore; 3" casing with drive shoe	8. HOLE LOCATION: Northing: 572531, Easting: 4499133 (UTM Zone 18N)
	9. SURFACE ELEVATION: 9.2 feet amsl (NAD83)
	10. DATE STARTED: 9/23/2021 — 11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 15.0 feet	15. DEPTH GROUNDWATER ENCOUNTERED: 8.2 feet bgs
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.0 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBTED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 73% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-15

PROJECT: Staten Island Warehouse | INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
9	0	CONCRETE	CONCRETE	0-4 (Rec:88%)	PID: 0 Gamma: 4221	SS-15
8	1	DENSE GRADED AGGREGATE (quarry stone; limestone gravel)	DGA			
7	2	SAND, coarse- to fine-graind, with fine-grained gravel, silt; dark gray; dry; loose	SAND			
6	3	CLAY, low plasticity, silty, with sand; reddish-brown; moist; firm	CLAY			
5	4	SAND, coarse- to fine-graind, with fine-grained gravel, silt; dark gray to dark brown; dry to moist; loose	SAND	4-8 (Rec:100 %)		
4	5				PID: 0 Gamma: 4436	SB-15 (5.0-6.0)
3	6	CLAY, low plasticity, silty, with sand, trace gravel; reddish-brown; moist; firm to soft	CLAY			
2	7				PID: 0 Gamma: 4619	SB-15 (7.0-8.0)
1	8	- wet/saturated; strong petroleum odor/sheen				

HTRW DRILLING LOG

HOLE NUMBER: SB-15

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	9					
0						
	10			8-12 (Rec:30%)		
-1						
	11					
-2						
	12					

HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: SB-16
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	
3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY	
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4' macrocore	8. HOLE LOCATION: Northing: 572540, Easting: 4499169 (UTM Zone 18N)	
	9. SURFACE ELEVATION: 6.8 feet amsl (NAD83)	
	10. DATE STARTED: 9/23/2021	11. DATE COMPLETED: 9/23/2021
12. OVERBURDEN THICKNESS: 3.4 feet	15. DEPTH GROUNDWATER ENCOUNTERD:	
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 3.4 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES:	DISTRUBERD	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a
	(0.0-2.0), (2.0-4.0)		

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 76% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	

HTRW DRILLING LOG

HOLE NUMBER: SB-16

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	TOPSOIL, silt, with sand; dark brown; moist; soft; with roots	TOPSOIL	0-3.4 (Rec:76%)	PID: 0 Gamma: 7116	SS-16
6.2	1	SAND, fine-grained, silty to clayey, trace gravel; reddish-brown; moist; firm to soft	SAND			
5.2	2				PID: 0 Gamma: 7121	SB-16 (2.0-3.0)
4.2	3	- Refusal on brick or concrete (hole was offset 5' in each direction)				

HTRW DRILLING LOG

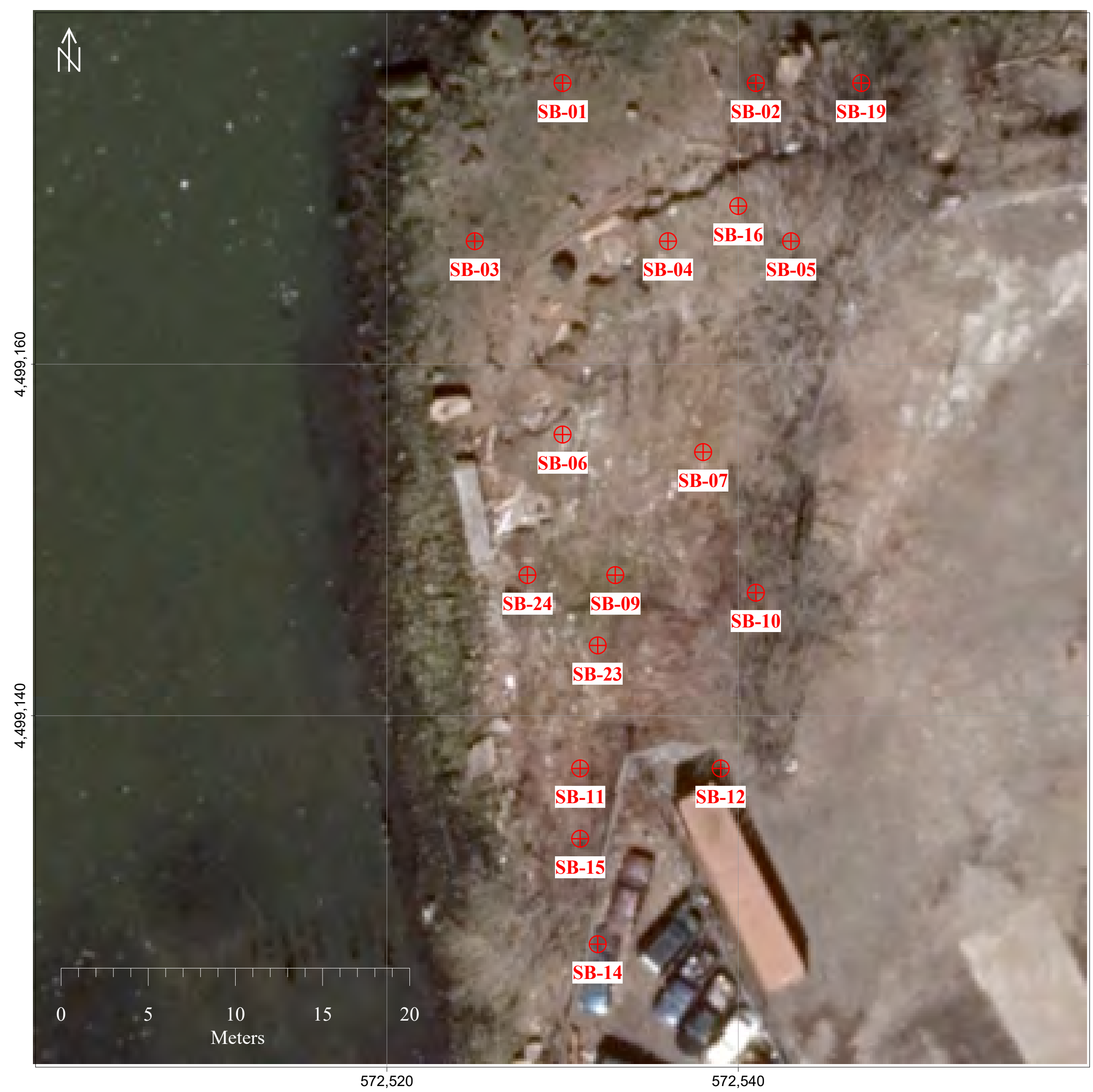
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-19**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572547, Easting: 4499176 (UTM Zone 18N)
	9. SURFACE ELEVATION: 2.9 feet amsl (NAD83)
	10. DATE STARTED: 9/24/2021 — 11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 2.4 feet	15. DEPTH GROUNDWATER ENCOUNTERD:
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 2.1 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		100% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-19

PROJECT: Staten Island Warehouse | INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	SAND, coarse- to fine-grained, with fine-grained gravel; with cobbles; brown to dark gray; moist; medium dense	SAND			
2.7						
	1			0-2.5 (Rec:100%)		
1.7						
	2					

HTRW DRILLING LOG

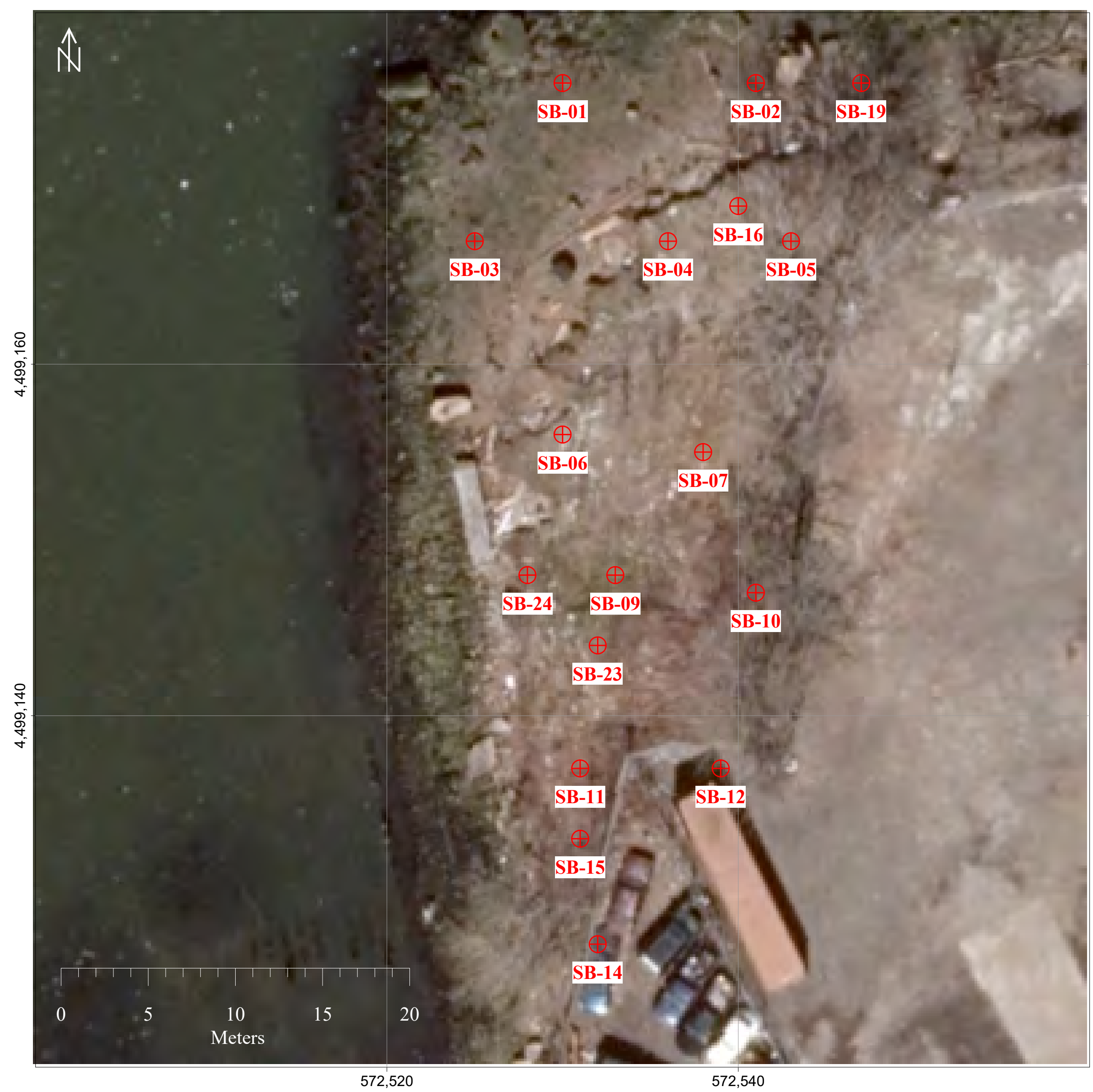
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-23**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR: AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572532, Easting: 4499144 (UTM Zone 18N)
	9. SURFACE ELEVATION: 7.1 feet amsl (NAD83)
	10. DATE STARTED: 9/24/2021 — 11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 2.5 feet	15. DEPTH GROUNDWATER ENCOUNTERD:
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 2.5 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBRED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 100% Recovered
			GSPEC-Norm21	U-Iso		

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-23

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIFICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	TOPSOIL, silt, with sand; dark brown; moist; soft; with roots	TOPSOIL	0-2.5 (Rec:100 %)	PID: 0 Gamma: 4684	SS-23
6.4		SAND, coarse- to fine-graind, with fine-grained gravel, silt; reddish-brown to dark brown; dry to moist; loose to medium dense	SAND			
	1				PID: 0 Gamma: 4615	SB-23 (0.5-1.5)
5.4						
	2					

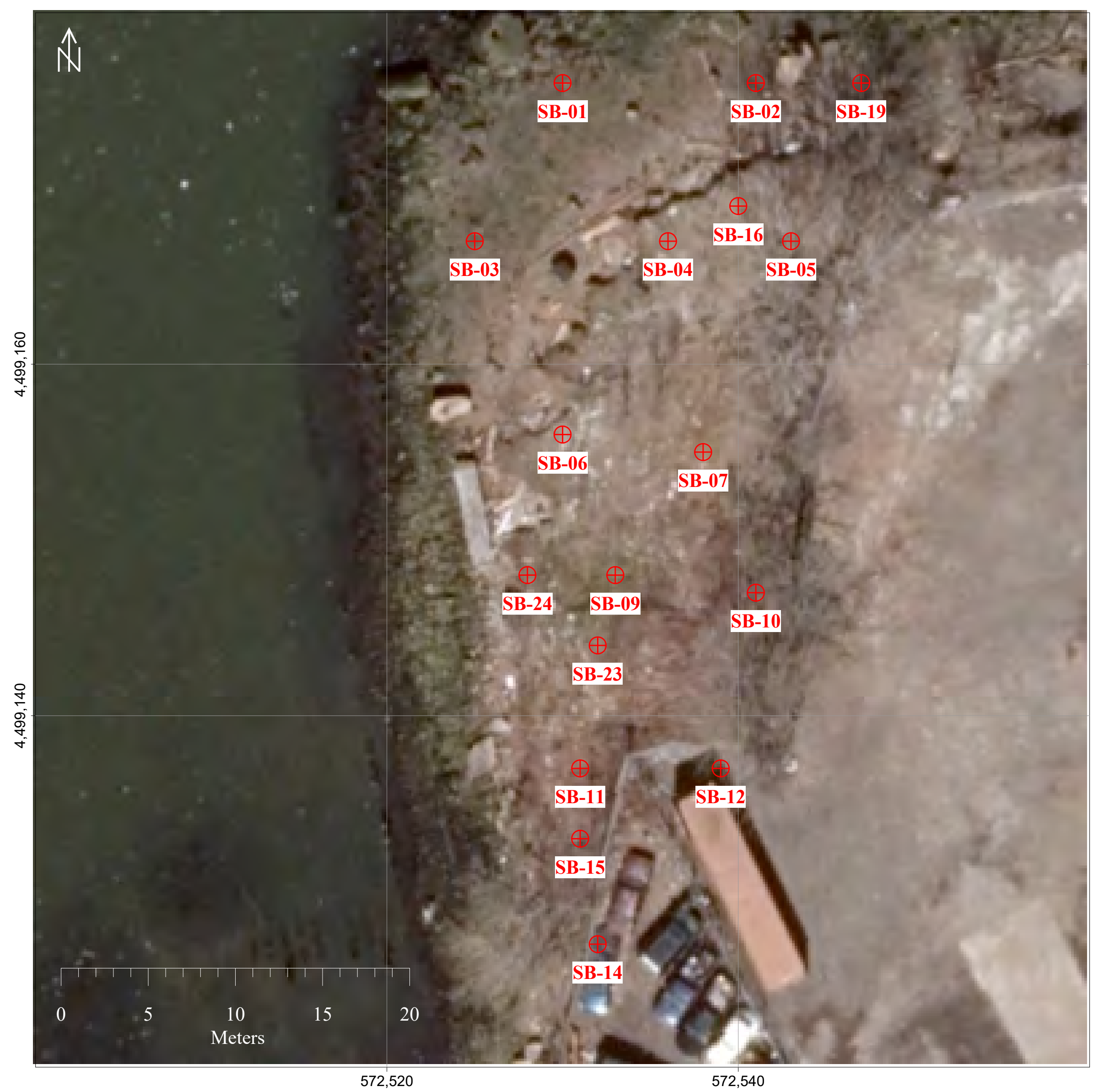
HTRW DRILLING LOG	DISTRICT: USACE, Kansas City District	HOLE NUMBER: **SB-24**
1. COMPANY NAME: GEO Consultants Corporation	2. DRILL SUBCONTRACTOR AARCO Environmental Services	

3. PROJECT: SIW Supplementary Site Inspection	4. LOCATION: Port Richard, NY
5. NAME OF DRILLER: Jose Garcia	6. MANUFACTURES DESIGNATION OF DRILL: Geoprobe 7822DT
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hand auger	8. HOLE LOCATION: Northing: 572528, Easting: 4499148 (UTM Zone 18N)
	9. SURFACE ELEVATION: 0.2 feet amsl (NAD83)
	10. DATE STARTED: 9/24/2021 — 11. DATE COMPLETED: 9/24/2021
12. OVERBURDEN THICKNESS: 2.5 feet	15. DEPTH GROUNDWATER ENCOUNTERD:
13. DEPTH DRILLED INTO ROCK: n/a	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 2.5 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: n/a	DISTRUBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: n/a

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY:
			GSPEC-Norm21	U-Iso		100% Recovered

22. DISPOSITION OF HOLE:	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR:
	X		Gamma scan	



HTRW DRILLING LOG

HOLE NUMBER: SB-24

PROJECT: Staten Island Warehouse

INSPECTOR: Benjamin Hooks, GEO Consultants Corporation

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	CLASSIF-ICATION (D)	PERCENT RECOVERY (E)	SCREENING & SAMPLE NO. (F)	REMARKS (G)
	0	TOPSOIL, silt, with sand; dark brown; moist; soft; with roots	TOPSOIL	0-2.5 (Rec:100 %)	PID: 0 Gamma: 4668	SS-24
-0.4		SAND, coarse- to fine-graind, with fine-grained gravel, silt; reddish-brown to dark brown; dry to moist; loose to medium dense	SAND		PID: 0 Gamma: 5359	SB-24 (0.5-2.0)
	1					
-1.4						
	2					

APPENDIX G

PHOTOGRAPH LOG

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Staten Island Warehouse

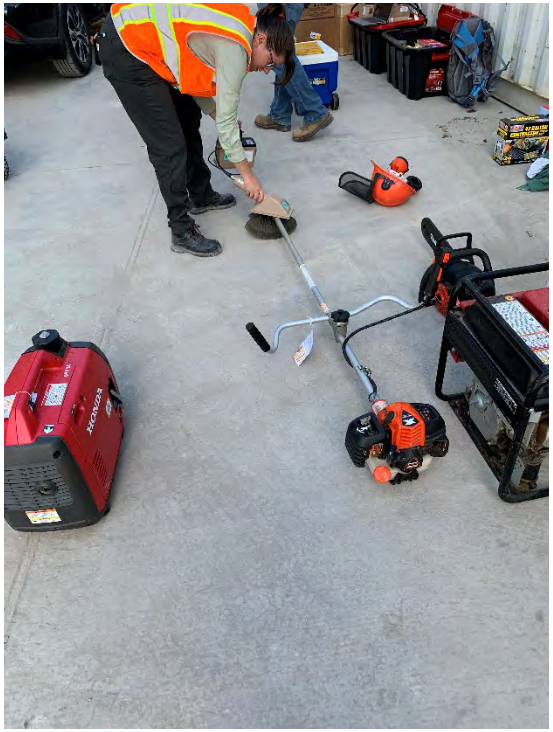
Photographic Documentation

September 2021


Staten Island Project Site (facing southeast)


Bayonne Bridge (facing north)

Surface Characterization Area (facing south)

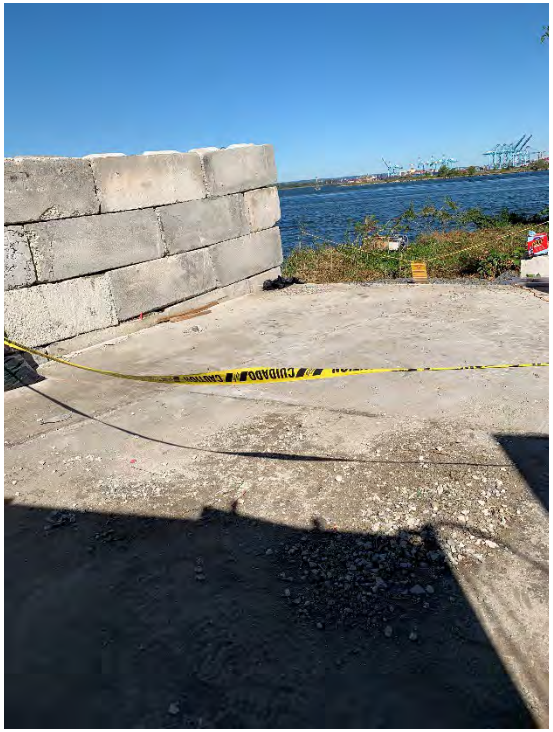


Equipment set-up/scanning (facing north)

Closed off block wall (facing northwest)

Blocks removed for access (facing north)

Sectioned off opening in fence (facing north)



Sectioned off opening (facing northwest)

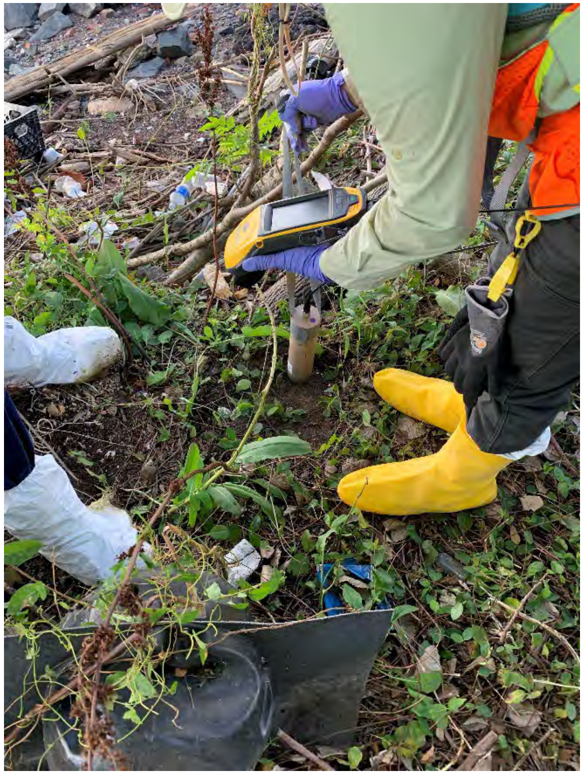

Setting up air monitor (facing west)


Setting up air monitor (facing west)


Brush clearing (facing east)

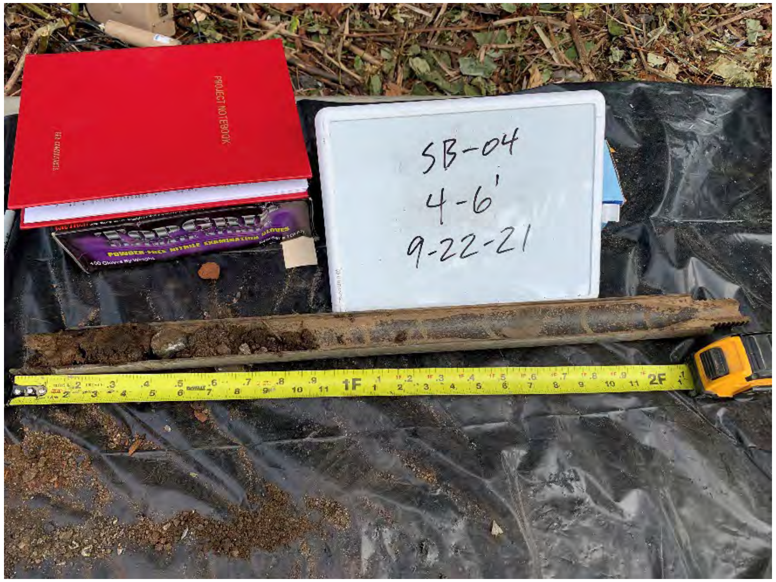

Marking sample locations (facing south)

Gamma walkover scan (facing north)



Gamma scan, elevated reading (facing west)

SB-04 (macro core)



SB-04 (split spoon)

SB-05

SB-05

SB-06

SB-07

SB-09

SB-10

SB-11

SB-12

SB-14

SB-15

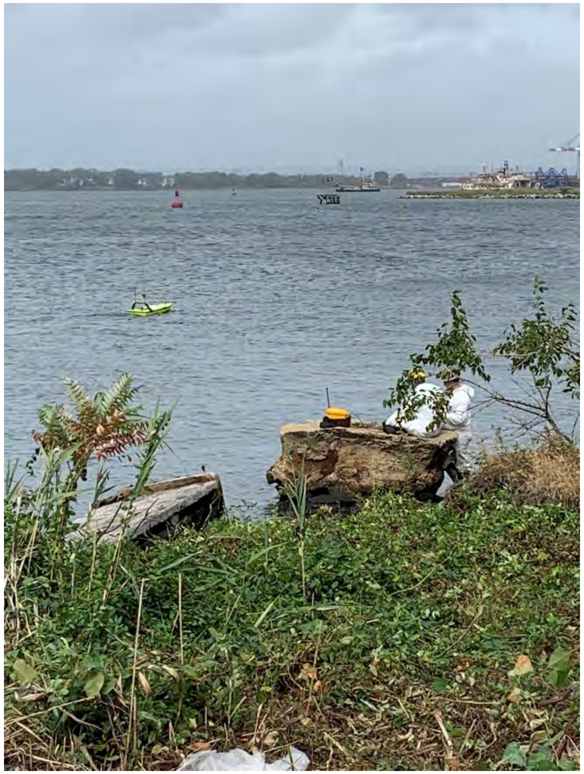
SB-16

Subsurface sampling, hand auguring

Downhole gamma scan (facing north)

SB-13 marker (facing north)

Broken macro core barrel (SB-04, at 4-feet bgs)



Hydrographic survey, unmanned vessel (facing west)

Test Pit-1

Test Pit-1


Test Pit-2, dewatering

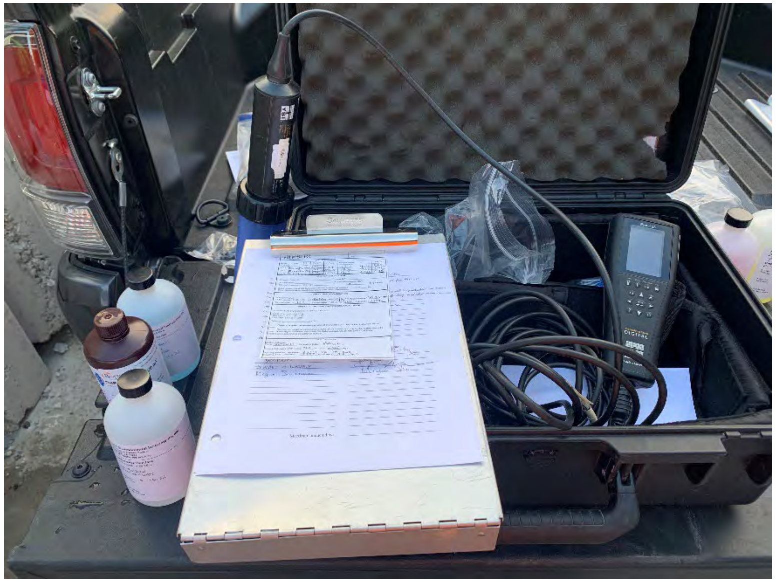

Test Pit-2, spoils


Test Pit-3


Test Pit-3


Test Pit-4

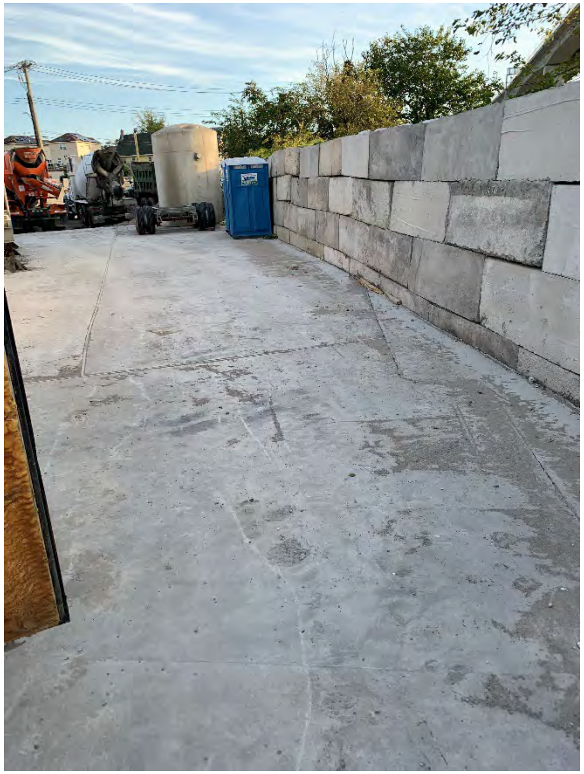

Test Pit-4, spoils



Calibrating water quality meter

PVC pipe removed from soil borings

Scanning out equipment



Restrooms (facing south)

Southwest corner of SIW Site (facing north)

Richmond Terrace Drive (facing east)

Southeast corner of SIW Site (facing northwest)

Mechanic area (facing northwest)

Main office (facing west)

Mechanic area (facing east)

Mechanic area (facing east)

Material storage area (facing west)


Main office (facing south)


Concrete batch loading area (facing west)

Possible entrance area (facing west)

Communication office (facing south)

Loading ramp (facing northeast)

Material storage (facing north)

Material storage (facing west)

Second concrete batch structure (facing southwest)

Communication office (facing northwest)


Fieldwork staging area (facing north)

Southwest corner of SIW Site (facing southwest)

West entrance to SIW Site (facing east)

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APPENDIX H

DOWNHOLE GAMMA LOGS

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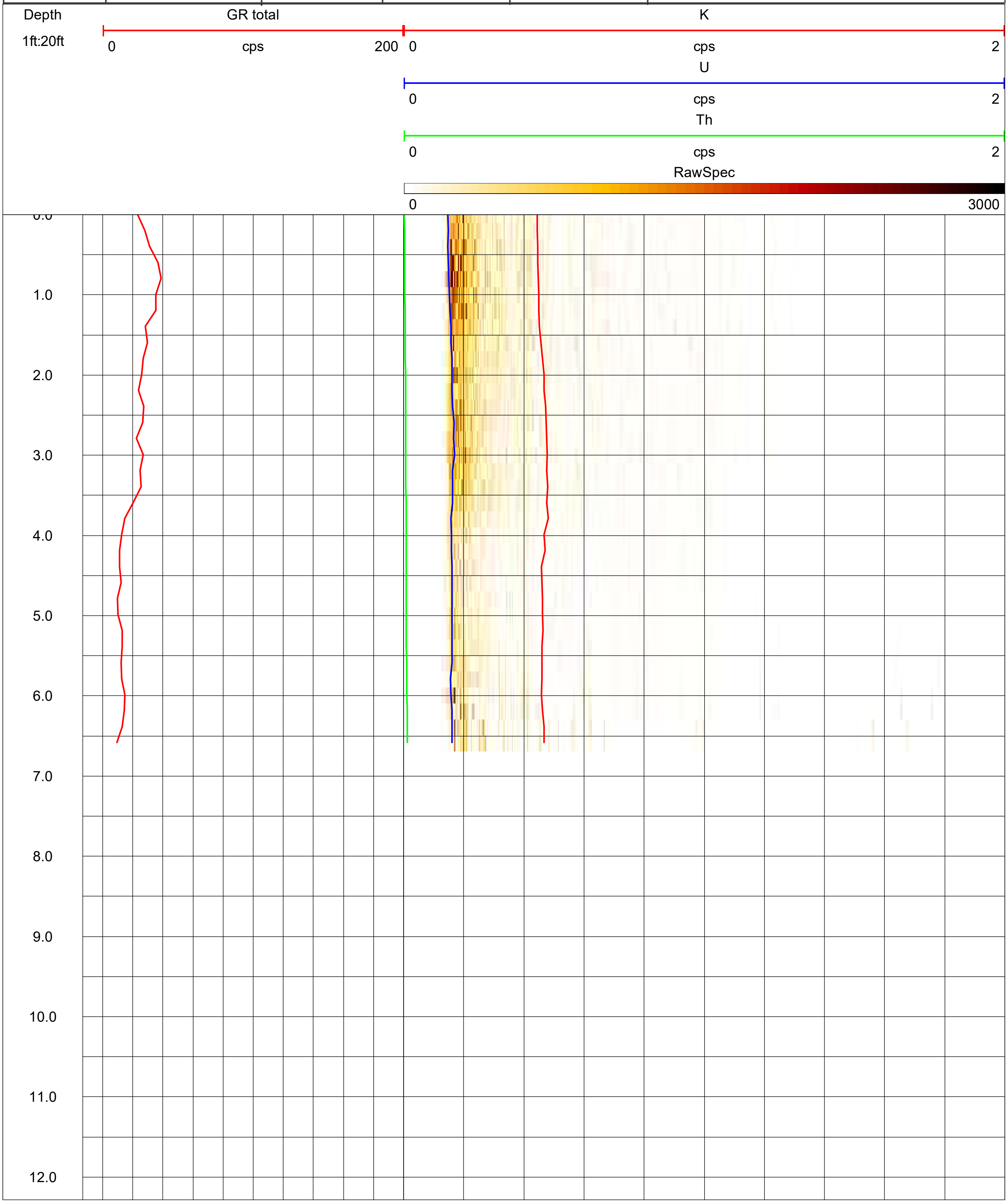
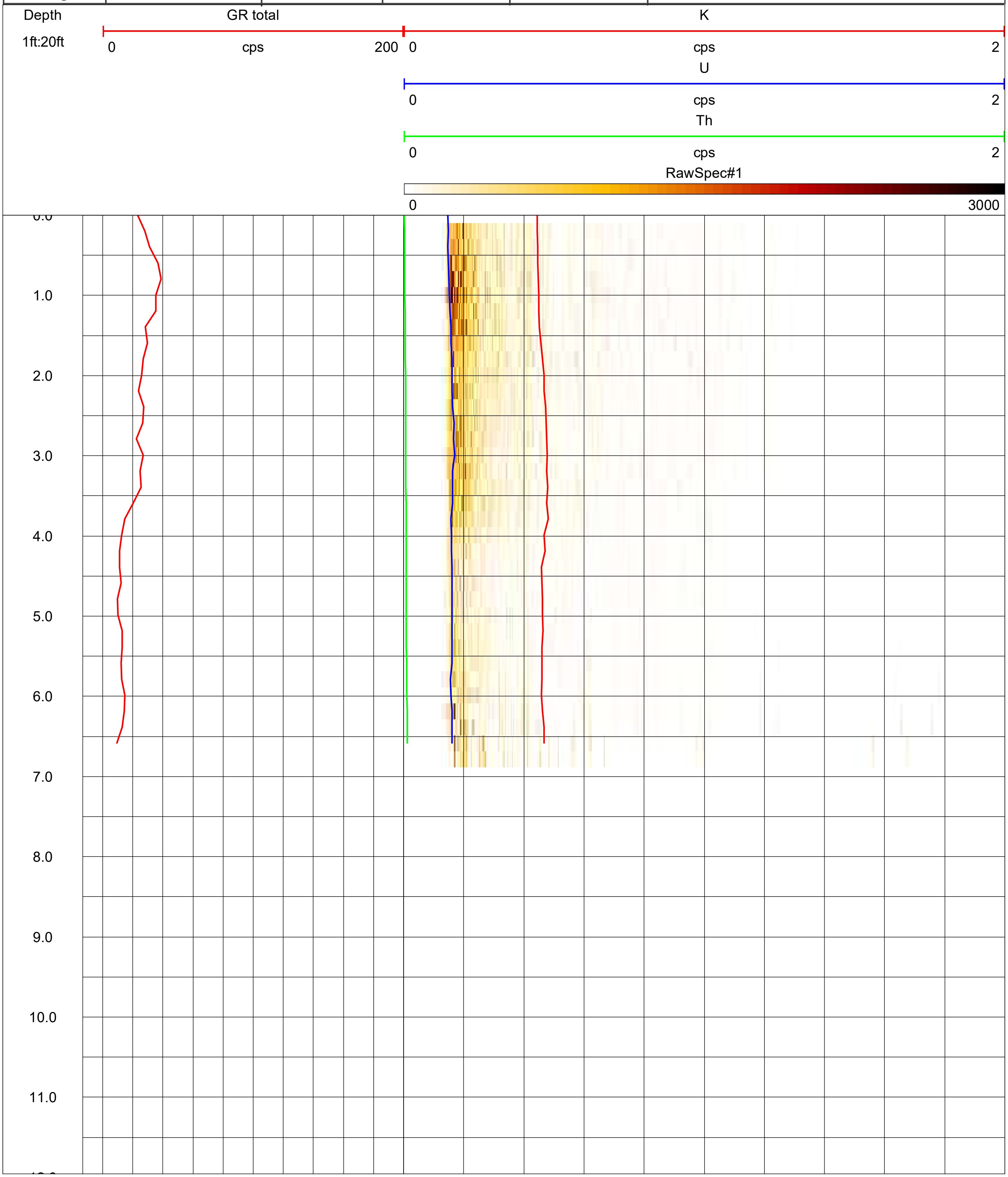
leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB04	File Name	09232021_SB04_DN1
Date	09/23/2021	Depth Drilled	6.5 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



leidos	Project	Former Staten Island Warehouse - Borehole Gamma
	Location	Staten Island, Port Richmond, New York

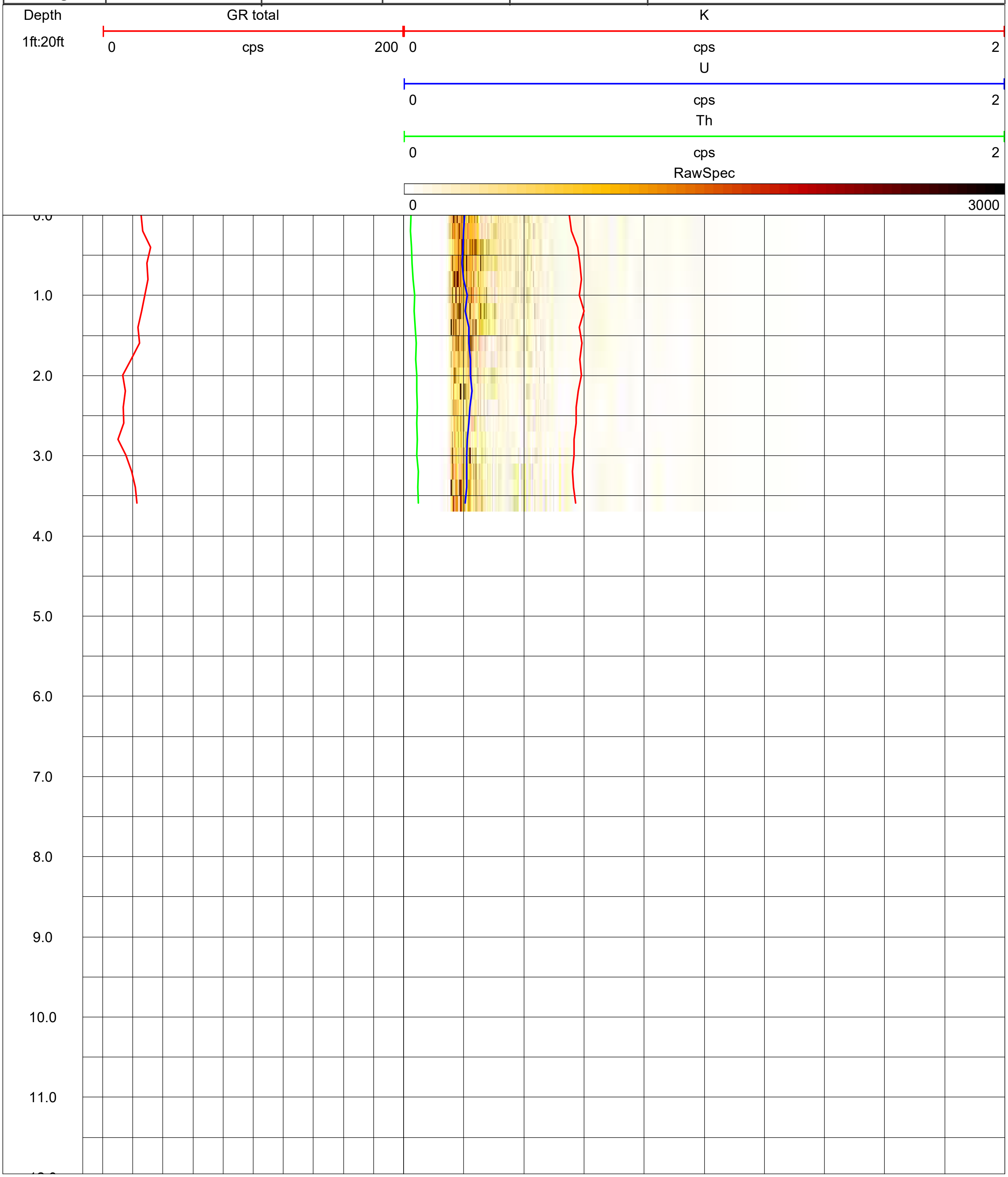
Location	SB04		File Name	09232021_SB04_DN2
Date	09/23/2021		Depth Drilled	6.5 feet BGS
Casing	2 inch PVC	BH Fluid	Logged By	Jeffrey J. Warren PG



leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB05	File Name	09222021_SB05_DN1
Date	09/22/2021	Depth Drilled	3.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG

leidos

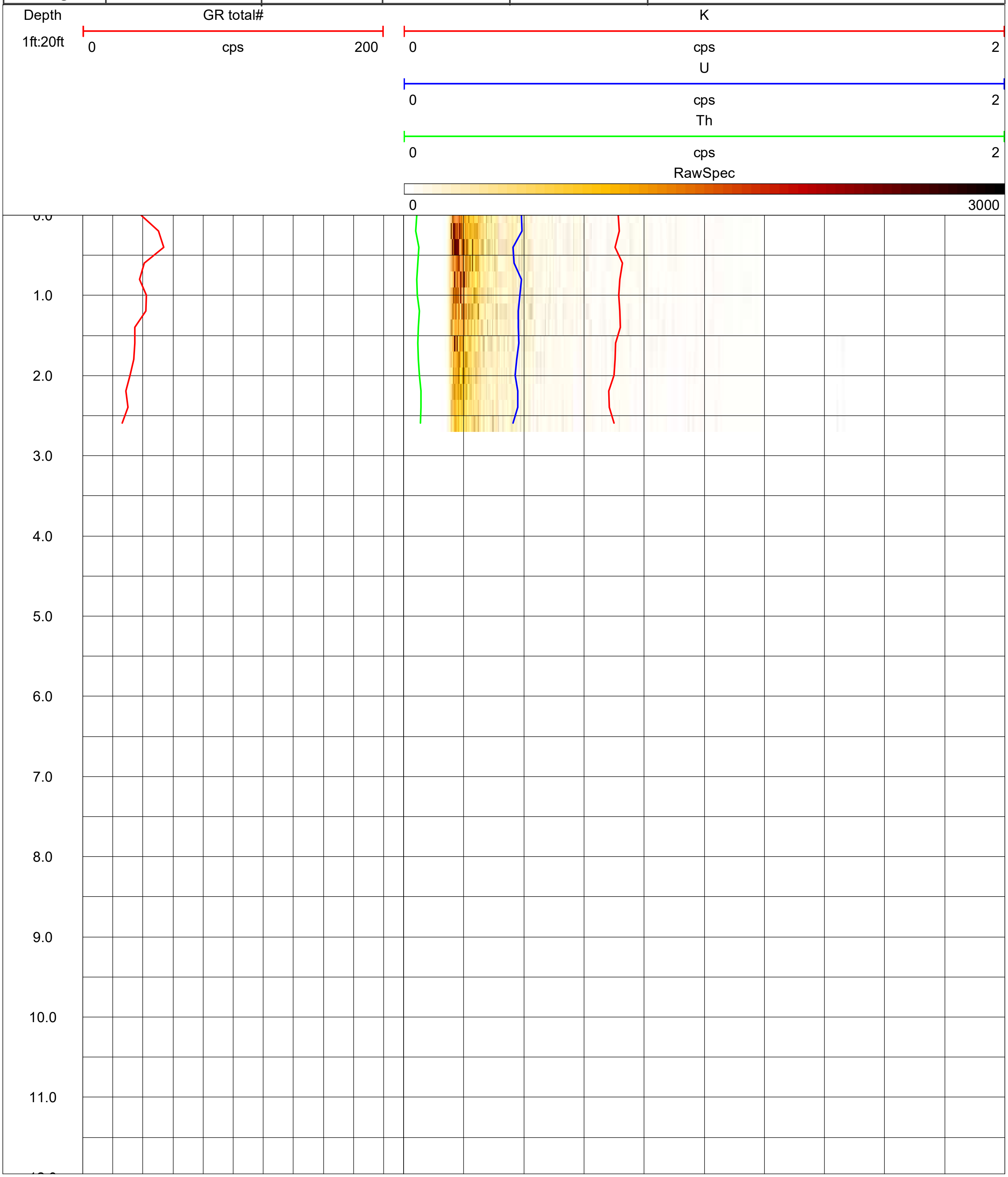
Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB05	File Name	09222021_SB05_DN2
Date	09/22/2021	Depth Drilled	3.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



leidos	Project	Former Staten Island Warehouse - Borehole Gamma
	Location	Staten Island, Port Richmond, New York

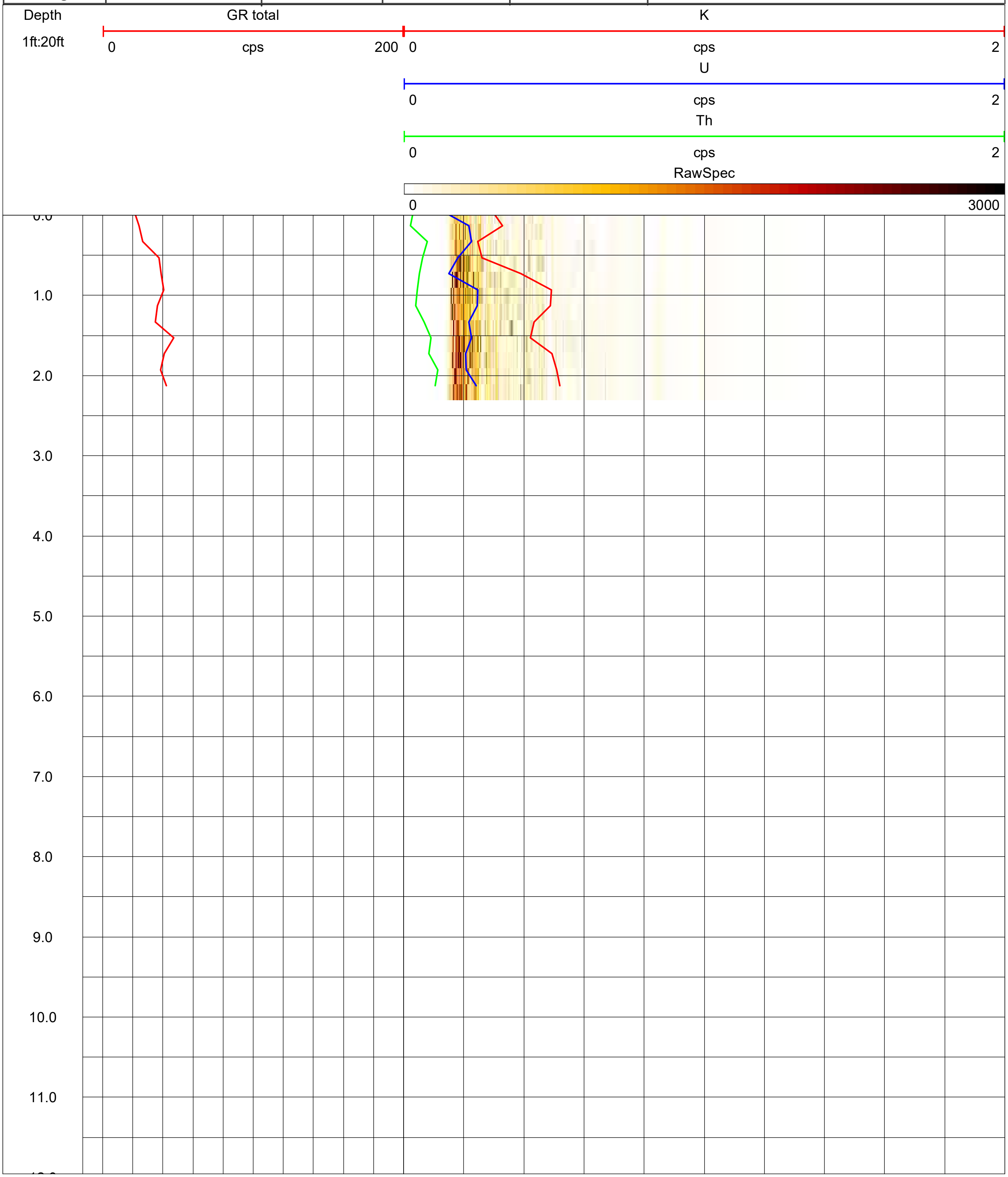
Location	SB06			File Name	09222021_SB06_DN1
Date	09/22/2021			Depth Drilled	2.5 feet BGS
Casing	2 inch PVC	BH Fluid		Logged By	Jeffrey J. Warren PG

leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB06	File Name	09222021_SB06_DN2
Date	09/22/2021	Depth Drilled	2.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG

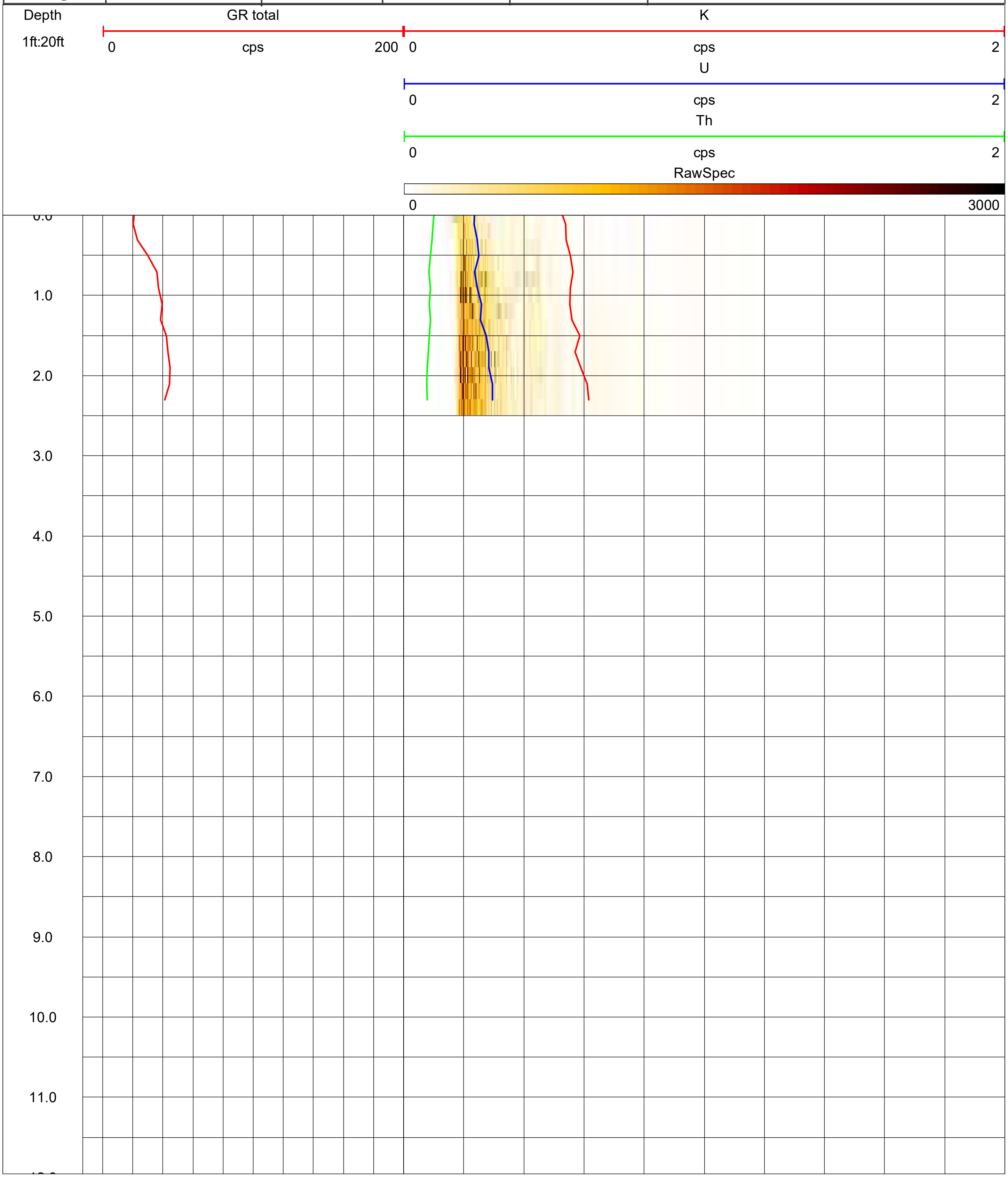


leidos	Project	Former Staten Island Warehouse - Borehole Gamma
	Location	Staten Island, Port Richmond, New York

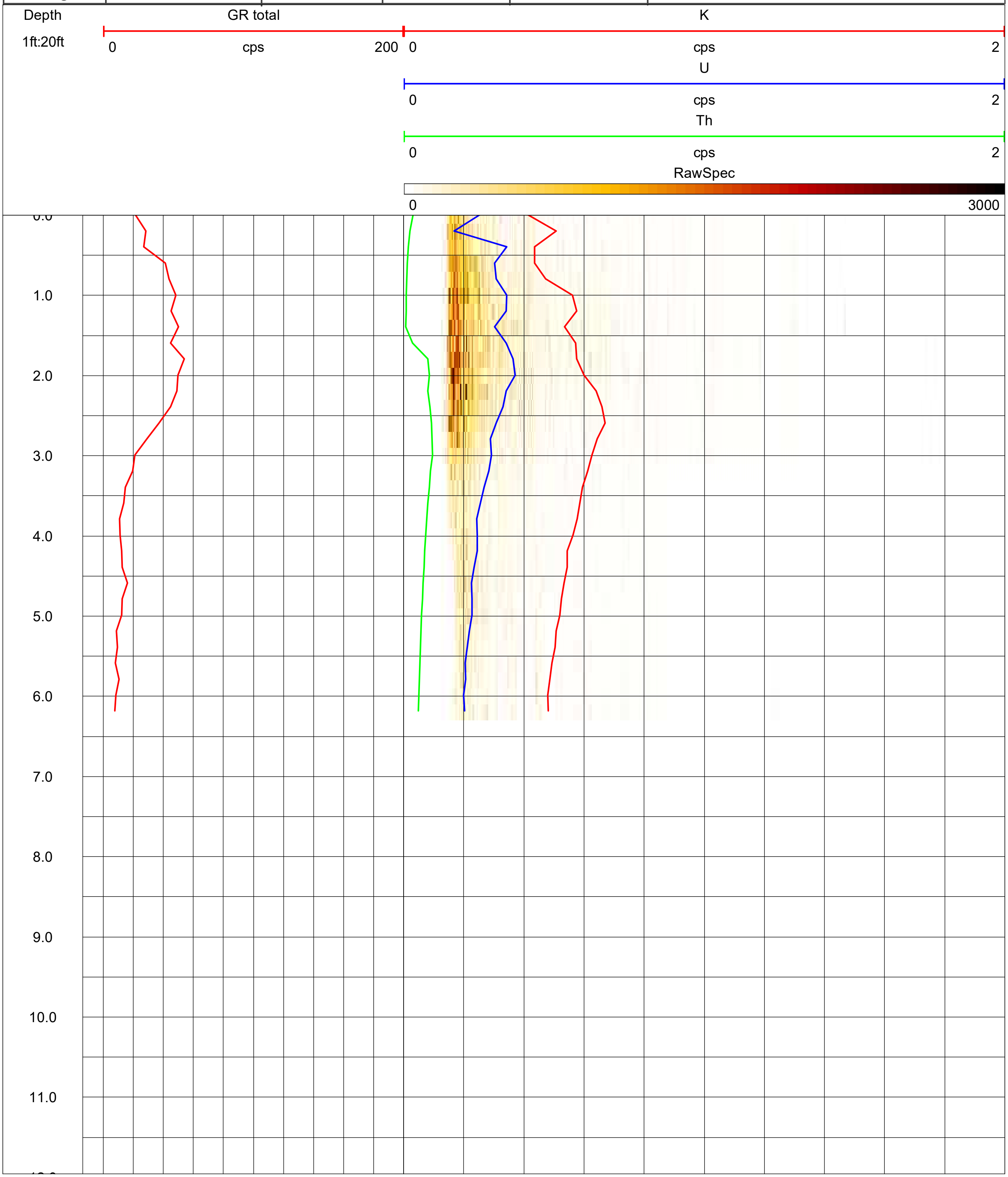
Location	SB07	File Name	09222021_SB07_DN1
Date	09/22/2021	Depth Drilled	2.5 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



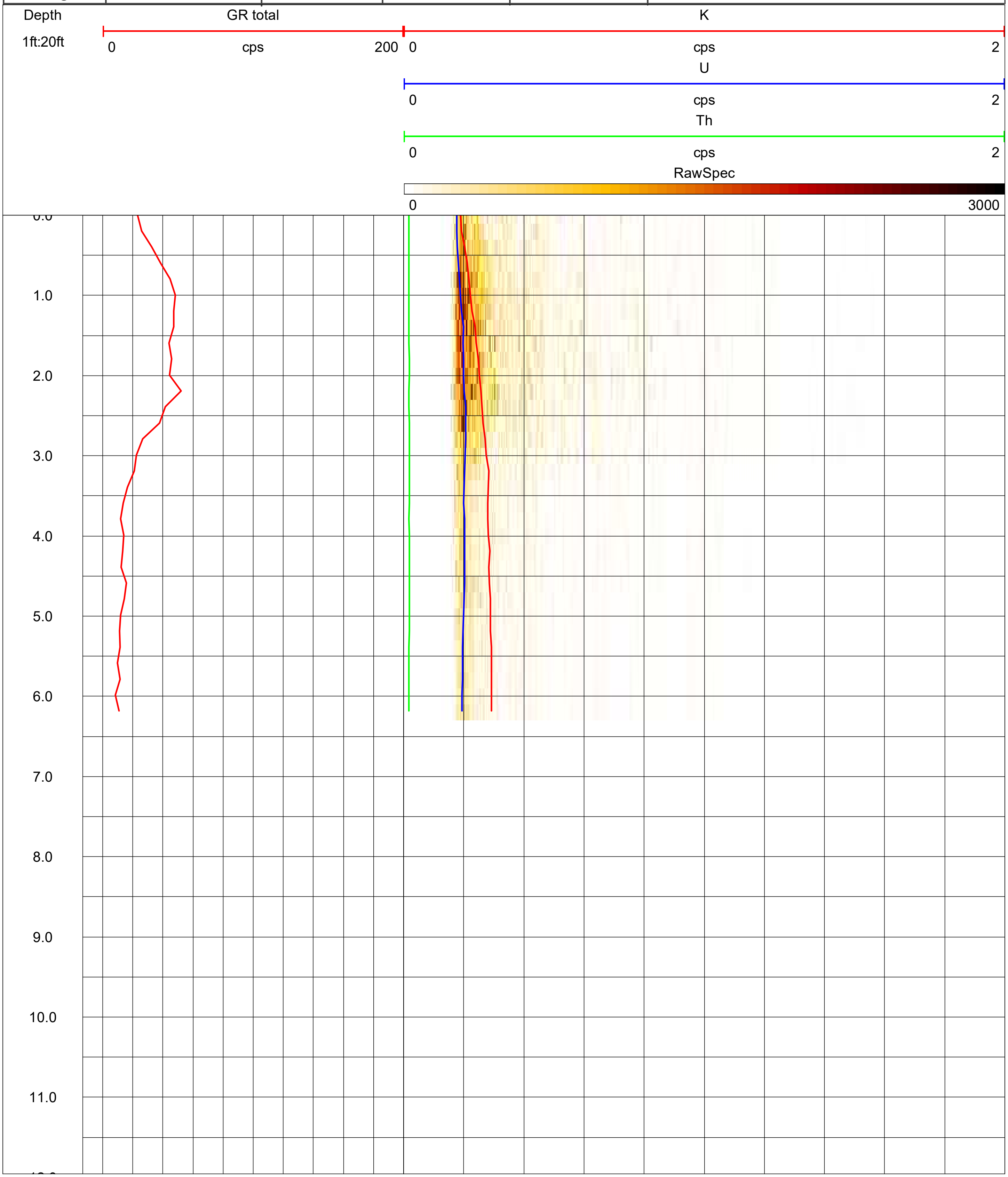
Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB07	File Name	09222021_SB07_DN2
Date	09/22/2021	Depth Drilled	2.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



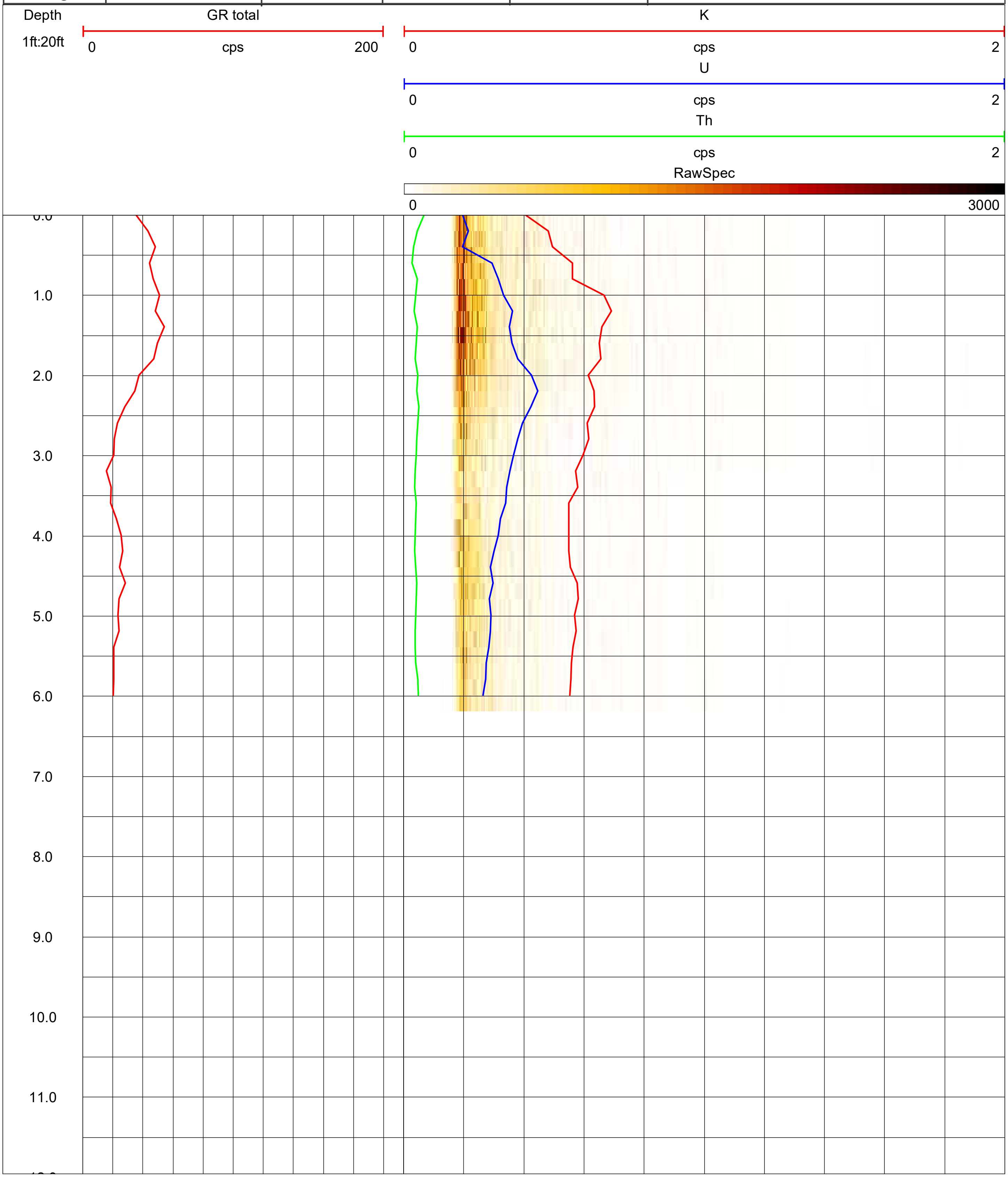
Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB09	File Name	09232021_SB09_DN1
Date	09/23/2021	Depth Drilled	6.2 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



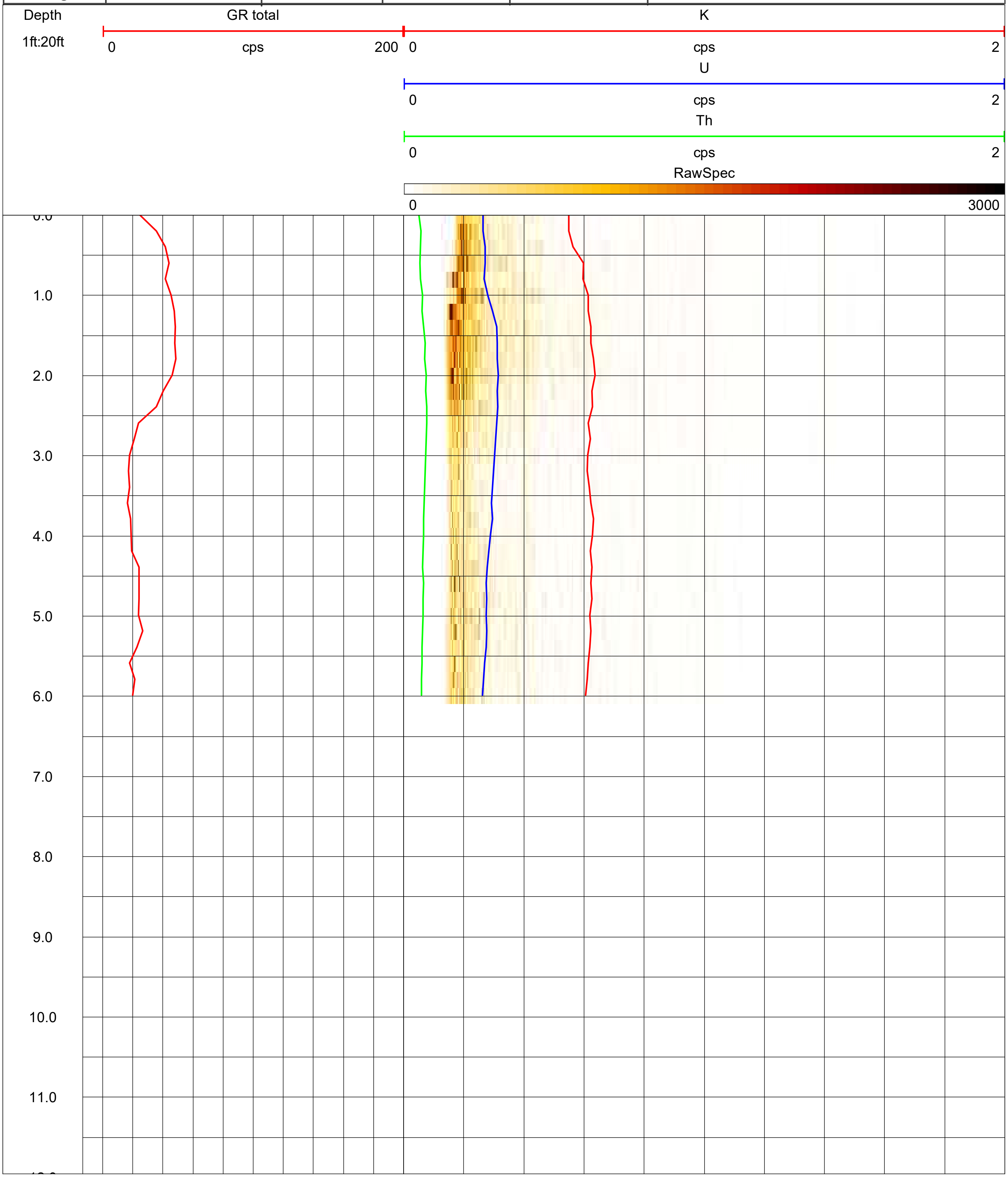
leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB09	File Name	09232021_SB09_DN2
Date	09/23/2021	Depth Drilled	6.2 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



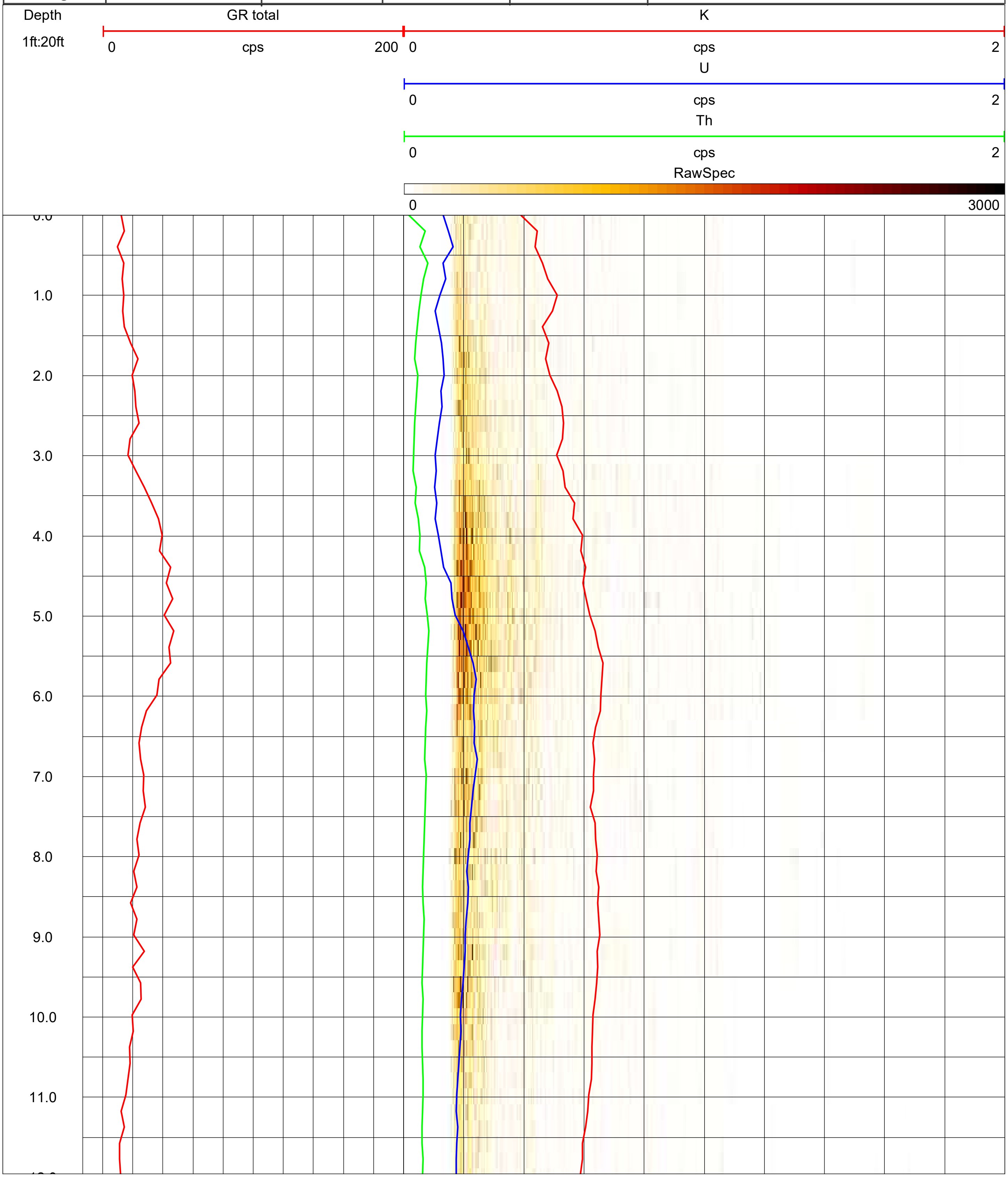
leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB10	File Name	09232021_SB10_DN1
Date	09/23/2021	Depth Drilled	6.0 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



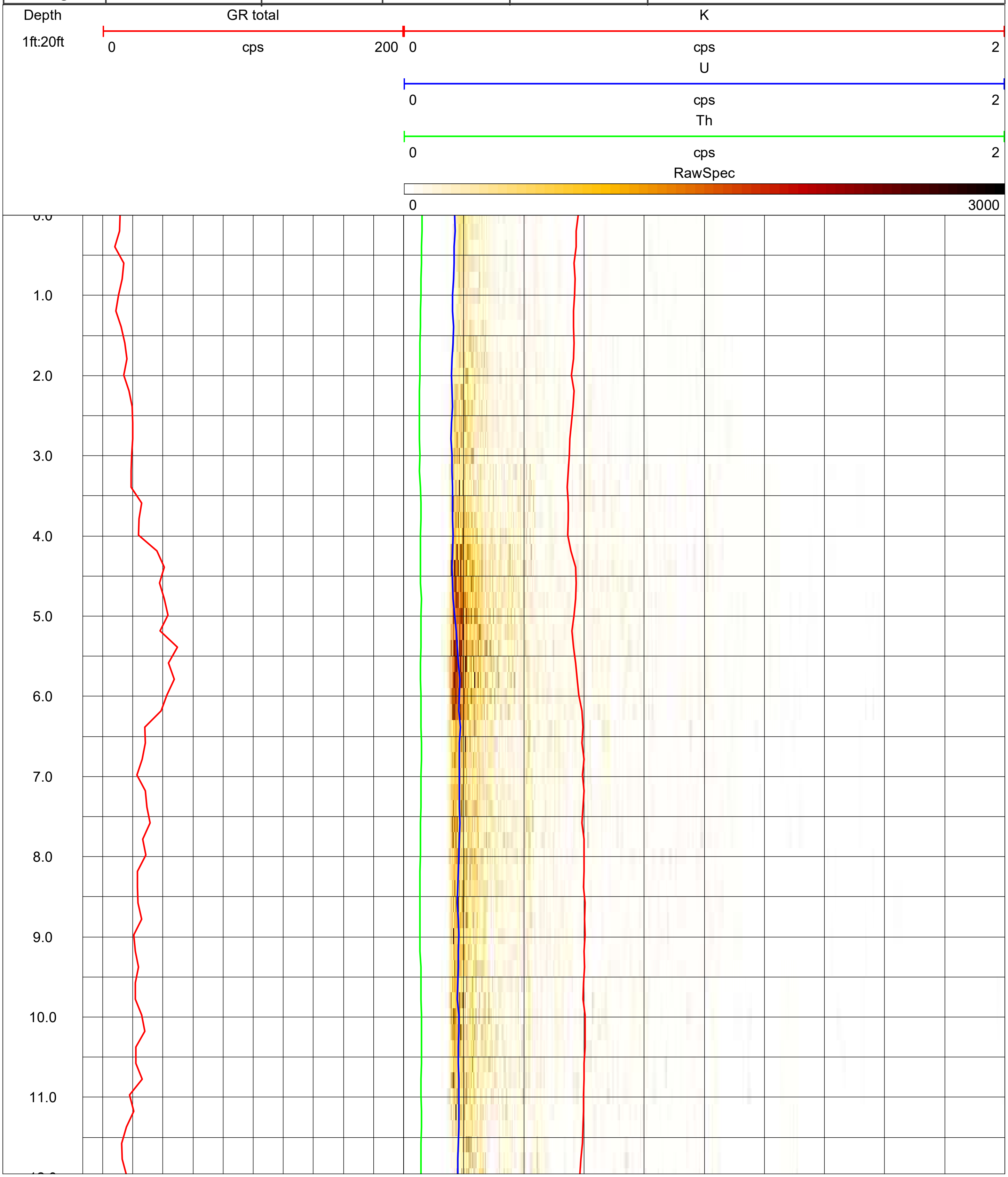
Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB10	File Name	09232021_SB10_DN2
Date	09/23/2021	Depth Drilled	6.0 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



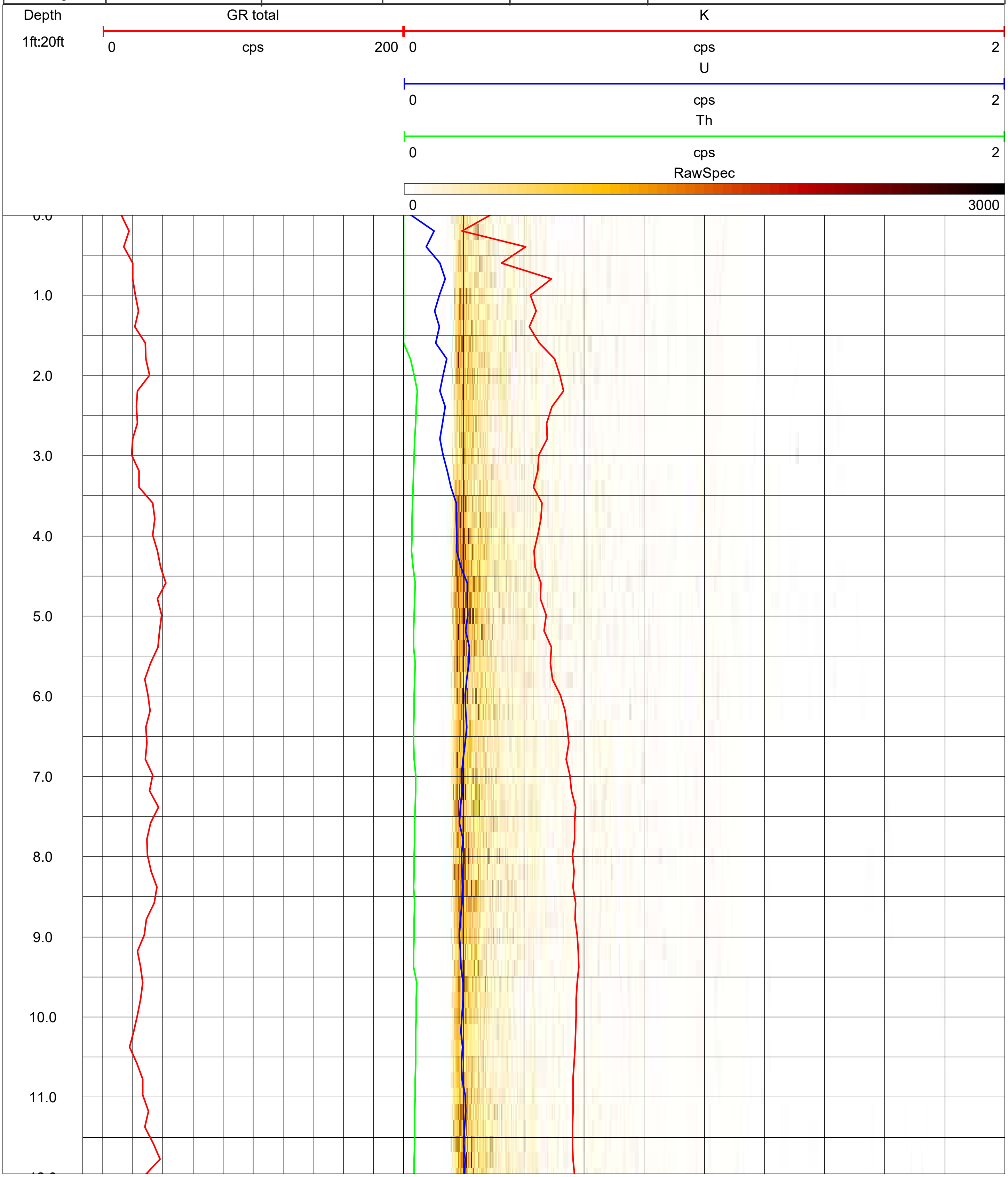
leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB11	File Name	09232021_SB11_DN1
Date	09/23/2021	Depth Drilled	12.8 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



leidos		Project	Former Staten Island Warehouse - Borehole Gamma
		Location	Staten Island, Port Richmond, New York
Location	SB11	File Name	09232021_SB11_DN2
Date	09/23/2021	Depth Drilled	12.8 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



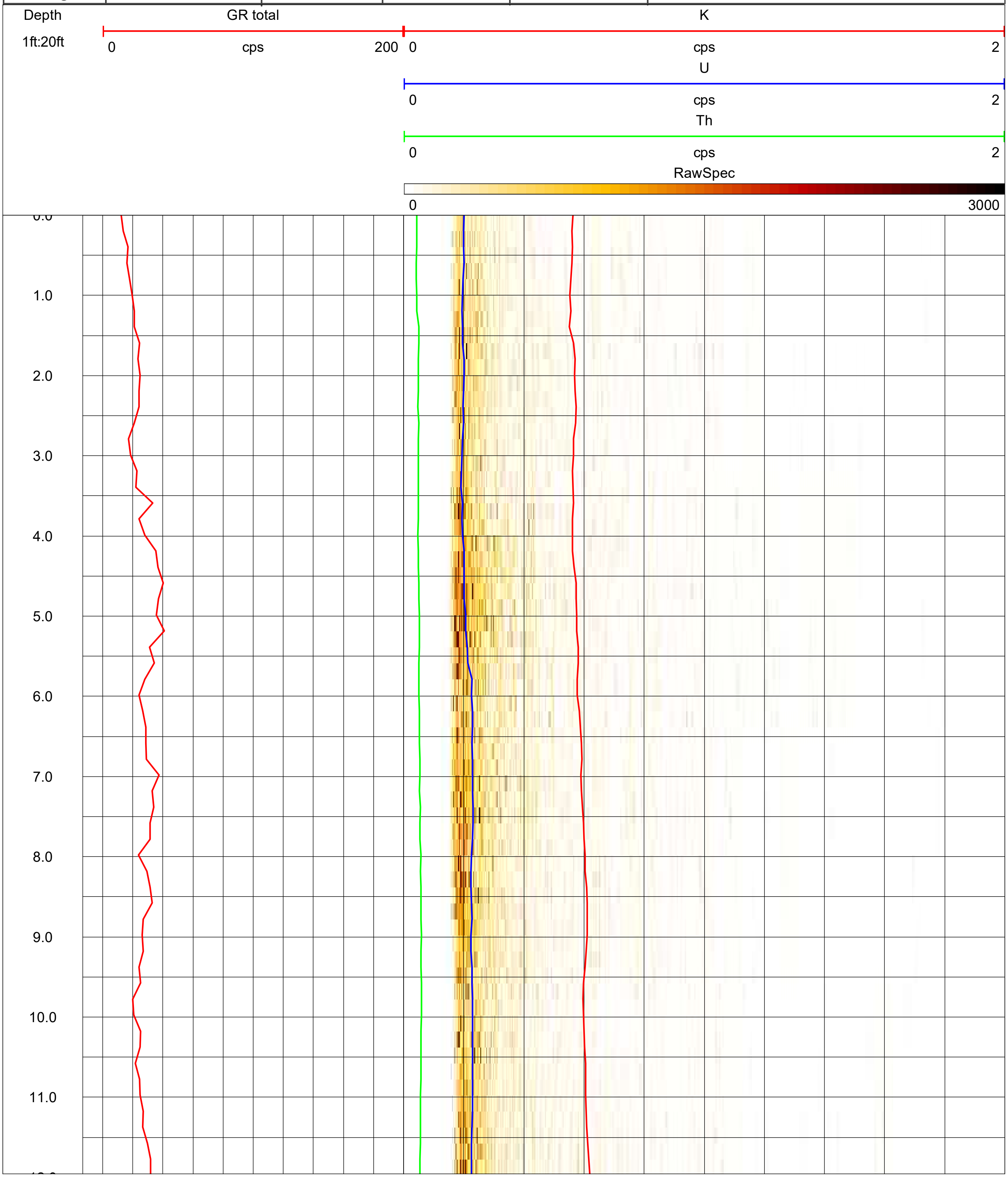
Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB12	File Name	09232021_SB12_DN1
Date	09/23/2021	Depth Drilled	12.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



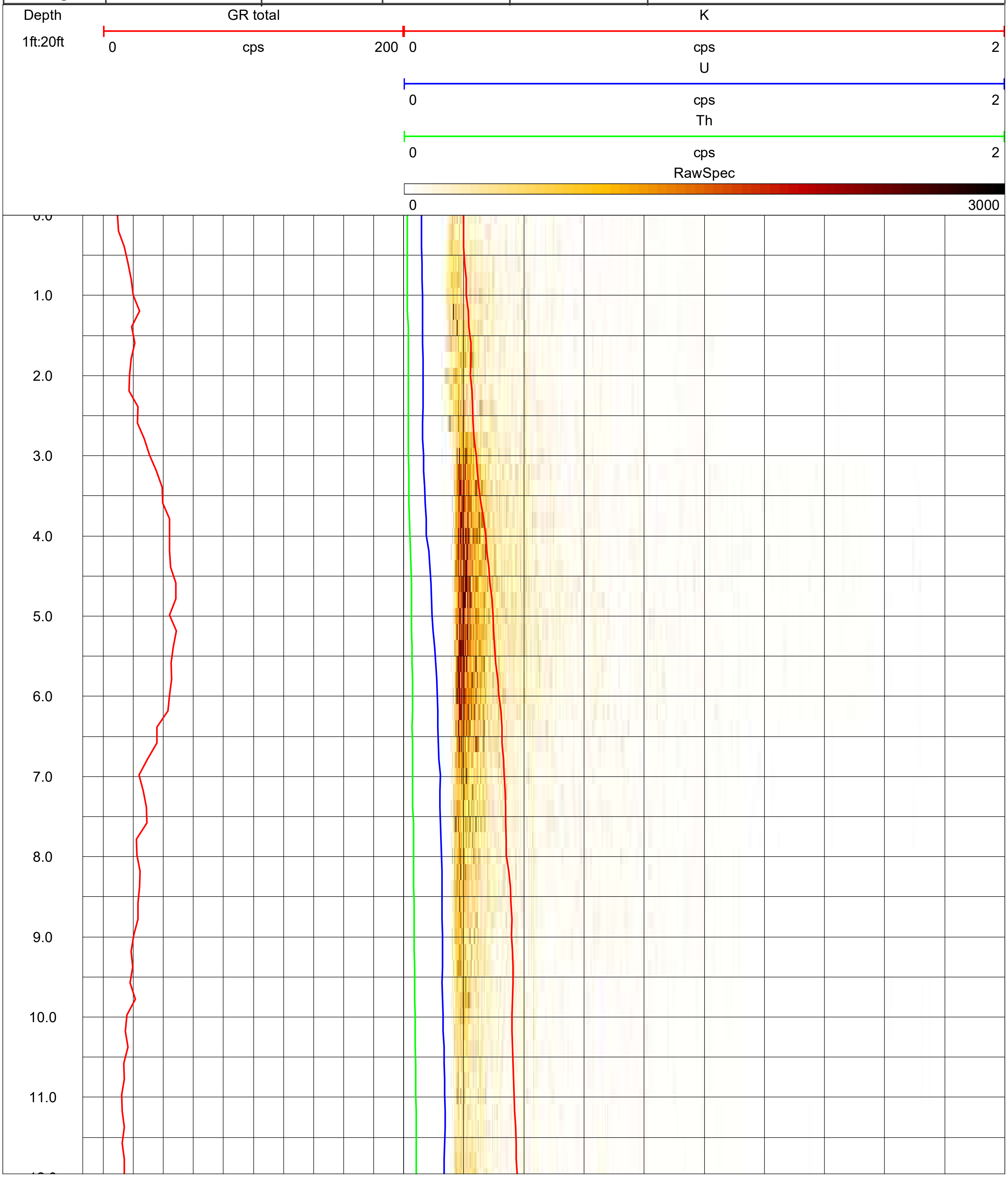
leidos

Project	Former Staten Island Warehouse - Borehole Gamma
Location	Staten Island, Port Richmond, New York

Location	SB12			File Name	09232021_SB12_DN2
Date	09/23/2021			Depth Drilled	12.5 feet BGS
Casing	2 inch PVC	BH Fluid		Logged By	Jeffrey J. Warren PG

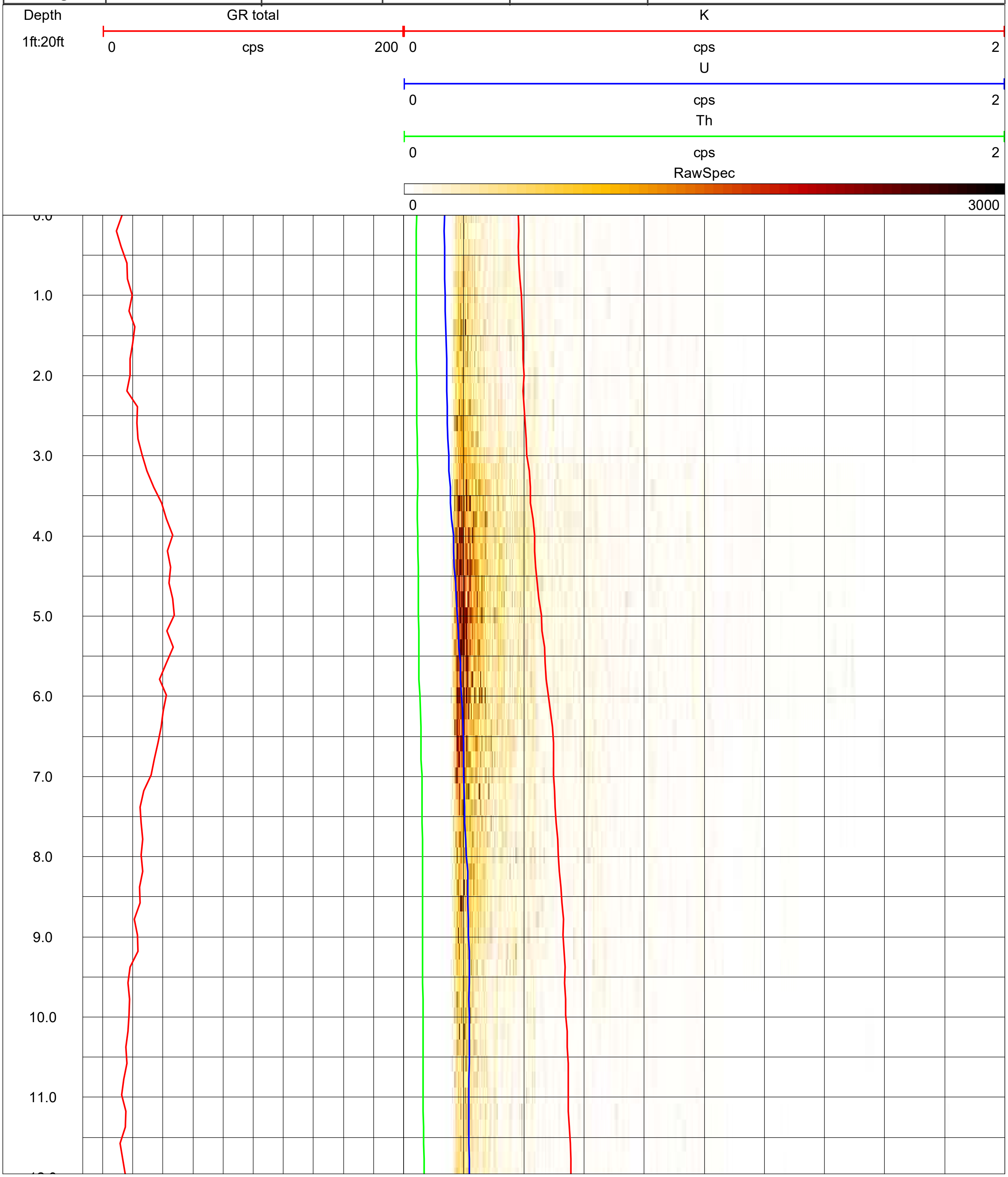


leidos	Project	Former Staten Island Warehouse - Borehole Gamma	
	Location	Staten Island, Port Richmond, New York	
Location	SB14	File Name	09242021_SB14_DN1
Date	09/24/2021	Depth Drilled	12.5 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



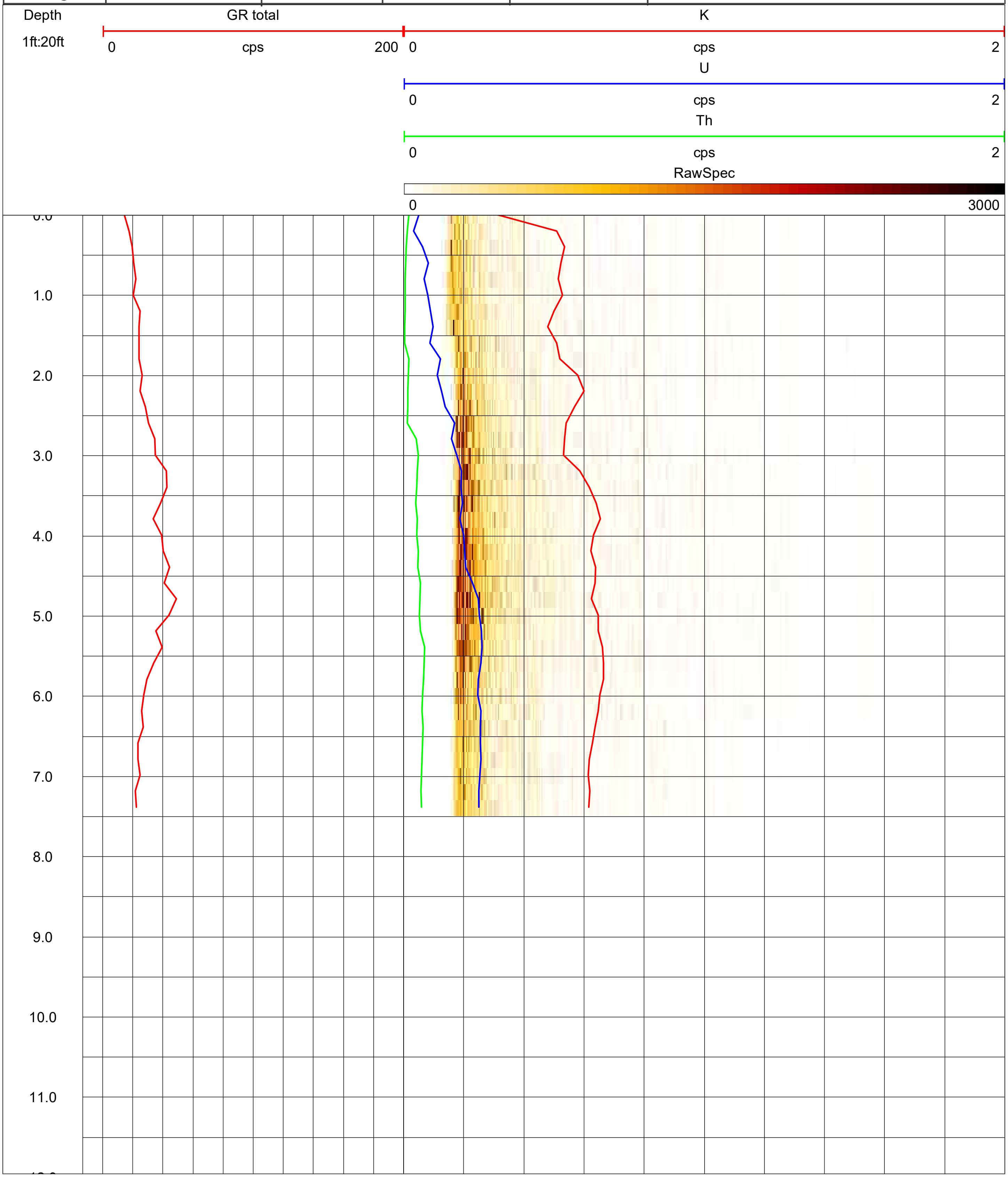
leidos

Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB14	File Name	09242021_SB14_DN2
Date	09/24/2021	Depth Drilled	12.5 feet BGS
Casing	2 inch PVC BH Fluid	Logged By	Jeffrey J. Warren PG



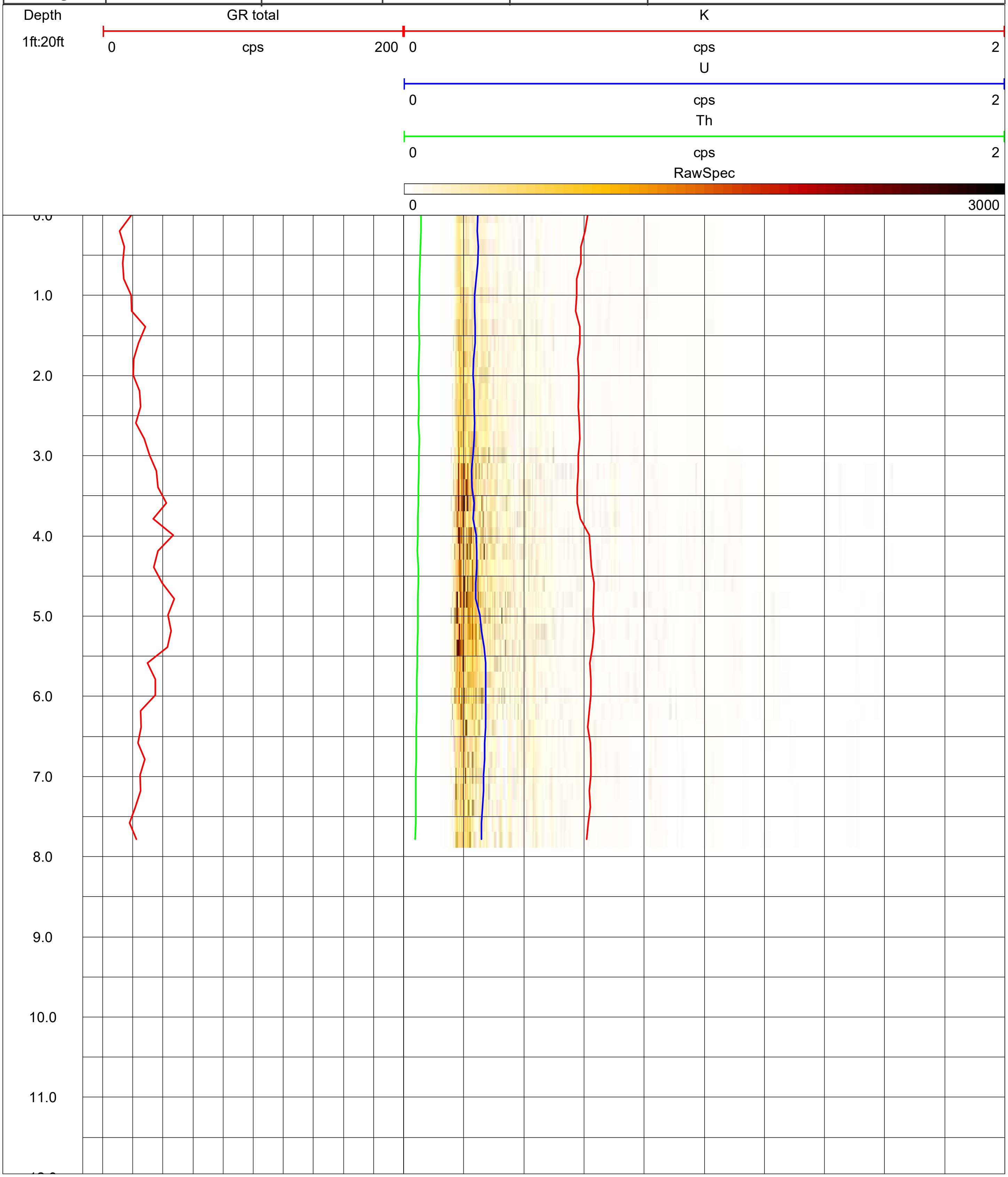
leidos

Project	Former Staten Island Warehouse - Borehole Gamma		
Location	Staten Island, Port Richmond, New York		
Location	SB15	File Name	09242021_SB15_DN1
Date	09/24/2021	Depth Drilled	7.7 feet BGS
Casing	2 inch PVC / BH Fluid	Logged By	Jeffrey J. Warren PG



leidos	Project	Former Staten Island Warehouse - Borehole Gamma
	Location	Staten Island, Port Richmond, New York

Location	SB15			File Name	09242021_SB15_DN2
Date	09/24/2021			Depth Drilled	7.7 feet BGS
Casing	2 inch PVC	BH Fluid		Logged By	Jeffrey J. Warren PG



APPENDIX I

RADIOLOGICAL SCAN DATA SHEETS

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Initial Instrument Check In

Meter Number:	127254	Detector Number:	384781
Meter Model:	2221	Detector Model:	44-10 I3
Cal. Due:	8/6/2022	Cal. Due:	9/8/2022

Gamma	Source Type:	Cs-137				
Gamma	Source #:	SAIC-0003	High Voltage (V):	1000		
Gamma	Source Activity (cpm):	N/A				
Gamma	Source count time (min):	1	Background count time (min):	1		
Gamma	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	3,422		
Gamma	72,559	3607	20% of Bkg.	685		
Gamma	73,511	3522	3 Standard Deviations of Bkg.	277		
Gamma	72,906	3378	Background Range (cpm):	2,737	to	4,107
Gamma	72,629	3462				
Gamma	73,041	3424	Average Source (gcpm):	72,944		
Gamma	73,285	3335	Average Net Source (ncpm):	69,522		
Gamma	72,714	3326	Source Range (gcpm):	58,356	to	87,532
Gamma	72,943	3462				
Gamma	72,750	3337				
Gamma	73,102	3366	Determined Inst. Efficiency:	N/A		

Calculated cpm rounded to integer numbers.

Performed By: Megan Sharma Date: 10-6-21

Reviewed By: [signature] Date: 10-6-21
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

Meter/Detector: 44-10 I3 / 2221 **Date (MO/YR):** Sept. 2021

Source		Bkgd QC Range (cpm)	Source QC Range (gcpm)		Number	Cal. Due	Post-use[b] Bkgd QC Range (cpm)	Post-use[b] Source QC Range (gcpm)
γ Source	Cs-137			Meter	127254	8/6/2022		
				Detector	384781	9/8/2022		
γ Source ID	SAIC-0003	2737 - 4107	58356 - 87532	HV Check Range (V)	990 - 1010		2737 - 4107	58356 - 87532

Date	Time	Pre-use Bkgd (cpm)	Pre-use Source (gcpm)	Bkgd & Source Checks in Range Sat/Unsat[a]	Battery Check Sat/Unsat[a]	HV Check Sat/Unsat[a]	Pre-use HPT Initials	Post-use Bkgd (cpm)	Post-use Source (gcpm)	Bkgd & Source Checks in Range Sat/Un-sat[a]	HPT Initials
9/23/2021	0730	3070	75868	SAT	SAT	SAT	MS	3452	79863	SAT	MS
9/24/2021	0730	3452	71093	SAT	SAT	SAT	MS				

Comments:

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.

[b] Post-use check at end of the day following FUSRAP FSS surveys, or other client surveys.

Reviewed By : [signature] **(RPM/Designee)** **Date :** 10-6-21

Initial Instrument Check In

Meter Number:	218563	Detector Number:	365209
Meter Model:	2221	Detector Model:	44-2 Y
Cal. Due:	9/8/2022	Cal. Due:	9/8/2022

Gamma	Source Type:	Cs-137					
Gamma	Source #:	SAIC-0003	High Voltage (V):	850			
Gamma	Source Activity (cpm):	N/A					
Gamma	Source count time (min):	1	Background count time (min):	1			
Gamma	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	756			
Gamma	16,514	747	20% of Bkg.	152			
Gamma	16,590	767	3 Standard Deviations of Bkg.	59			
Gamma	16,665	766	Background Range (cpm):	604	to	908	
Gamma	16,363	744					
Gamma	16,550	770	Average Source (gcpm):	16,504			
Gamma	16,504	747	Average Net Source (ncpm):	15,748			
Gamma	16,414	785	Source Range (gcpm):	13,204	to	19,804	
Gamma	16,460	719					
Gamma	16,516	771					
Gamma	16,467	741	Determined Inst. Efficiency:	N/A			

Calculated cpm rounded to integer numbers.

Performed By: Megan Sherman Date: 10-6-21

Reviewed By: [signature] Date: 10-6-21
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

Meter/Detector: 44-2 Y / 2221 **Date (MO/YR):** Sept. 2021

Source		Bkgd QC Range (cpm)	Source QC Range (gcpm)	Bkgd & Source Checks in Range		Number	Cal. Due	Post-use[b]			
γ Source	Cs-137				Meter	218563	9/8/2022	Bkgd QC Range (cpm)	Source QC Range (gcpm)	Bkgd & Source Checks in Range	HPT Initials
					Detector	365209	9/8/2022				
γ Source ID	SAIC-0003	604 - 908	13204 - 19804		Battery Check	HV Check Range (V) 840 - 860	Pre-use HPT	604 - 908	13204 - 19804		
Date	Time	Pre-use Bkgd (cpm)	Pre-use Source (gcpm)	Sat/Unsat[a]	Sat/Unsat[a]	Sat/Unsat[a]	Initials	Post-use Bkgd (cpm)	Post-use Source (gcpm)	Sat/Un-sat[a]	
9/22/2021	1404	789	15947	SAT	SAT	SAT	MS	656	15787	SAT	MS
9/23/2021	0730	656	15787	SAT	SAT	SAT	MS				
9/27/2021	0719	854	16909	SAT	SAT	SAT	MS	776	15594	SAT	MS

Comments:

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.

[b] Post-use check at end of the day following FUSRAP FSS surveys, or other client surveys.

Reviewed By : ____________ **(RPM/Designee)** **Date :** 10-6-21

Initial Instrument Check In

Meter Number:	196062	Detector Number:	357755
Meter Model:	2221	Detector Model:	44-10 P
Cal. Due:	8/6/2022	Cal. Due:	9/8/2022

Gamma	Source Type:	Cs-137				
Gamma	Source #:	SAIC-0003	High Voltage (V):	900		
Gamma	Source Activity (cpm):	N/A				
Gamma	Source count time (min):	1	Background count time (min):	1		
Gamma	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	3,315		
Gamma	77,477	3266	20% of Bkg.	663		
Gamma	77,601	3392	3 Standard Deviations of Bkg.	188		
Gamma	78,128	3302	Background Range (cpm):	2,652	to	3,978
Gamma	75,905	3259				
Gamma	76,181	3275	Average Source (gcpm):	76,395		
Gamma	75,980	3331	Average Net Source (ncpm):	73,080		
Gamma	76,386	3444	Source Range (gcpm):	61,116	to	91,674
Gamma	75,123	3257				
Gamma	75,647	3341				
Gamma	75,518	3286	Determined Inst. Efficiency:	N/A		

Calculated cpm rounded to integer numbers.

Performed By: Megan Sherman Date: 10-6-21

Reviewed By: [signature] Date: 10-6-21
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

Meter/Detector: 44-10 P / 2221 **Date (MO/YR):** Sept. 2021

Source		Bkgd QC Range (cpm)	Source QC Range (gcpm)	Bkgd & Source Checks in Range		Number	Cal. Due	Post-use[b]			
γ Source	Cs-137				Meter	196062	8/6/2022	Bkgd QC Range (cpm)	Source QC Range (gcpm)	Bkgd & Source Checks in Range	HPT Initials
					Detector	357755	9/8/2022				
γ Source ID	SAIC-0003	2652 - 3978	61116 - 91674		Battery Check	HV Check Range (V) 890 - 910	Pre-use HPT	2652 - 3978	61116 - 91674		
Date	Time	Pre-use Bkgd (cpm)	Pre-use Source (gcpm)	Sat/Unsat[a]	Sat/Unsat[a]	Sat/Unsat[a]	Initials	Post-use Bkgd (cpm)	Post-use Source (gcpm)	Sat/Un-sat[a]	
9/21/2021	0748	3502	75731	SAT	SAT	SAT	MS	3089	71195	SAT	MS
9/22/2021	0815	3089	71195	SAT	SAT	SAT	MS				
9/23/2021	0730	3194	76138	SAT	SAT	SAT	MS	3351	79179	SAT	MS
9/24/2021	0730	3351	72181	SAT	SAT	SAT	MS	3591	71324	SAT	MS
9/27/2021	0720	3409	72010	SAT	SAT	SAT	MS	3787	75138	SAT	MS

Comments:

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.
[b] Post-use check at end of the day following FUSRAP FSS surveys, or other client surveys.

Reviewed By : [illegible signature] **(RPM/Designee)** **Date :** 10-6-21

Exposure Rate Meter Setup Record

Date : 9/20/2021 **Leidos ID :** MicroR A **Location :** Staten Island Site

Instrument:	Models	Serial Numbers	Cal. Due Date
Meter:	Model 19	347262	5/30/2022
Detector:	NA	NA	NA

Instrument Range	Source		Source Position	Observed Exposure Rate[1]		Acceptance Criteria[1,2]			Units
	ID	Isotope		Reading	Units	Minimum	to	Maximum	
X250	SAIC-0003	Cs-137	Contact on Bottom of Car	80	μR/hr	64	to	96	μR/hr
					μR/hr	0	to	0	μR/hr

[1] Insert information on row with appropriate units.
[2] ± 20% of observed exposure rate.

Comments/Restrictions: Meter only source checked at X250 scale.

Megan Sherman
Calculated By :

Date : 10-6-21

Approved By :

Date: 10-6-21

Daily Check-In of Dose Rate Instruments

Meter: MicroR A **Date (MO/YR):** Sept. 2021

Source		Pre-Use Source QC	Source Check in Range	Scale		Post-Use[b] Source QC	Source Check in Range[b]		Model	Serial Number	Cal. Due
γ Source	Cs-137			X250				Meter	Model 19	347262	5/30/2022
γ Source ID	SAIC-0003	64 - 96		Bat. Check	HPT Initial	64 - 96		Detector	NA	NA	NA
Date	Time	Reading (µR/hr)	Sat/Unsat[a]	Sat/Unsat[a]		Reading (µR/hr)	Sat/Unsat[a]	HPT Initial[b]	Comments		
9/20/2021	1140	80	SAT	SAT	MS						
9/21/2021	0800	80	SAT	SAT	MS						
9/22/2021	0820	75	SAT	SAT	MS						
9/23/2021	0733	80	SAT	SAT	MS						
9/24/2021	0727	80	SAT	SAT	MS						
9/27/2021	0723	75	SAT	SAT	MS						

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.

[b] Post-use check at end of the day following FUSRAP FSS surveys, or other client surveys.

Reviewed By : [signature] (RPM/Designee) **Date :** 10-6-21

Initial Instrument Check In

Meter Number:	345532	Detector Number:	394879
Meter Model:	2360	Detector Model:	43-89 B
Cal. Due:	6/3/2022	Cal. Due:	6/3/2022

Alpha	Source Type:	Th-230	Date of Check-in	9/19/2021		
Alpha	Source #:	SAIC-0002				
Alpha	4 pi Source Activity (cpm):	22,596	Detector Area (cm^2):	125		
Alpha	2 pi Source Activity (cpm):	11,498	Surface Efficiency 4pi/2pi:	1	/	0.25
Alpha	Source count time (min):	1	Background count time (min):	10		
Alpha	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	0.15		
Alpha	3,386	0	3 Standard Deviations of Bkg.	0.54		
Alpha	3,295	0.2	Background Range (CPM):	0	to	2
Alpha	3,385	0				
Alpha	3,388	0	Average Source (gcpm):	3,344		
Alpha	3,372	0.5	Average Net Source (ncpm):	3,343		
Alpha	3,317	0.2	Source Range (gcpm):	2,676	to	4,012
Alpha	3,398	0.1		4 pi		2 pi
Alpha	3,383	0.1	Determined Inst. Efficiency:	0.1479		0.2907
Alpha	3,257	0	MDA (dpm/100cm^2):	23		48
Alpha	3,258	0.4	ncpm that are less than MDA:	4		4

Beta	Source Type:	SrY-90				
Beta	Source #:	SAIC-0001				
Beta	4 pi Source Activity (cpm):	7,545	Detector Area (cm^2):	125		
Beta	2 pi Source Activity (cpm):	5,281	Surface Efficiency 4pi/2pi:	1	/	0.25
Beta	Source count time (min):	1	Background count time (min):	1		
Beta	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	191		
Beta	2,244	183	3 Standard Deviations of Bkg.	39		
Beta	2,326	166	Background Range (CPM):	152	to	230
Beta	2,233	206				
Beta	2,334	184	Average Source (gcpm):	2,271		
Beta	2,270	205	Average Net Source (ncpm):	2,080		
Beta	2,269	200	Source Range (gcpm):	1,817	to	2,725
Beta	2,250	202		4 pi		2 pi
Beta	2,214	191	Determined Inst. Efficiency:	0.276		0.394
Beta	2,237	192	MDA (dpm/100cm^2):	195		547
Beta	2,328	181	ncpm that are less than MDA:	67		67

Calculated cpm rounded to integer numbers for ranges.

Performed By: Megan Shume Date: 10-6-21

Reviewed By: [signature] Date: 10-6-21
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

Meter/Detector: 2360 / 43-89 B **Date (MO/YR) :** Sept. 2021

Sources		Pre-Use					Number	Cal. Due	Post-Use[b]				Beta	
α Source	Th-230	Bkgd QC range (cpm)		Source QC range (gcpm)		Meter	345532	6/3/2022	Bkgd QC range (cpm)		Source QC range (gcpm)		Inst Eff 4 pi: 0.276	
α Source ID	SAIC-0002					Detector	394879	6/3/2022					Avg Bkgd (cpm): 191	
β Source	SrY-90	Alpha	Beta	Alpha	Beta	Bkgd & Source Checks in Range	Alpha		Alpha	Beta	Alpha	Beta	Bkgd & Source Checks in Range	Post-use HPT
β Source ID	SAIC-0001	0 - 2	152 - 230	2676 - 4012	1817 - 2725		Inst Eff 4 pi: 0.1479		0 - 2	152 - 230	2676 - 4012	1817 - 2725		
		Bkgrd. QC (cpm)		Source QC (gcpm)			Avg Bkgd (cpm): 0.15		Bkgrd. QC (cpm)		Source QC (gcpm)			
Date	Pre-Use Time						Bat. Check	Pre-use						
		Alpha	Beta	Alpha	Beta	Sat/Unsat[a]	Sat/Unsat[a]	HPT Initial	Alpha	Beta	Alpha	Beta	Sat/Unsat[a]	Initial
9/20/2021	0609	0.2	197	3392	2314	SAT	SAT	MS						
9/21/2021	0558	0.4	209	3312	2237	SAT	SAT	MS						
9/22/2021	0815	0.6	197	3527	2311	SAT	SAT	MS						
9/23/2021	0730	0.3	159	3758	2227	SAT	SAT	MS						
9/24/2021	0727	0.3	216	3629	2361	SAT	SAT	MS	0.2	187	3749	2360	SAT	MS
9/27/2021	0728	0.3	188	3842	2386	SAT	SAT	MS	0.8	182	3807	2380	SAT	MS

Comment:

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.

[b] Post-use check at end of the day following FUSRAP FSS surveys, or other client surveys.

Reviewed By : ____________ **(RPM/Designee)** **Date :** 10-6-21

Initial Instrument Check In

Meter Number:	346227	Detector Number:	NA
Meter Model:	3030	Detector Model:	N/A
Cal. Due:	6/8/2022	Cal. Due:	N/A

Alpha	Source Type:	Th - 230	Date of Check-in	9/20/2021		
Alpha	Source #:	SAIC-0002				
Alpha	Source Activity (cpm):	22,596				
Alpha	Source count time (min):	1	Background count time (min):	10		
Alpha	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	0.13		
Alpha	7,820	0.2	20% of Bkg. (cpm)	0.03		
Alpha	7,839	0.1	3 Standard Dev. of Bkg. (cpm)	0.29		
Alpha	7,891	0.1	Background Range (cpm):	0.0	to	2.0
Alpha	7,932	0.2				
Alpha	7,774	0.3	Average Source (gcpm):	7,847		
Alpha	7,760	0.1	Average Net Source (ncpm):	7,846		
Alpha	7,776	0.2	Source Range (gcpm):	6,278	to	9,416
Alpha	7,862	0.0				
Alpha	7,873	0.1				
Alpha	7,940	0.0	Determined Inst. Efficiency:	0.347		

Beta	Source Type:	SrY - 90				
Beta	Source #:	SAIC-0001				
Beta	Source Activity (cpm):	7,544				
Beta	Source count time (min):	1	Background count time (min):	10		
Beta	**Source GCPM**	**BKG CPM**	Average Bkg. (cpm):	31		
Beta	2,955	31	20% of Bkg.	7		
Beta	2,998	35	3 Standard Deviations of Bkg.	17		
Beta	2,974	23	Background Range (cpm):	14	to	48
Beta	2,955	33				
Beta	2,996	39	Average Source (gcpm):	2,973		
Beta	2,913	22	Average Net Source (ncpm):	2,942		
Beta	3,024	36	Source Range (gcpm):	2,379	to	3,567
Beta	2,921	35				
Beta	3,017	28				
Beta	2,974	31	Determined Inst. Efficiency:	0.390		

Calculated cpm rounded to integer numbers.

Performed By: Megan Sherman Date: 10-6-21

Reviewed By: [signature] Date: 10-6-21
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG   Meter/Detector: 3030 / N/A   Date (MO/YR) : Sept. 2021

Source		Pre-Use				Bkgd & Source Checks in Range		Number	Cal. Due
α Source	Th - 230	Bkgd QC range (cpm)		Source QC range (gcpm)			Meter	346227	6/8/2022
α Source ID	SAIC-0002	Alpha	Beta	Alpha	Beta		Detector	NA	N/A
β Source	SrY - 90	0 - 2	14 - 48	6278 - 9416	2379 - 3567		Alpha	Inst Eff: 0.347	Avg Bkgd (cpm): 0.13
β Source ID	SAIC-0001	Bkgd QC (cpm)		Source QC (gcpm)			Beta	Inst Eff: 0.39	Avg Bkgd (cpm): 31
Date	Time	Alpha	Beta	Alpha	Beta	Sat/Unsat[a]	HPT Initial	Comment	
9/20/2021	2015	0.1	30	7814	2953	Sat	MS		
9/22/2021	1950	0.1	29	7868	2951	Sat	MS		
9/23/2021	1705	0.1	33	7946	3008	Sat	MS		
9/27/2021	1909	0.1	33	7797	2920	Sat	MS		

[a] Record unsatisfactory QC check(s) in the comment block and repeat the evaluation as necessary. Tag the instrument out of service and notify the RPM if the instrument will not meet criteria.

Reviewed By : [signature] (RPM/Designee)   Date : 10-6-21

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-001.0	Page 1 of 1
PURPOSE OF SURVEY: Incoming Survey on Equipment	DATE: 9/20/21	TIME: 9:45

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Generator							0	0	< MDA	200	9	< MDA	4
2	Air Sampler							0	0	< MDA	200	9	< MDA	4
3	Weed Whacker							0	0	< MDA	175	0	< MDA	4
4	Shears							0	0	< MDA	200	9	< MDA	4
5	Chainsaw							0	0	< MDA	150	0	< MDA	4
6	Wood Chipper							0	0	< MDA	175	0	< MDA	4
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sherman / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-001.0		Page 1 of 1
PURPOSE OF SURVEY: Release Survey on Equipment		DATE: 9/20/21	TIME: 16:30

Instrument Type(s):		Detector Area (cm²)	Serial Number:		Cal. Due Date		Background: (CPM)		Efficiency: (%)	
			meter	detector	meter	detector	Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Generator							0	0	< MDA	150	0	< MDA	4
2	Air Sampler							0	0	< MDA	150	0	< MDA	4
3	Weed Whacker							0	0	< MDA	200	9	< MDA	4
4	Shears							0	0	< MDA	210	19	< MDA	4
5	Chainsaw							0	0	< MDA	175	0	< MDA	4
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sherman / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-002.0	Page 1 of 1
PURPOSE OF SURVEY: Release Survey on Equipment	DATE: 9/21/21	TIME: 17:00

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β- 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA ____	βγ MDA ____	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Wood Chipper							1	1	< MDA	200	9	< MDA	5
2	Air Sampler							0	0	< MDA	200	9	< MDA	5
3	Generator							0	0	< MDA	200	9	< MDA	4
4														
5														
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Shyrmer / 10-6-21 ____ / ____

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 ____ / ____

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island | HSWP: SI-21-004.0 | Page 1 of 1

PURPOSE OF SURVEY: Incoming Survey on Drill Rig | DATE: 9/22/21 | TIME: 9:45

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β⁻ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Right Track	0	0	< MDA	143	0	< MDA	0	0	< MDA	200	9	< MDA	4
2	Augers Composite	1	1	< MDA	186	0	< MDA	0	0	< MDA	150	0	< MDA	4
3	Left Track	0	0	< MDA	219	28	< MDA	0	0	< MDA	200	9	< MDA	5
4	Control Panels	0	0	< MDA	193	2	< MDA	0	0	< MDA	250	59	< MDA	4
5	Drill Arms	2	2	< MDA	209	18	< MDA	0	0	< MDA	200	9	< MDA	5
6	Drill Body	0	0	< MDA	190	0	< MDA	0	0	< MDA	150	0	< MDA	4
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpmTotal α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sherma / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1	
PURPOSE OF SURVEY: Incoming Survey on Equipment	DATE: 9/22/21	TIME: 8:00	

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Folding Table							0	0	< MDA	250	59	< MDA	5
2	Handheld Air Monitor							0	0	< MDA	200	9	< MDA	4
3	Tape Measurer							0	0	< MDA	200	9	< MDA	5
4	Downhole Logger Detector							0	0	< MDA	225	34	< MDA	4
5	Downhole Logger Cart/Equip							0	0	< MDA	200	9	< MDA	5
6	2" PVC Pipes							0	0	< MDA	175	0	< MDA	4
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Thorne / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Release Survey on Equipment	DATE: 9/22/21	TIME: 17:30

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA ____	βγ MDA ____	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Air Sampler							0	0	< MDA	200	9	< MDA	5
2	Generator							0	0	< MDA	200	9	< MDA	5
3	Handheld Air Monitor							0	0	< MDA	175	0	< MDA	4
4	PPE and Trash Bag**							0	0	< MDA	250	59	< MDA	5
5	Downhole logger detector							0	0	< MDA	200	9	< MDA	5
6	Downhole logger Cart/Equip							0	0	< MDA	200	9	< MDA	5
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans. **All PPE scanned as workers left Restricted Area

TECHNICIAN(S) SIGNATURE/ DATE: Megan Shymu / 10-6-21 ______ / ______

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 ______ / ______

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Limited Quantity	DATE: 9/22/21	TIME: 17:30

Instrument Type(s):		Detector Area (cm²)	Serial Number:		Cal. Due Date		Background: (CPM)		Efficiency: (%)	
			meter	detector	meter	detector	Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2360 / 43-89	NA	125	NA	NA	NA	NA	NA	NA	NA	NA
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 240	Removable βγ 2400	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA	βγ MDA	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Cooler #1	0	0	< MDA	189	0	< MDA							5
2														
3														
4														
5														
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Shipping survey on sample cooler from drilling activities on 9-22-21

TECHNICIAN(S) SIGNATURE/ DATE Megan Sherman / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island		HSWP: SI-21-002.0		Page 1 of 1
PURPOSE OF SURVEY: Incoming Survey on Equipment			DATE: 9/23/21	TIME: 8:00

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background (CPM) Alpha (α)	Background (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Hydrographic Boat							0	0	< MDA	200	9	< MDA	4
2	Hydrographic Control Panels							0	0	< MDA	200	9	< MDA	5
3	Hydrographic Laptop							0	0	< MDA	170	0	< MDA	4
4	Surveyor Laptop							0	0	< MDA	225	34	< MDA	5
5	Surveyor GPS							1	1	< MDA	200	9	< MDA	5
6	Surveyor GPS Pole							0	0	< MDA	200	9	< MDA	5
7	Downhole Logger Detector							0	0	< MDA	200	9	< MDA	5
8	Downhole Logger Cart/Equip							0	0	< MDA	150	0	< MDA	5
9	2" PVC Pipes							2	2	< MDA	275	84	243	5
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sherman / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Release Survey on Drill Rig	DATE: 9/23/21	TIME: 15:00

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Right Track	0	0	< MDA	227	36	< MDA	1	1	< MDA	256	65	< MDA	5
2	Augers Composite	1	1	< MDA	182	0	< MDA	0	0	< MDA	200	9	< MDA	5
3	Left Track	0	0	< MDA	179	0	< MDA	0	0	< MDA	250	59	< MDA	6
4	Control Panels	0	0	< MDA	202	11	< MDA	0	0	< MDA	200	9	< MDA	5
5	Drill Arms	0	0	< MDA	193	2	< MDA	0	0	< MDA	175	0	< MDA	5
6	Drill Body	1	1	< MDA	201	10	< MDA	0	0	< MDA	200	9	< MDA	5
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE Megan Shryne /10-6-21 /

REVIEWER SIGNATURE/ DATE: [illegible] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-002.0	Page 1 of 2
PURPOSE OF SURVEY: Release Survey on Equipment	DATE: 9/23/21	TIME: 16:45

Instrument Type(s):		Detector Area (cm²)	Serial Number:		Cal. Due Date		Background: (CPM)		Efficiency: (%)	
			meter	detector	meter	detector	Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Hydrographic Boat							0	0	< MDA	150	0	< MDA	5
2	Hydrographic Control Panels							0	0	< MDA	175	0	< MDA	5
3	Hydrographic Laptop							0	0	< MDA	150	0	< MDA	5
4	Surveyor Laptop							0	0	< MDA	200	9	< MDA	4
5	Surveyor GPS							1	1	< MDA	200	9	< MDA	5
6	Surveyor GPS Pole							0	0	< MDA	225	34	< MDA	5
7	Handheld Air Monitor							0	0	< MDA	200	9	< MDA	5
8	Air Sampler							0	0	< MDA	175	0	< MDA	6
9	Generator							0	0	< MDA	250	59	< MDA	5
10	Folding Table							0	0	< MDA	200	9	< MDA	5

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: [signature] / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT (Supplement)

SURVEY LOCATION Staten Island

Administrative Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
11	Downhole Logger Detector							0	0	< MDA	200	9	< MDA	5
12	Downhole Logger Cart/Equip							0	0	< MDA	200	9	< MDA	5
13	PPE and Trash Bag**							0	0	< MDA	225	34	< MDA	6
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans. **All PPE scanned as workers left Restricted Area

TECHNICIAN(S) SIGNATURE/ DAT Megan Shumer / 10-6-21 /

REVIEWER SIGNATURE/ DATE [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY Limited Quantity	DATE: 9/23/21	TIME: 16:20

Instrument Type(s):	Detector Area (cm²)	Serial Number:		Cal. Due Date		Background: (CPM)		Efficiency: (%)	
		meter	detector	meter	detector	Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☑ Ludlum 2360 / 43-89 B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2360 / 43-89 NA	125	NA	NA	NA	NA	NA	NA	NA	NA
☐ Ludlum 2221 / 44-9 NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 240	Removable β 2400	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA	βγ MDA	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Cooler #2	0	0	< MDA	178	0	< MDA							4
2														
3														
4														
5														
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Shipping survey on sample cooler from drilling activities on 9-23-21

TECHNICIAN(S) SIGNATURE/ DATE Megan Sherman / 10-6-21 ____ / ____

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 ____ / ____

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island | HSWP: SI-21-002.0 | Page 1 of 1

PURPOSE OF SURVEY: Incoming Survey on Equipment | DATE: 9/24/21 | TIME: 8:00

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β- 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Post Hole Digger							0	0	< MDA	200	9	< MDA	5
2	Hand Auger and T-Bar							2	2	< MDA	225	34	< MDA	5
3	Trowel							0	0	< MDA	175	0	< MDA	5
4	Downhole Logger Detector							0	0	< MDA	200	9	< MDA	5
5	Downhole Logger Cart/Equip							0	0	< MDA	200	9	< MDA	5
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Shimmer / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Incoming Survey on Excavator	DATE: 9/24/21	TIME: 8:00

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Right Track	0	0	< MDA	164	0	< MDA	0	0	< MDA	200	9	< MDA	4
2	Back Stabalizer	1	1	< MDA	150	0	< MDA	0	0	< MDA	200	9	< MDA	4
3	Left Track	1	1	< MDA	154	0	< MDA	0	0	< MDA	150	0	< MDA	4
4	Cockpit	1	1	< MDA	172	0	< MDA	0	0	< MDA	200	9	< MDA	4
5	Interior Bucket	1	1	< MDA	267	76	275	0	0	< MDA	175	0	< MDA	4
6	Exterior Bucket	0	0	< MDA	156	0	< MDA	0	0	< MDA	200	9	< MDA	4
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE Megan Sherman /10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-002.0	Page 1 of 1
PURPOSE OF SURVEY: Release on Equipment	DATE: 9/24/21	TIME: 16:30

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Post Hole Digger							0	0	< MDA	200	9	< MDA	5
2	Hand Auger and T-Bar							2	2	< MDA	225	34	< MDA	5
3	Trowel							0	0	< MDA	175	0	< MDA	5
4	PPE and Trash Bag**							0	0	< MDA	200	9	< MDA	5
5	Air Sampler							0	0	< MDA	200	9	< MDA	5
6	Generator							0	0	< MDA	200	9	< MDA	5
7	Downhole Logger Detector							0	0	< MDA	225	34	< MDA	4
8	Downhole Logger Cart/Equip							1	1	< MDA	150	0	< MDA	5
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans. **All PPE scanned as workers left Restricted Area

TECHNICIAN(S) SIGNATURE/ DATE: Megan Shume / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island | HSWP: SI-21-004.0 | Page 1 of 1

PURPOSE OF SURVEY: Survey for Release on Excavator | DATE: 9/24/21 | TIME: 16:30

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA 23	βγ MDA 195	4

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Right Track	0	0	< MDA	189	0	< MDA	0	0	< MDA	215	24	< MDA	4
2	Back Stabalizer	0	0	< MDA	248	57	207	2	2	< MDA	302	111	322	4
3	Left Track	1	1	< MDA	176	0	< MDA	1	1	< MDA	156	0	< MDA	4
4	Cockpit	1	1	< MDA	167	0	< MDA	0	0	< MDA	200	9	< MDA	4
5	Interior Bucket	0	0	< MDA	159	0	< MDA	2	2	< MDA	187	0	< MDA	4
6	Exterior Bucket	0	0	< MDA	181	0	< MDA	0	0	< MDA	158	0	< MDA	4
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sharma / 10-6-21 | /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 | /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Limited Quantity	DATE: 9/24/21	TIME: 17:00

Instrument Type(s):	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 3030 B	N/A	346227	NA	6/8/22	NA	0.1	31	34.7%	39.0%
☐ Ludlum 2360 / 43-89 NA	125	NA	NA	NA	NA	NA	NA	NA	NA
☐ Ludlum 2221 / 44-9 NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 240	Removable βγ 2400	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 12	βγ MDA 57	α MDA	βγ MDA	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Cooler #1	0	0	< MDA	33	2	< MDA							8
2	Cooler #2	0	0	< MDA	22	0	< MDA							6
3	Cooler #3	0	0	< MDA	27	0	< MDA							15
4	Cooler #4	0	0	< MDA	30	0	< MDA							7
5	Cooler #5	0	0	< MDA	25	0	< MDA							8
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.
Shipping survey on sample cooler from test pit and sampling activities on 9-24-21

TECHNICIAN(S) SIGNATURE/ DATE Megan Sharma / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-002.0	Page 1 of 1
PURPOSE OF SURVEY: Incoming Survey on Equipment	DATE: 9/27/21	TIME: 8:00

Instrument Type(s):		Detector Area (cm²)	Serial Number:		Cal. Due Date		Background: (CPM)		Efficiency: (%)	
			meter	detector	meter	detector	Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable βγ 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Post Hole Digger							0	0	< MDA	200	9	< MDA	5
2	Trowel							2	2	< MDA	225	34	< MDA	5
3	Water Sampling Tubes							0	0	< MDA	200	9	< MDA	5
4														
5														
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Scanned with 43-89 -- Total α and Total βγ are based off of direct scans.

TECHNICIAN(S) SIGNATURE/ DATE: Megan Sharme /10-6-21 /

REVIEWER SIGNATURE/ DATE: [illegible] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-002.0	Page 1 of 1	
PURPOSE OF SURVEY: Incoming Survey on Equipment	DATE: 9/27/21	TIME: 14:00	

Instrument Type(s):		Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☐ Ludlum 2929 / 43-10-1	NA	N/A	NA	NA	NA	NA	NA	NA	NA	NA
☑ Ludlum 2360 / 43-89	B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2221 / 44-9	NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R	A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 600*	Removable β- 600*	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA	βγ MDA	α MDA 23	βγ MDA 195	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	pm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	pm/100cm β Removable	Gross CPM α Total	Net CPM α Total	pm/100cm α Total	Gross CPM β Total	Net CPM β Total	pm/100cm β Total	uR/hr
1	Post Hole Digger							0	0	< MDA	200	9	< MDA	5
2	Trowel							2	2	< MDA	225	34	< MDA	5
3	Water Sampling Tubes x3							0	0	< MDA	200	9	< MDA	5
4	2" PVC Pipes x7							2	2	< MDA	275	84	243	4
5	PPE and Trash Bag**							0	0	< MDA	200	9	< MDA	6
6														
7														
8														
9														
10														

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.
Scanned with 43-89 -- Total α and Total βγ are based off of direct scans. **All PPE scanned as workers left Restricted Area

TECHNICIAN(S) SIGNATURE/ DATE: Megan Shuma / 10-6-21 /

REVIEWER SIGNATURE/ DATE: [signature] / 10-6-21 /

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: Staten Island	HSWP: SI-21-004.0	Page 1 of 1
PURPOSE OF SURVEY: Limited Quantity	DATE: 9/27/21	TIME: 14:00

Instrument Type(s):	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☑ Ludlum 2360 / 43-89 B	125	345532	394879	6/3/22	6/3/22	0.2	191	14.8%	27.6%
☐ Ludlum 2360 / 43-89 NA	125	NA	NA	NA	NA	NA	NA	NA	NA
☐ Ludlum 2221 / 44-9 NA	15.5	NA	NA	NA	NA	NA	NA	NA	NA
☑ Micro - R A	N/A	347262	NA	5/30/22	NA	NA	NA	NA	NA

Contamination Limits: (dpm/100cm²)	Removable α 240	Removable βγ 2400	Total α 600*	Total βγ 600*	BKG
Instrument MDA: (dpm/100cm²)	α MDA 23	βγ MDA 195	α MDA	βγ MDA	5

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm β Total	uR/hr
1	Cooler #1	3	3	< MDA	196	5	< MDA							6
2	Cooler #2	1	1	< MDA	185	0	< MDA							7
3	Cooler #3	0	0	< MDA	179	0	< MDA							5
4	Cooler #4	1	1	< MDA	199	8	< MDA							6
5	Cooler #5	0	0	< MDA	183	0	< MDA							6
6	Cooler #6	0	0	< MDA	196	5	< MDA							7
7	Cooler #7	2	2	< MDA	197	6	< MDA							10
8	Cooler #8	5	5	33	205	14	< MDA							8
9	Cooler #9	8	8	53	155	0	< MDA							8
10	Cooler #10	1	1	< MDA	200	9	< MDA							6

REMARKS: **Notify RPM if any administrative limits are exceeded.** *Site Limits are 600dpm Total α + β combined.

Shipping survey on sample coolers from sampling activities on 9-27-21

TECHNICIAN(S) SIGNATURE/ DATE Megan Shyne / 10-6-21 /

REVIEWER SIGNATURE/ DATE [signature] / 10-6-21 /

APPENDIX J

AIR MONITORING DATA

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Non-Occupational Air Sample Report

Date: 9/20/2021 Sample ID: SI-092021-02 HSWP#: SI-21-001

Alpha AE value: 3.50E-12 µCi/ml (H) Beta AE value: NA µCi/ml (H)

General Area: ☐ Boundary: ☑

Site: Staten Island Radionuclides: Gross Alpha

Location: Downwind Sampled By: M. Sherman

Activity Performed: Brush Clearing

Wearer (if applicable): NA

Monitor Workers: NA

Pump Model: LV-1D S/N: 4577 Calibration Due Date 9/9/2022

Flow Meter: NA S/N: NA Calibration Due Date NA

Sample Information		Date & Time	Flow Rate (lpm)
	Start	9/20/21 11:26	40
	Stop	9/20/21 16:50	40
	Total minutes	324	Average Flow Rate: 40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 324 (minutes) = 1.30E+04 Liters (A)

Remarks:

Sent to lab after a screen for final count ☐ Sent to lab without a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	Units	1st Count	2nd Count	3rd Count	1st Count	2nd Count	3rd Count
Count Date		09/20/21					
Count Time		2100					
Sample Count Time	Minutes	10					
Total Count		12					
Sample Count Rate	CPM	1.56					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.30E+04	1.30E+04	1.30E+04	1.30E+04	1.30E+04	1.30E+04
Net count Rate (CPM) (B)	CPM	1.46					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	4.25					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	1.48E-13					
DAC/AE Fraction = (G)/(H)		0.0422					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/20/2021 Sample ID: SI-092021-01 HSWP#: SI-21-001

Alpha AE value: 3.50E-12 µCi/ml (H) Beta AE value: N/A µCi/ml (H)

General Area: ☐ Boundary: ☑

Site: Staten Island Radionuclides: Gross Alpha

Location: Upwind Sampled By: M. Sherman

Activity Performed: Brush Clearing

Wearer (if applicable): NA

Monitor Workers: NA

Pump Model: LV-1D S/N: 4576 Calibration Due Date 9/9/2022

Flow Meter: NA S/N: NA Calibration Due Date NA

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/20/21 11:15	Start	40
	Stop	9/20/21 16:40	Stop	40
	Total minutes	325	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 325 (minutes) = **1.30E+04** Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/20/21					
Count Time		2100					
Sample Count Time	Minutes	10					
Total Count		16					
Sample Count Rate	CPM	2.08					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.30E+04	1.30E+04	1.30E+04	1.30E+04	1.30E+04	1.30E+04
Net count Rate (CPM) (B)	CPM	1.98					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	5.76					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	2.00E-13					
DAC/AE Fraction = (G)/(H)		0.0571					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/21/2021	Sample ID: SI-092121-02		HSWP#: SI-21-002
Alpha AE value: 3.50E-12 µCi/ml (H)		Beta AE value: N/A µCi/ml (H)	
General Area: ☐	Boundary: ☑		
Site: Staten Island	Radionuclides: Gross Alpha		
Location: Downwind		Sampled By: M. Sherman	
Activity Performed: Gamma Walkover, Brush Clearing			
Wearer (if applicable): NA			
Monitor Workers: NA			
Pump Model: LV-1D	S/N: 4577	Calibration Due Date	9/9/2022
Flow Meter: NA	S/N: NA	Calibration Due Date	NA

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/21/21 7:58	Start	40
	Stop	9/21/21 15:18	Stop	40
	Total minutes	440	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 440 (minutes) = **1.76E+04** Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ | Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☐	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		**ALPHA**			**BETA**		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/22/21					
Count Time		2000					
Sample Count Time	Minutes	10					
Total Count		6					
Sample Count Rate	CPM	0.78					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.76E+04	1.76E+04	1.76E+04	1.76E+04	1.76E+04	1.76E+04
Net count Rate (CPM) (B)	CPM	0.68					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	1.98					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	5.07E-14					
DAC/AE Fraction = (G)/(H)		0.0145					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/21/2021		Sample ID: SI-092121-01			HSWP#: SI-21-002	
Alpha AE value: 3.50E-12 µCi/ml (H)				Beta AE value: NA µCi/ml (H)		
General Area: ☐	Boundary: ☑					
Site: Staten Island			Radionuclides: Gross Alpha			
Location: Upwind				Sampled By: M. Sherman		
Activity Performed: Gamma Walkover, Brush Clearing						
Wearer (if applicable): NA						
Monitor Workers: NA						
Pump Model: LV-1D		S/N: 4577		Calibration Due Date	9/9/2022	
Flow Meter: NA		S/N: NA		Calibration Due Date	NA	

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/21/21 7:54	Start	40
	Stop	9/21/21 15:30	Stop	40
	Total minutes	456	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 456 (minutes) = 1.82E+04 Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ | Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/22/21					
Count Time		2000					
Sample Count Time	Minutes	10					
Total Count		2					
Sample Count Rate	CPM	0.26					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.82E+04	1.82E+04	1.82E+04	1.82E+04	1.82E+04	1.82E+04
Net count Rate (CPM) (B)	CPM	0.16					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	0.47					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	1.15E-14					
DAC/AE Fraction = (G)/(H)		0.0033					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date:	9/22/2021	Sample ID:	SI-092221-02		HSWP#:	SI-21-004
Alpha AE value:	3.50E-12 µCi/ml (H)			Beta AE value:	NA	µCi/ml (H)
General Area: ☐	Boundary: ☑					
Site:	Staten Island	Radionuclides:	Gross Alpha			
Location:	Downwind	Sampled By:	M. Sherman			
Activity Performed:	Gamma Walkover, Drill Rig					
Wearer (if applicable):	NA					
Monitor Workers:	NA					
Pump Model:	LV-1D	S/N:	4576	Calibration Due Date	9/9/2022	
Flow Meter:	NA	S/N:	NA	Calibration Due Date	NA	

Sample Information		Date & Time			Flow Rate (lpm)
	Start	9/22/21 10:38		Start	40
	Stop	9/22/21 16:45		Stop	40
	Total minutes	367		Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 367 (minutes) = 1.47E+04 Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ | Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/22/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		12					
Sample Count Rate	CPM	1.56					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.47E+04	1.47E+04	1.47E+04	1.47E+04	1.47E+04	1.47E+04
Net count Rate (CPM) (B)	CPM	1.46					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	4.25					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	1.30E-13					
DAC/AE Fraction = (G)/(H)		0.0373					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman   Date: 10-7-21

Reviewed By: [signature]   Date: 10-7-21

Non-Occupational Air Sample Report

Date:	9/22/2021	Sample ID:	SI-092221-01	HSWP#:	SI-21-004
Alpha AE value:	3.50E-12 µCi/ml (H)		Beta AE value:	NA	µCi/ml (H)
General Area:	[ ]	Boundary:	[x]		
Site:	Staten Island		Radionuclides:	Gross Alpha	
Location:	Upwind		Sampled By:	M. Sherman	
Activity Performed:	Gamma Walkover, Drill Rig				
Wearer (if applicable):	NA				
Monitor Workers:	NA				
Pump Model:	LV-1D	S/N:	4577	Calibration Due Date	9/9/2022
Flow Meter:	NA	S/N:	NA	Calibration Due Date	NA

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/22/21 9:01	Start	40
	Stop	9/22/21 17:00	Stop	40
	Total minutes	479	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 479 (minutes) = 1.92E+04 Liters (A)

Remarks:

Sent to lab **after** a screen for final count [ ] Sent to lab **without** a screen for final count [ ]

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	[x]	[ ]	[ ]
					[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]

Screening Count Information		**ALPHA**			**BETA**		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/22/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		9					
Sample Count Rate	CPM	1.17					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.92E+04	1.92E+04	1.92E+04	1.92E+04	1.92E+04	1.92E+04
Net count Rate (CPM) (B)	CPM	1.07					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	3.11					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	7.32E-14					
DAC/AE Fraction = (G)/(H)		0.0209					
Final Count?		[x]	[ ]	[ ]	[ ]	[ ]	[ ]

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified [ ]

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/23/2021			Sample ID: SI-092321-02				HSWP#: SI-21-004		
Alpha AE value: 3.50E-12 µCi/ml (H)					Beta AE value: NA µCi/ml (H)				
General Area: ☐	Boundary: ☑								
Site: Staten Island				Radionuclides: Gross Alpha					
Location: Downwind					Sampled By: M. Sherman				
Activity Performed: Gamma Walkover, Drill Rig									
Wearer (if applicable): NA									
Monitor Workers: NA									
Pump Model: LV-1D			S/N: 4576			Calibration Due Date 9/9/2022			
Flow Meter: NA			S/N: NA			Calibration Due Date NA			
Sample Information		Date & Time					Flow Rate (lpm)		
	Start	9/23/21 8:16				Start	40		
	Stop	9/23/21 15:00				Stop	40		
	Total minutes	404				Average Flow Rate:	40		
Min. Non-Occupational Air Sample Volume= 2.8 E3 L									
Sample Volume =	40 (lpm)	x	404	(minutes) =	1.62E+04 Liters (A)				
Remarks:									
Sent to lab **after** a screen for final count ☐				Sent to lab **without** a screen for final count ☐					

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/23/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		5					
Sample Count Rate	CPM	0.65					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.62E+04	1.62E+04	1.62E+04	1.62E+04	1.62E+04	1.62E+04
Net count Rate (CPM) (B)	CPM	0.55					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	1.60					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	4.46E-14					
DAC/AE Fraction = (G)/(H)		0.0128					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/23/2021	Sample ID: SI-092321-01	HSWP#: SI-21-004
Alpha AE value: 3.50E-12 µCi/ml (H)	Beta AE value: NA µCi/ml (H)	
General Area: ☐	Boundary: ☑	
Site: Staten Island	Radionuclides: Gross Alpha	
Location: Upwind	Sampled By: M. Sherman	
Activity Performed: Gamma Walkover, Drill Rig		
Wearer (if applicable): NA		
Monitor Workers: NA		
Pump Model: LV-1D	S/N: 4577	Calibration Due Date 9/9/2022
Flow Meter: NA	S/N: NA	Calibration Due Date NA

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/23/21 7:56	Start	40
	Stop	9/23/21 15:13	Stop	40
	Total minutes	437	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 437 (minutes) = 1.75E+04 Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		**ALPHA**			**BETA**		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/23/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		6					
Sample Count Rate	CPM	0.78					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.75E+04	1.75E+04	1.75E+04		1.75E+04	1.75E+04
Net count Rate (CPM) (B)	CPM	0.68					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	1.98					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	5.10E-14					
DAC/AE Fraction = (G)/(H)		0.0146					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/24/2021		Sample ID: SI-092421-02				HSWP#: SI-21-004	
Alpha AE value: 3.50E-12 µCi/ml (H)				Beta AE value: NA µCi/ml (H)			
General Area: ☐	Boundary: ☑						
Site: Staten Island				Radionuclides: Gross Alpha			
Location: Downwind				Sampled By: M. Sherman			
Activity Performed: Gamma Walkover, Drill Rig							
Wearer (if applicable): NA							
Monitor Workers: NA							
Pump Model: LV-1D		S/N: 4576		Calibration Due Date		9/9/2022	
Flow Meter: NA		S/N: NA		Calibration Due Date		NA	

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/24/21 8:08	Start	40
	Stop	9/24/21 16:03	Stop	40
	Total minutes	475	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 475 (minutes) = **1.90E+04** Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/27/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		2					
Sample Count Rate	CPM	0.26					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.90E+04	1.90E+04	1.90E+04	1.90E+04	1.90E+04	1.90E+04
Net count Rate (CPM) (B)	CPM	0.16					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	0.47					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	1.10E-14					
DAC/AE Fraction = (G)/(H)		0.0032					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/24/2021		Sample ID: SI-092421-01			HSWP#: SI-21-004	
Alpha AE value: 3.50E-12 µCi/ml (H)				Beta AE value: NA µCi/ml (H)		
General Area: ☐	Boundary: ☑					
Site: Staten Island			Radionuclides: Gross Alpha			
Location: Upwind				Sampled By: M. Sherman		
Activity Performed: Gamma Walkover, Drill Rig						
Wearer (if applicable): NA						
Monitor Workers: NA						
Pump Model: LV-1D		S/N: 4577		Calibration Due Date	9/9/2022	
Flow Meter: NA		S/N: NA		Calibration Due Date	NA	
Sample Information		Date & Time			Flow Rate (lpm)	
	Start	9/24/21 8:18		Start	40	
	Stop	9/24/21 16:02		Stop	40	
	Total minutes	464		Average Flow Rate:	40	
Min. Non-Occupational Air Sample Volume= 2.8 E3 L						
Sample Volume =	40 (lpm)	x 464	(minutes) =	1.86E+04 Liters (A)		
Remarks:						

Sent to lab **after** a screen for final count ☐			Sent to lab **without** a screen for final count ☐			
Instrument Information	Serial Number		Cal. Due Date		1st Count	2^{nd} Count	3^{rd} Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		ALPHA			BETA		
Variables	**Units**	**1^{st} Count**	**2^{nd} Count**	**3^{rd} Count**	**1st Count**	**2^{nd}Count**	**3^{rd} Count**
Count Date		09/27/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		0					
Sample Count Rate	CPM	0.00					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	1.86E+04	1.86E+04	1.86E+04	1.86E+04	1.86E+04	1.86E+04
Net count Rate (CPM) (B)	CPM	-0.10					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	-0.29					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	-7.06E-15					
DAC/AE Fraction = (G)/(H)		-0.0020					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/27/2021 Sample ID: SI-092721-02 HSWP#: SI-21-004

Alpha AE value: 3.50E-12 μCi/ml (H) Beta AE value: NA μCi/ml (H)

General Area: ☐ Boundary: ☑

Site: Staten Island Radionuclides: Gross Alpha

Location: Downwind Sampled By: M. Sherman

Activity Performed: Sediment, Surface Soil sampling

Wearer (if applicable): NA

Monitor Workers: NA

Pump Model: LV-1D S/N: 4577 Calibration Due Date 9/9/2022

Flow Meter: NA S/N: NA Calibration Due Date NA

Sample Information

	Date & Time		Flow Rate (lpm)
Start	9/27/21 7:54	Start	40
Stop	9/27/21 11:15	Stop	40
Total minutes	201	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 201 (minutes) = 8.04E+03 Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		**ALPHA**			**BETA**		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/27/21					
Count Time		2130					
Sample Count Time	Minutes	10					
Total Count		30					
Sample Count Rate	CPM	3.90					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	8.04E+03	8.04E+03	8.04E+03	8.04E+03	8.04E+03	8.04E+03
Net count Rate (CPM) (B)	CPM	3.80					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	11.06					
Conc.=(F) / (2.22E9*(A)) (G)	μCi/ml	6.20E-13					
DAC/AE Fraction = (G)/(H)		0.1771					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

Non-Occupational Air Sample Report

Date: 9/27/2021		Sample ID: SI-092721-01			HSWP#: SI-21-004	
Alpha AE value: 3.50E-12 µCi/ml (H)			Beta AE value: NA µCi/ml (H)			
General Area: ☐	Boundary: ☑					
Site: Staten Island			Radionuclides: Gross Alpha			
Location: Upwind			Sampled By: M. Sherman			
Activity Performed: Sediment, Surface soil sampling						
Wearer (if applicable): NA						
Monitor Workers: NA						
Pump Model: LV-1D		S/N: 4576		Calibration Due Date	9/9/2022	
Flow Meter: NA		S/N: NA		Calibration Due Date	NA	

Sample Information		Date & Time		Flow Rate (lpm)
	Start	9/27/21 7:58	Start	40
	Stop	9/27/21 11:16	Stop	40
	Total minutes	198	Average Flow Rate:	40

Min. Non-Occupational Air Sample Volume= 2.8 E3 L

Sample Volume = 40 (lpm) x 198 (minutes) = **7.92E+03** Liters (A)

Remarks:

Sent to lab **after** a screen for final count ☐ Sent to lab **without** a screen for final count ☐

Instrument Information	Serial Number		Cal. Due Date		1st Count	2nd Count	3rd Count
Instrument Type	meter	detector	meter	detector			
Ludlum 3030	346227	NA	6/8/2022	NA	☑	☐	☐
					☐	☐	☐
					☐	☐	☐

Screening Count Information		**ALPHA**			**BETA**		
Variables	**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date		09/27/21					
Count Time		2115					
Sample Count Time	Minutes	10					
Total Count		23					
Sample Count Rate	CPM	2.99					
Background Count Rate	CPM	0.10					
Volume of Air (Liters) (A)	Liters	7.92E+03	7.92E+03	7.92E+03	7.92E+03	7.92E+03	7.92E+03
Net count Rate (CPM) (B)	CPM	2.89					
Counter Efficiency (C)		0.347					
Collection Efficiency (D)	0.99	0.99					
Efficiency = (C)*(D) (E)		0.344					
Activity (DPM)= (B) / (E) (F)	DPM	8.41					
Conc.=(F) / (2.22E9*(A)) (G)	µCi/ml	4.78E-13					
DAC/AE Fraction = (G)/(H)		0.1367					
Final Count?		☑	☐	☐	☐	☐	☐

Note: DAC/AE Fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

Calculated By: Megan Sherman Date: 10-7-21

Reviewed By: [signature] Date: 10-7-21

APPENDIX K

PREVIOUS SAMPLING INSPECTION RESULTS

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Table 1. Previous sampling results (1992 and 2008).

		Parameter CAS# Units	Co-60 10198-40-0 pCi/g	Cs-137 10045-97-3 pCi/g	K-40 13966-00-2 pCi/g	Pb-212 15092-94-1 pCi/g	Pb-214 15067-28-4 pCi/g	Ra-226 13982-63-3 pCi/g
Sample ID	**Sample Depth (inches bgs)**	**Sample Date**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Oak Ridge National Laboratory Samples								
ST1	13-16	7/10/1980	NA	NA	NA	NA	NA	590 ± 1.2
NYSDEC Samples								
NR-2-92-003-072201	0-3	7/14/1992	< 0.1	< 0.2	6.2 ± 1.2	0.29 ± 0.16	0.81 ± 0.27	0.53 ± 0.21
NR-2-92-003-072202	3-6	7/14/1992	< 0.11	< 0.24	9.9 ± 2.6	0.7 ± 0.19	0.87 ± 0.23	0.9 ± 0.36
NR-2-92-003-072203	6-10.5	7/14/1992	< 0.1	< 0.18	9 ± 2.1	1.05 ± 0.15	0.98 ± 0.19	0.87 ± 0.24
NR-2-92-003-072204	10.5-14	7/14/1992	< 0.22	< 0.34	6.8 ± 3.7	1.05 ± 0.31	1.48 ± 0.38	1.06 ± 0.47
NR-2-92-003-072205	14-18-E	7/14/1992	< 0.18	< 0.26	9.9 ± 3.3	2.58 ± 0.27	2.51 ± 0.33	1.95 ± 0.4
NR-2-92-003-072206	0-2	7/14/1992	< 0.49	< 0.56	9.7 ± 6.3	1.7 ± 0.58	114.6 ± 2.2	95.3 ± 2.2
NR-2-92-003-072207	2-4	7/14/1992	< 0.34	< 0.54	7.5 ± 6.2	2.6 ± 0.51	18.7 ± 1	16 ± 1.2
NR-2-92-003-072208	4-6	7/14/1992	< 0.87	< 1.8	< 26	2 ± 1.1	18.7 ± 1.9	16.3 ± 2.5
NR-2-92-003-072209	6-10	7/14/1992	< 0.22	< 0.39	7.9 ± 4.6	1.32 ± 0.29	2.03 ± 0.47	2.07 ± 0.52
NR-2-92-003-072210	10-14	7/14/1992	< 0.12	< 0.22	10.7 ± 2.7	1.17 ± 0.19	1.2 ± 0.21	0.99 ± 0.24
NR-2-92-003-072211	14-16.5	7/14/1992	< 0.14	< 0.25	9.5 ± 3.1	1.61 ± 0.23	1.24 ± 0.38	1.53 ± 0.35
NR-2-92-003-072212	0-3	7/14/1992	< 0.28	< 0.65	5.6 ± 5.2	1.89 ± 0.47	53.6 ± 1.2	44.4 ± 1.2
NR-2-92-003-072213	2-4	7/14/1992	< 1.1	< 0.94	< 14	6.9 ± 1.5	453.1 ± 4.8	383.1 ± 4.8
NR-2-92-003-072214	4-6	7/14/1992	< 0.43	< 0.43	10.2 ± 7.7	1.88 ± 0.59	62.8 ± 1.8	51.7 ± 1.7
NR-2-92-003-072215	6-11	7/14/1992	< 0.11	< 0.12	14.5 ± 2	1.27 ± 0.15	1.38 ± 0.19	1.06 ± 0.21
NR-2-92-003-072216	11-14	7/14/1992	< 0.11	< 0.13	10.1 ± 2.2	1.48 ± 0.17	1.4 ± 0.25	1.01 ± 0.31
NR-2-92-003-072217	14-17	7/14/1992	< 0.16	< 0.18	8.4 ± 3.1	1.21 ± 0.29	1.48 ± 0.29	1.15 ± 0.31
NR-2-92-003-072218	0-2	7/14/1992	< 0.83	< 0.68	17 ± 11	< 1.7	534.4 ± 3.8	455.9 ± 3.9
NR-2-92-003-072219	2-4	7/14/1992	< 37	< 29	< 406	< 70	48350 ± 167	38840 ± 160
NR-2-92-003-072220	4-6	7/14/1992	< 18	< 19	< 349	< 22	2629 ± 76	2212 ± 77
NR-2-92-003-072221	6-8	7/14/1992	< 22	< 22	< 349	< 27	5308 ± 102	4109 ± 101
NR-2-92-003-072222	8-12	7/14/1992	< 0.19	< 0.2	8.2 ± 3.6	1.59 ± 0.27	31.6 ± 0.74	26.69 ± 0.79
NR-2-92-003-072223	12-17.5	7/14/1992	< 0.13	< 0.15	10.4 ± 2.2	2.41 ± 0.2	3.34 ± 0.31	2.89 ± 0.39
NR-2-92-003-072224	0-6	7/14/1992	< 0.62	< 0.53	15.3 ± 9.3	2.98 ± 0.76	280.8 ± 2.9	237.8 ± 3
NR-2-92-003-072225	6-12	7/14/1992	< 0.14	< 0.14	7.9 ± 2.6	1.84 ± 0.19	5.2 ± 0.35	4.36 ± 0.4
NR-2-92-003-072226	12-16.5	7/14/1992	< 0.13	< 0.14	8.4 ± 2.5	2.14 ± 0.19	3.05 ± 0.28	2.41 ± 0.39
NR-2-92-003-072227	0-4	7/14/1992	< 0.26	< 0.22	14.6 ± 4.1	1.6 ± 0.4	291.1 ± 1.5	254.9 ± 1.5
NR-9-92-003-072101	2	7/14/1992	< 0.054	0.2 ± 0.078	22.1 ± 1.3	1.237 ± 0.09	1.06 ± 0.11	1.02 ± 0.12
NR-9-92-003-071401	2	7/14/1992	< 0.043	0.33 ± 0.077	9.8 ± 1.1	1.178 ± 0.088	1.06 ± 0.13	0.93 ± 0.11
USEPA, NYSDEC, and NYDOH Samples								
885056	0-6	2/20/2008	NA	NA	NA	NA	NA	15.46 ± 0.5
885057	0-6	2/20/2008	NA	NA	NA	NA	NA	3.84 ± 0.2
885058	0-6	2/20/2008	NA	NA	NA	NA	NA	17.26 ± 0.6
885059	0-6	2/20/2008	NA	NA	NA	NA	NA	90.27 ± 2.8
885060	0-6	2/20/2008	NA	NA	NA	NA	NA	1102 ± 33
885061	0-6	2/20/2008	NA	NA	NA	NA	NA	6.088 ± 0.3
885062	0-6	2/20/2008	NA	NA	NA	NA	NA	1.333 ± 0.1

bgs: below ground surface; Co: cobalt; Cs: cesium; ID: identification, K: potassium; NA: not applicable, NYSDEC: New York State Department of Environmental Conservation; NYDOH: New York Department of Health; pCi/g: picocuries per gram; Pb: lead; Ra: radium; USEPA: U.S. Environmental Protection Agency

2021 Note:Text was highlighted as part of 2013 Site Inspection Report (USACE 2017)

Table 1. Previous sampling results (continued).

		Parameter CAS# Units	Th-228 14274-82-9 pCi/g	Th-232 7440-29-1 pCi/g	Tl-208 14913-50-9 pCi/g	U-238 7440-61-1 pCi/g	U-235 15117-96-1 pCi/g	Sn-113 13966-06-8 pCi/g
Sample ID	**Sample Depth (inches bgs)**	**Sample Date**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Oak Ridge National Laboratory Samples								
ST1	13-16	7/10/1980	NA	NA	NA	660 ± 19.8	NA	NA
NYSDEC Samples								
NR-2-92-003-072201	0-3	7/14/1992	< 0.56	< 0.4	< 0.52	< 1.7	NA	NA
NR-2-92-003-072202	3-6	7/14/1992	0.74 ± 0.49	0.65 ± 0.57	0.68 ± 0.46	< 1.9	NA	NA
NR-2-92-003-072203	6-10.5	7/14/1992	1.2 ± 0.41	0.73 ± 0.5	1.11 ± 0.38	< 1.6	NA	NA
NR-2-92-003-072204	10.5-14	7/14/1992	1.58 ± 0.67	1.23 ± 0.99	1.46 ± 0.62	< 2.8	NA	NA
NR-2-92-003-072205	14-18-E	7/14/1992	2.6 ± 0.56	2.13 ± 0.85	2.41 ± 0.52	3 ± 2.6	NA	NA
NR-2-92-003-072206	0-2	7/14/1992	2 ± 1.3	1.8 ± 1.7	1.8 ± 1.2	121 ± 13	9.65 ± 0.72	NA
NR-2-92-003-072207	2-4	7/14/1992	1.9 ± 1.3	3.8 ± 2.1	1.7 ± 1.2	31.6 ± 7.8	1.96 ± 0.41	NA
NR-2-92-003-072208	4-6	7/14/1992	< 4.5	< 4	< 4.2	32 ± 16	2.3 ± 1	NA
NR-2-92-003-072209	6-10	7/14/1992	1.08 ± 0.75	< 0.98	1 ± 0.7	17.7 ± 3.5	NA	NA
NR-2-92-003-072210	10-14	7/14/1992	1.72 ± 0.48	1.33 ± 0.56	1.6 ± 0.44	4.4 ± 2.4	NA	NA
NR-2-92-003-072211	14-16.5	7/14/1992	1.56 ± 0.69	1.72 ± 0.8	1.45 ± 0.64	4.7 ± 2.7	NA	NA
NR-2-92-003-072212	0-3	7/14/1992	< 1.4	3.1 ± 1.2	< 1.3	28.5 ± 5.6	3.09 ± 0.37	NA
NR-2-92-003-072213	2-4	7/14/1992	4.7 ± 2.7	< 4.1	4.3 ± 2.5	191.4 ± 2.8	19.3 ± 1.6	NA
NR-2-92-003-072214	4-6	7/14/1992	1.5 ± 1.1	< 39	1.4 ± 1	34.5 ± 7.9	3.54 ± 0.59	NA
NR-2-92-003-072215	6-11	7/14/1992	1.52 ± 0.39	1.32 ± 0.51	1.41 ± 0.36	15.6 ± 2.5	NA	NA
NR-2-92-003-072216	11-14	7/14/1992	1.42 ± 0.41	1.46 ± 0.52	1.31 ± 0.38	7.1 ± 2.2	NA	NA
NR-2-92-003-072217	14-17	7/14/1992	1.63 ± 0.51	1.49 ± 0.73	1.51 ± 0.47	8.6 ± 3.1	NA	NA
NR-2-92-003-072218	0-2	7/14/1992	< 1.9	< 3.1	< 1.7	412 ± 23	25.5 ± 1.2	5 ± 1.3
NR-2-92-003-072219	2-4	7/14/1992	< 76	< 131	< 70	49190 ± 973	2983 ± 53	NA
NR-2-92-003-072220	4-6	7/14/1992	< 45	< 76	< 42	9984 ± 563	616 ± 32	NA
NR-2-92-003-072221	6-8	7/14/1992	< 56	< 86	< 52	27860 ± 1021	1342 ± 45	NA
NR-2-92-003-072222	8-12	7/14/1992	1.05 ± 0.56	1.67 ± 0.78	0.97 ± 0.52	83.4 ± 5.8	5.05 ± 0.31	NA
NR-2-92-003-072223	12-17.5	7/14/1992	2.43 ± 0.43	2.41 ± 0.78	2.25 ± 0.4	21.2 ± 3.2	1.17 ± 0.15	NA
NR-2-92-003-072224	0-6	7/14/1992	< 1.5	< 2.4	< 1.4	345 ± 17	22.64 ± 0.97	NA
NR-2-92-003-072225	6-12	7/14/1992	1.76 ± 0.47	2.22 ± 0.66	1.63 ± 0.44	20.9 ± 2.8	1.49 ± 0.17	NA
NR-2-92-003-072226	12-16.5	7/14/1992	2.16 ± 0.57	2.3 ± 0.57	2 ± 0.52	7.7 ± 2.7	NA	NA
NR-2-92-003-072227	0-4	7/14/1992	1.88 ± 0.72	2.4 ± 1	1.74 ± 0.67	182 ± 11	12.66 ± 0.53	NA
NR-9-92-003-072101	2	7/14/1992	1.16 ± 0.19	1.51 ± 0.33	1.07 ± 0.18	< 1.2	NA	NA
NR-9-92-003-071401	2	7/14/1992	1.1 ± 0.21	1.12 ± 0.25	1.02 ± 0.2	< 1.1	NA	NA
USEPA, NYSDEC, and NYDOH Samples								
885056	0-6	2/20/2008	NA	0.77 ± 0.1	NA	14.04 ± 2.9	1.37 ± 0.34	NA
885057	0-6	2/20/2008	NA	0.39 ± 0.1	NA	2.63 ± 1.48	0.33 ± 0.16	NA
885058	0-6	2/20/2008	NA	0.65 ± 0.1	NA	8.37 ± 2.83	0.92 ± 0.35	NA
885059	0-6	2/20/2008	NA	0.83 ± 0.2	NA	116.4 ± 8.91	9.45 ± 0.89	NA
885060	0-6	2/20/2008	NA	< 0.7	NA	1187 ± 45.1	89.17 ± 3.92	NA
885061	0-6	2/20/2008	NA	1 ± 0.1	NA	3.4 ± 1.97	0.6 ± 0.21	NA
885062	0-6	2/20/2008	NA	0.73 ± 0.1	NA	< 1.03	< 0.12	NA

bgs: below ground surface; ID: identification, NYSDEC: New York State Department of Environmental Conservation; NYDOH: New York Department of Health; pCi/g: picocuries per gram; Sn: tin; Th: thallium; Tl: thallium; U: uranium; USEPA: U.S. Environmental Protection Agency

Table 2. Results of radiation subsurface soil samples (alpha and gamma spectroscopy) for the Staten Island Warehouse Site (2011).

		Analyte		**K-40**				**Ra-226**				**Th-232**				**U-234**				**U-235**				**U- 238**			
		CAS#		**13966-00-2**				**13982-63-3**				**7440-29-1**				**13966-29-5**				**15117-96-1**				**7440-61-1**			
		Units		**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Screening Level		**None**				**1.96**				**3.07**				**4.02**				**3.95**				**1.96**			
		Source of Screening Level		**None**				**USEPA 2008 Background**				**Residential PRG**				**Residential PRG**				**Residential PRG**				**USEPA 2008 Background**			
Sample ID		**Sample Date**		**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**
SIW-SB-001P-0.0-5.0	SIW-SB-001P-0.0-5.0	40736	Above 5 feet	6.8		2	1.9	1.76		0.31	0.14	1.71		0.38	0.21	1.73		0.23	0.02	0.079		0.043	0.015	1.6		0.22	0.01
SIW-SB-002P-0.0-5.0	SIW-SB-002P-0.0-5.0	40736	Above 5 feet	7.4		1.4	1	0.86		0.21	0.18	0.91		0.23	0.14	0.66		0.12	0.02	0.033		0.025	0.013	0.66		0.11	0.01
SIW-SB-003P-0.0-5.0	SIW-SB-003P-0.0-5.0	40736	Above 5 feet	14.9		2.1	1	1.07		0.22	0.17	1.3		0.28	0.18	0.65		0.12	0.03	0.027	U	0.027	0.035	0.66		0.12	0.04
SIW-SB-004P-0.0-5.0	SIW-SB-004P-0.0-5.0	40736	Above 5 feet	10.4		1.6	0.5	1.22		0.21	0.16	0.65		0.22	0.25	0.71		0.12	0.03	0.026		0.023	0.014	0.64		0.12	0.02
SIW-SB-DUP-001*	SIW-SB-004P-0.0-5.0	40736	Above 5 feet	7.7		1.7	0.9	1.06		0.25	0.18	0.54		0.29	0.4	0.78		0.13	0.01	0.046		0.03	0.022	0.79		0.13	0.01
SIW-SB-005P-0.0-5.0	SIW-SB-005P-0.0-5.0	40737	Above 5 feet	12.5		1.8	0.9	1.8		0.27	0.16	1.58		0.3	0.24	2.73		0.32	0.02	0.166		0.064	0.016	2.67		0.32	0.01
SIW-SB-006P-0.0-5.0	SIW-SB-006P-0.0-5.0	40737	Above 5 feet	10.8		1.7	0.5	0.72		0.16	0.13	0.54		0.19	0.27	0.67		0.12	0.02	0.028		0.024	0.022	0.65		0.12	0.01
SIW-SB-007P-0.0-5.0	SIW-SB-007P-0.0-5.0	40737	Above 5 feet	10.3		1.7	0.9	0.96		0.17	0.11	0.65		0.23	0.35	0.82		0.13	0.02	0.063		0.036	0.022	0.87		0.14	0.02
SIW-SB-008P-0.0-5.0	SIW-SB-008P-0.0-5.0	40738	Above 5 feet	12		2.1	1.1	1.57		0.29	0.2	1.47		0.32	0.3	1.24		0.19	0.02	0.053		0.035	0.016	0.92		0.15	0.01
SIW-SB-009P-0.0-5.0	SIW-SB-009P-0.0-5.0	40738	Above 5 feet	15.3		3.6	2.8	47.6		3.1	0.5	2.82		0.72	1.1	40.7		4.3	0.3	4.5		1.6	1.9	40.9		4.3	0.2
SIW-SB-010P-0.0-5.0	SIW-SB-010P-0.0-5.0	40739	Above 5 feet	11.5		2.7	2	1.77		0.42	0.32	1.03		0.41	0.45	1.53		0.2	0.02	0.083		0.042	0.014	1.28		0.18	0.01
SIW-SB-DUP-005*	SIW-SB-010P-0.0-5.0	40739	Above 5 feet	11.5		2.6	1.8	1.72		0.35	0.22	1.27		0.39	0.23	1.75		0.22	0.03	0.076		0.04	0.014	1.84		0.23	0.02
SIW-SB-011P-0.0-5.0	SIW-SB-011P-0.0-5.0	40737	Above 5 feet	15.8		2.9	1.2	1.79		0.34	0.19	1.72		0.4	0.47	0.9		0.14	0.01	0.019	U	0.021	0.023	1		0.15	0.02
SIW-SB-012P-0.0-5.0	SIW-SB-012P-0.0-5.0	40737	Above 5 feet	15		2.2	1.1	1.22		0.24	0.19	1.44		0.34	0.26	0.75		0.13	0.03	0.064		0.037	0.014	0.86		0.14	0.01
SIW-SB-013P-0.0-5.0	SIW-SB-013P-0.0-5.0	40738	Above 5 feet	4.5	U	3	4.8	95.8		5.9	0.7	1.2	U	0.88	1.6	37.3		3.4	0.05	4.6		2.3	2.8	36.6		3.3	0.03
SIW-SB-014P-0.0-5.0	SIW-SB-014P-0.0-5.0	40737	Above 5 feet	1.57		0.28	0.11	0.102		0.024	0.017	0.068		0.028	0.06	0.74		0.13	0.02	0.067		0.037	0.014	0.73		0.13	0.03
SIW-SB-015P-0.0-5.0	SIW-SB-015P-0.0-5.0	40738	Above 5 feet	15		3.5	2.7	54.4		3.5	0.6	1.55		0.63	1.1	65.4		6.4	0.2	4.2		1.3	1.9	63		6.2	0.3
SIW-SB-016P-0.0-5.0	SIW-SB-016P-0.0-5.0	40738	Above 5 feet	13.9		2.2	1.2	8.29		0.73	0.26	2.11		0.46	0.31	9.68		0.93	0.02	0.48		0.12	0.04	9.63		0.92	0.03
SIW-SB-017P-0.0-5.0	SIW-SB-017P-0.0-5.0	40738	Above 5 feet	13.7		2.1	1.2	3.84		0.44	0.22	1.29		0.28	0.23	1.83		0.23	0.03	0.078		0.04	0.013	1.9		0.24	0.01
SIW-SB-018P-0.0-5.0	SIW-SB-018P-0.0-5.0	40738	Above 5 feet	16.2		2.6	1.6	26.1		1.8	0.5	2.6		0.66	0.57	34.5		3.1	0.05	2.9		1.4	1.6	34.2		3.1	0.06
SIW-SB-DUP-003*	SIW-SB-018P-0.0-5.0	40738	Above 5 feet	15.5		2.2	1.2	20.5		1.5	0.4	2.91		0.64	0.54	24.6		2.2	0.06	1.32		0.76	1.3	24		2.2	0.07
SIW-SB-019P-0.0-5.0	SIW-SB-019P-0.0-5.0	40737	Above 5 feet	6.7		1.6	1.3	0.46		0.15	0.14	0.13	U	0.14	0.34	0.447		0.09	0.028	0.013	U	0.016	0.021	0.473		0.094	0.032
SIW-SB-020P-0.0-5.0	SIW-SB-020P-0.0-5.0	40738	Above 5 feet	14.1		2	1	1.41		0.24	0.17	1.52		0.29	0.11	1.98		0.26	0.03	0.101		0.05	0.027	2.01		0.26	0.02
SIW-SB-021P-0.0-5.0	SIW-SB-021P-0.0-5.0	40739	Above 5 feet	14.9		2.2	1.1	1.5		0.28	0.2	1.47		0.27	0.19	1.15		0.17	0.02	0.069		0.039	0.014	1.15		0.17	0.01
SIW-SB-022P-0.0-5.0	SIW-SB-022P-0.0-5.0	40738	Above 5 feet	16.4		2.4	0.7	1.15		0.25	0.21	1.63		0.34	0.14	0.78		0.16	0.03	0.034	U	0.036	0.041	0.92		0.18	0.02
SIW-SB-023P-0.0-5.0	SIW-SB-023P-0.0-5.0	40739	Above 5 feet	12.1		2.2	1.3	2.48		0.36	0.23	2.67		0.41	0.29	2.54		0.3	0.02	0.134		0.056	0.015	2.62		0.31	0.02
SIW-SB-024P-0.0-5.0	SIW-SB-024P-0.0-5.0	40739	Above 5 feet	11.4		2	1.3	1.63		0.28	0.2	1.9		0.32	0.13	1.61		0.21	0.01	0.069		0.036	0.012	1.69		0.21	0.01
SIW-SB-DUP-004*	SIW-SB-024P-0.0-5.0	40739	Above 5 feet	12.2		2	1	1.63		0.28	0.2	1.68		0.37	0.26	1.85		0.24	0.02	0.062		0.037	0.024	1.89		0.24	0.02
SIW-SB-025P-0.0-5.0	SIW-SB-025P-0.0-5.0	40739	Above 5 feet	10.6		2	1.5	1.09		0.23	0.18	1.51		0.32	0.14	1.08		0.16	0.01	0.038		0.027	0.013	1.03		0.15	0.01
SIW-SB-026P-0.0-5.0	SIW-SB-026P-0.0-5.0	40739	Above 5 feet	14.5		2.3	1.2	1.87		0.37	0.29	2.36		0.5	0.44	1.9		0.24	0.02	0.077		0.042	0.015	1.77		0.23	0.02
		Analyte		**K-40**				**Ra-226**				**Th-232**				**U-234**				**U-235**				**U- 238**			
		CAS#		**13966-00-2**				**13982-63-3**				**7440-29-1**				**13966-29-5**				**15117-96-1**				**7440-61-1**			
		Units		**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
		Screening Level		**None**				**1.96**				**3.07**				**4.02**				**3.95**				**1.96**			
		Source of Screening Level		**None**				**USEPA 2008 Background**				**Residential PRG**				**Residential PRG**				**Residential PRG**				**USEPA 2008 Background**			
				16.4				**95.8**				**2.91**				**65.4**				**4.6**				**63**			
		MAX		**16.4**		**2.4**		**95.8**		**5.9**		**2.91**		**0.64**		**65.4**		**6.4**		**4.6**		**2.3**		**63**		**6.2**	
SIW-SB-001P-5.0-10.0	SIW-SB-001P-5.0-10.0	40736	Below 5 feet	9.8		1.6	0.5	0.74		0.19	0.16	1.09		0.31	0.2	1.7		0.26	0.02	0.079		0.052	0.037	1.89		0.27	0.02
SIW-SB-003P-5.0-8.0	SIW-SB-003P-5.0-8.0	40736	Below 5 feet	9.2		2.2	1.6	0.97		0.21	0.11	1.07		0.25	0.26	0.64		0.12	0.02	0.019	U	0.02	0.023	0.456		0.094	0.024
SIW-SB-004P-5.0-10.0	SIW-SB-004P-5.0-10.0	40736	Below 5 feet	11.2		1.7	0.9	0.93		0.18	0.14	1.24		0.24	0.24	0.55		0.1	0.01	0.02		0.02	0.013	0.64		0.11	0.02
SIW-SB-005P-5.0-8.0	SIW-SB-005P-5.0-8.0	40737	Below 5 feet	15.4		2.8	1.2	1.58		0.3	0.14	1.78		0.36	0.55	1.42		0.27	0.03	0.123		0.078	0.033	1.42		0.27	0.03
SIW-SB-DUP-002*	SIW-SB-005P-5.0-8.0	40737	Below 5 feet	17.4		2.5	1.3	1.7		0.29	0.21	1.68		0.41	0.45	1.38		0.19	0.02	0.074		0.04	0.014	1.26		0.18	0.01
SIW-SB-006P-5.0-8.0	SIW-SB-006P-5.0-8.0	40737	Below 5 feet	11.1		1.6	0.8	0.7		0.16	0.14	0.74		0.2	0.09	0.48		0.094	0.022	0.022		0.021	0.021	0.431		0.088	0.02
SIW-SB-007P-5.0-8.0	SIW-SB-007P-5.0-8.0	40737	Below 5 feet	11		1.8	1.1	2.8		0.36	0.2	1.17		0.33	0.29	3.93		0.42	0.01	0.152		0.058	0.014	3.59		0.39	0.01
SIW-SB-008P-5.0-8.0	SIW-SB-008P-5.0-8.0	40738	Below 5 feet	12.3		2	0.7	2.04		0.31	0.19	2.81		0.41	0.14	2.06		0.25	0.02	0.124		0.052	0.014	1.82		0.23	0.02
SIW-SB-009P-5.0-8.0	SIW-SB-009P-5.0-8.0	40738	Below 5 feet	14.6		2.4	1.2	2.13		0.34	0.23	1.26		0.29	0.26	4.08		0.45	0.01	0.7		0.5	0.63	3.99		0.45	0.01
SIW-SB-010P-5.0-8.0	SIW-SB-010P-5.0-8.0	40739	Below 5 feet	11.6		1.9	1	0.6		0.17	0.17	1.19		0.21	0.12	0.73		0.13	0.01	0.056		0.036	0.015	0.66		0.12	0.02
SIW-SB-011P-5.0-8.0	SIW-SB-011P-5.0-8.0	40737	Below 5 feet	17.8		2.6	1.3	1.29		0.27	0.22	1.73		0.32	0.3	0.75		0.13	0.02	0.037		0.028	0.014	0.65		0.12	0.01
SIW-SB-012P-5.0-8.0	SIW-SB-012P-5.0-8.0	40737	Below 5 feet	17.3		2.4	0.6	0.97		0.2	0.17	1.57		0.33	0.12	0.83		0.15	0.01	0.037		0.031	0.017	0.82		0.14	0.01
SIW-SB-013P-5.0-8.0	SIW-SB-013P-5.0-8.0	40738	Below 5 feet	15.7		2.3	1.1	3.7		0.44	0.24	2.91		0.42	0.42	6.77		0.68	0.03	0.35		0.1	0.04	6.15		0.63	0.03
SIW-SB-014P-5.0-8.0	SIW-SB-014P-5.0-8.0	40737	Below 5 feet	23.3		3	1.2	1.02		0.24	0.2	1.22		0.27	0.43	1.91		0.25	0.04	0.131		0.059	0.036	1.88		0.25	0.03
SIW-SB-016P-5.0-8.0	SIW-SB-016P-5.0-8.0	40738	Below 5 feet	11		2.3	1.1	1.27		0.31	0.22	1.27		0.36	0.19	2.2		0.26	0.03	0.131		0.053	0.026	2.12		0.26	0.03
SIW-SB-019P-5.0-8.0	SIW-SB-019P-5.0-8.0	40737	Below 5 feet	8		1.4	0.6	0.26		0.12	0.15	0.49		0.16	0.1	0.246		0.061	0.022	0.0031	U	0.0084	0.019	0.273		0.064	0.009
SIW-SB-020P-5.0-8.0	SIW-SB-020P-5.0-8.0	40738	Below 5 feet	13		1.9	0.5	1.08		0.18	0.11	0.97		0.23	0.26	1.06		0.17	0.03	0.029		0.028	0.028	1		0.16	0.02
SIW-SB-021P-5.0-8.0	SIW-SB-021P-5.0-8.0	40739	Below 5 feet	9.8		1.8	1.3	0.71		0.18	0.16	0.61		0.25	0.41	0.92		0.14	0.02	0.031		0.025	0.021	0.96		0.14	0.02
SIW-SB-022P-5.0-8.0	SIW-SB-022P-5.0-8.0	40738	Below 5 feet	19.6		2.5	1.1	1.25		0.26	0.2	1.5		0.35	0.29	0.67		0.14	0.03	0.012	U	0.02	0.032	0.73		0.14	0.03
SIW-SB-023P-5.0-8.0	SIW-SB-023P-5.0-8.0	40739	Below 5 feet	9		1.9	0.9	0.78		0.18	0.11	0.59		0.22	0.33	1.28		0.18	0.02	0.048		0.031	0.022	1.19		0.17	0.02
				23.3				3.7				2.91				6.77				0.7				6.15			
		MAX		23.3		3		3.7		0.44		2.91		0.42	0.42	6.77		0.68		0.7		0.5		6.15		0.63	

VALUE ıe exceeds the Screening Level as outlined in the QAPP (USACE 2011b)

ɔn Goal, Qual: Data Qualifer; UPL: Upper Prediction Limit; USEPA: U.S. Environmental Protection Agency; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 3. Downhole gamma scan results (cpm) (2011).

Depth (ft bgs)	001	002	003*	004	005**	006	007*	008	009	010**	011*	012	013*	014	015	016	017	018	019*	020	021**	022*	023*	024	025**	026**
1	2000	1400	-	1000	1158	491	-	2700	6100	-	1231	2168	10000	1530	7000	2700	1900	19000	800	1700	-	1600	2500	2800	-	-
2	3000	1700	-	1200	2586	943	-	1700	3300	-	2123	2431	2600	1600	1500	1700	1800	5000	950 (1.5 ft)	1500	-	3000	3300	1900	-	-
3	2000	500	-	1100	1718	1136	-	1400	1300	-	2716	1930	2000	1169	1300	2300	820	2000	-	1900	-	3500	1500	1400	-	-
4	2000	500	-	1200	2100	1744	-	1629	1100	-	2522	1560	2700	750	900	1100	550	1300	-	1500	-	1500	754	900	-	-
5	-	600	-	1300	-	1112	-	2500	2600	-	-	1460	4200	1250	1500	800	-	2000	-	1700	-	-	500	1100 (4.5 ft)	-	-
6	-	-	-	1400	-	1021	-	2000	800	-	-	-	5600	850	-	-	-	4500 (5 ft)	-	-	-	-	-	-	-	-
7	-	-	-	1600	-	904 (6.5 ft)	-	2100	1500	-	-	-	-	900	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	1500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Hole collapsed; **Encountered groundwater; --: no data; cpm: counts per minute; ft bgs: foot/feet below ground surface

Table 4. Results of radiation surface soil samples (alpha and gamma spectroscopy) for the Staten Island Warehouse Site (2011).

	Analyte	**K-40**				**Ra-226**				**Th-232**				**U-234**				**U-235**				**U- 238**			
	CAS#	**13966-00-2**				**13982-63-3**				**7440-29-1**				**13966-29-5**				**15117-96-1**				**7440-61-1**			
	Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
	Screening Level	**None**				**1.96**				**3.07**				**4.02**				**3.95**				**1.96**			
	Source of Screening Level	**None**				**USEPA 2008 Background**				**Residential PRG**				**Residential PRG**				**Residential PRG**				**USEPA 2008 Background**			
Sample ID	**Sample Date**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**
SIW-SS-001P-0.0-2.0	7/16/2011	12.3		2.1	0.7	**5.72**		0.61	0.3	1.94		0.42	0.15	1.78		0.22	0.02	0.111		0.045	0.012	1.94		0.23	0.009
SIW-SS-002P-0.0-2.0	7/16/2011	14.5		2.1	1.1	1.74		0.33	0.25	1.77		0.35	0.12	1.23		0.17	0.02	0.062		0.036	0.026	1.37		0.19	0.02
SIW-SS-003P-0.0-2.0	7/15/2011	10.2		1.5	0.7	0.38		0.1	0.1	0.69		0.17	0.15	0.287		0.072	0.018	0.005	U	0.01	0.014	0.283		0.073	0.032
SIW-SS-004P-0.0-2.0	7/15/2011	9.5		2	1	0.72		0.19	0.14	0.56		0.2	0.35	0.65		0.11	0.03	0.024	U	0.023	0.027	0.475		0.094	0.024
SIW-SS-005P-0.0-2.0	7/16/2011	6.9		1.5	0.7	**2.81**		0.38	0.22	1.26		0.32	0.13	3.16		0.35	0.02	0.133		0.053	0.014	**2.88**		0.33	0.02
SIW-SS-006P-0.0-2.0	7/15/2011	6.9		1.2	0.8	0.23		0.11	0.12	0.45		0.14	0.13	0.233		0.062	0.017	0.005	U	0.014	0.029	0.233		0.063	0.024
SIW-SS-007P-0.0-2.0	7/15/2011	9.2		1.4	0.7	0.38		0.12	0.12	0.49		0.14	0.08	0.361		0.085	0.031	0.008	U	0.015	0.028	0.314		0.078	0.029
SIW-SS-008P-0.0-2.0	7/16/2011	5.5		1.1	0.8	**2.96**		0.37	0.21	**3.32**		0.38	0.22	1.77		0.24	0.04	0.092		0.047	0.016	**2.04**		0.26	0.01
SIW-SS-009P-0.0-2.0	7/16/2011	17.1		4.4	3.2	**36.3**		2.6	0.6	2.01		0.8	1.2	**33.9**		3	0.05	2.9		1.2	1.7	**33.4**		3	0.06
SIW-SS-010P-0.0-2.0	7/15/2011	9		1.5	0.5	**2.88**		0.36	0.21	1.38		0.34	0.32	2.68		0.3	0.03	0.162		0.058	0.022	**2.8**		0.31	0.03
SIW-SS-011P-0.0-2.0	7/16/2011	10.4		1.7	1.1	1.27		0.25	0.19	0.64		0.22	0.3	1.13		0.16	0.03	0.093		0.043	0.021	0.96		0.15	0.01
SIW-SS-012P-0.0-2.0	7/16/2011	12.5		2.5	1.2	**3.29**		0.48	0.26	2.13		0.44	0.2	1.91		0.24	0.03	0.152		0.056	0.022	1.88		0.23	0.02
SIW-SS-013P-0.0-2.0	7/16/2011	11.5		2.7	1.9	**19.1**		1.4	0.4	1.82		0.52	0.53	**9.11**		0.87	0.02	0.54		0.12	0.03	**9.48**		0.9	0.02
SIW-SS-014P-0.0-2.0	7/16/2011	11.4		2	1.3	**5.28**		0.52	0.24	1.66		0.39	0.37	1.75		0.22	0.03	0.068		0.039	0.027	1.58		0.21	0.02
SIW-SS-015P-0.0-2.0	7/16/2011	15.8		2.9	1.2	**19.5**		1.6	0.4	2.36		0.7	0.79	**10.3**		0.97	0.02	0.53		0.12	0.03	**10.1**		0.96	0.02
SIW-SS-016P-0.0-2.0	7/16/2011	13.5		3.7	2.9	42		2.8	0.5	2.82		0.82	0.77	**11.9**		1.1	0.03	0.69		0.15	0.02	**11.5**		1.1	0.01
SIW-SS-DUP-002*	7/16/2011	11.4		2.5	2.1	**33.2**		2.2	0.5	2.82		0.68	0.64	**11.8**		1.1	0.04	0.56		0.13	0.03	**11.8**		1.1	0.04
SIW-SS-017P-0.0-2.0	7/16/2011	12.2		1.9	1.1	**6.97**		0.66	0.29	1.49		0.34	0.33	1.78		0.23	0.02	0.054		0.034	0.023	1.82		0.23	0.01
SIW-SS-018P-0.0-2.0	7/16/2011	13.7		3.2	2.5	**35.2**		2.3	0.5	2.29		0.84	0.78	**58.4**		5.8	0.2	3		1.3	1.6	**56.6**		5.6	0.2
SIW-SS-DUP-004*	7/16/2011	17.7		3.7	2.6	**36.5**		2.5	0.6	**3.37**		0.73	0.8	**38**		3.4	0.05	2.7		1.3	1.7	**31.2**		7.2	8.1
SIW-SS-019P-0.0-2.0	7/15/2011	4.3		1.3	1.1	0.47		0.13	0.09	0.19	U	0.19	0.33	0.277		0.069	0.017	0.014		0.016	0.013	0.291		0.071	0.017
SIW-SS-020P-0.0-2.0	7/16/2011	6.9		1.6	1.4	**2.46**		0.34	0.19	1.19		0.3	0.19	1.65		0.21	0.02	0.06		0.035	0.022	1.72		0.22	0.02
SIW-SS-021P-0.0-2.0	7/15/2011	12.1		2	1.2	1.49		0.3	0.24	2.01		0.37	0.22	1.73		0.24	0.04	0.082		0.048	0.04	1.7		0.23	0.04
SIW-SS-DUP-001*	7/15/2011	11		1.9	0.7	1.82		0.29	0.17	1.46		0.32	0.13	1.85		0.26	0.03	0.078		0.05	0.045	1.9		0.26	0.04
SIW-SS-022P-0.0-2.0	7/16/2011	10.1		1.5	0.7	0.49		0.12	0.11	0.4		0.15	0.31	0.328		0.075	0.021	0.0034		0.0093	0.021	0.331		0.075	0.021
SIW-SS-023P-0.0-2.0	7/16/2011	11.8		2.3	1.1	**3.77**		0.5	0.23	2.2		0.48	0.4	2.19		0.27	0.03	0.097		0.046	0.015	**2.21**		0.27	0.02
SIW-SS-024P-0.0-2.0	7/16/2011	12.6		1.8	0.9	1.75		0.26	0.16	1.18		0.24	0.24	1.87		0.24	0.01	0.088		0.043	0.014	1.79		0.23	0.02
SIW-SS-DUP-003*	7/16/2011	13.1		2.3	1	1.49		0.27	0.15	1.02		0.29	0.26	1.69		0.22	0.03	0.058		0.035	0.014	1.72		0.22	0.01
SIW-SS-025P-0.0-2.0	7/16/2011	7		1.3	1	0.91		0.19	0.19	0.76		0.21	0.22	2.85		0.33	0.02	0.42		0.34	0.41	**2.72**		0.32	0.01
SIW-SS-026P-0.0-2.0	7/15/2011	10.5		1.9	1.1	1.86		0.33	0.24	2.26		0.37	0.4	1.72		0.22	0.02	0.089		0.043	0.013	1.58		0.21	0.01
SIW-SS-027P-0.0-2.0	7/15/2011	18.4		2.2	0.5	1.03		0.2	0.15	1.79		0.29	0.16	0.84		0.14	0.03	0.046		0.035	0.037	0.85		0.14	0.04
SIW-SS-028P-0.0-2.0	7/15/2011	9.4		1.6	1	1.52		0.24	0.16	1.37		0.24	0.17	1.78		0.22	0.02	0.09		0.043	0.022	1.64		0.21	0.02
SIW-SS-029P-0.0-2.0	7/16/2011	7.5		1.3	0.8	1.37		0.22	0.16	0.87		0.22	0.21	2.19		0.27	0.03	0.103		0.048	0.015	**2.14**		0.26	0.02
SIW-SS-030P-0.0-2.0	7/16/2011	12.9		1.9	0.6	1.64		0.28	0.19	1.53		0.35	0.18	1.64		0.22	0.01	0.11		0.051	0.016	1.6		0.22	0.02
SIW-SS-031P-0.0-2.0	7/16/2011	14.7		2.3	1.3	**2.19**		0.35	0.24	1.71		0.33	0.23	0.81		0.14	0.02	0.037		0.028	0.014	0.75		0.13	0.01
SIW-SS-032P-0.0-2.0	7/16/2011	10.6		1.6	0.7	0.57		0.13	0.11	0.73		0.17	0.15	0.5		0.1	0.01	0.021		0.021	0.014	0.412		0.091	0.011
SIW-SS-033P-0.0-2.0	7/16/2011	13.6		2.5	1.1	**2.2**		0.37	0.2	1.97		0.41	0.38	1.94		0.25	0.03	0.104		0.05	0.016	**2.25**		0.28	0.01
SIW-SS-034P-0.0-2.0	7/16/2011	8.5		1.7	1.1	**2.32**		0.33	0.19	1.82		0.3	0.19	1.9		0.24	0.01	0.075		0.039	0.013	1.72		0.22	0.02
SIW-SS-035P-0.0-2.0	7/16/2011	7.2		1.5	1.1	1.93		0.3	0.19	0.69		0.22	0.12	2.09		0.26	0.01	0.084		0.045	0.026	**2.12**		0.27	0.02
SIW-SS-036P-0.0-2.0	7/17/2011	9.9		1.9	1.2	**2.21**		0.32	0.2	2.41		0.38	0.27	1.71		0.23	0.02	0.092		0.047	0.016	1.67		0.23	0.01
SIW-SS-037P-0.0-2.0	7/17/2011	12.3		2	1	**2.66**		0.39	0.27	**3.12**		0.52	0.3	3.22		0.36	0.03	0.148		0.059	0.025	**3.38**		0.37	0.01
SIW-SS-038P-0.0-2.0	7/17/2011	14.3		2.7	1.2	1.89		0.35	0.19	1.66		0.38	0.21	0.94		0.15	0.03	0.038		0.028	0.023	1.04		0.16	0.02
SIW-SS-039P-0.0-2.0	7/17/2011	11.3		1.9	0.6	**2.59**		0.35	0.21	1		0.28	0.38	1.45		0.19	0.02	0.08		0.04	0.022	1.37		0.19	0.02
SIW-SS-040P-0.0-2.0	7/17/2011	12.3		2	1.1	1.65		0.32	0.26	1.53		0.27	0.21	1.91		0.24	0.03	0.105		0.049	0.029	**1.98**		0.25	0.02
SIW-SS-DUP-005*	7/17/2011	11.3		1.8	1.1	1.49		0.26	0.19	1.37		0.29	0.22	1.66		0.22	0.03	0.094		0.046	0.024	1.44		0.2	0.04
SIW-SS-041P-0.0-2.0	7/17/2011	16.1		2.8	1.1	1.39		0.29	0.18	1.37		0.3	0.19	0.77		0.17	0.04	0.007	U	0.02	0.045	0.9		0.19	0.04
SIW-SS-042P-0.0-2.0	7/17/2011	6.1		1.1	0.4	0.33		0.12	0.13	0.28		0.14	0.17	0.254		0.07	0.025	0.016		0.019	0.014	0.278		0.073	0.012
SIW-SS-043P-0.0-2.0	7/17/2011	11.7		1.9	1.1	**6.18**		0.6	0.25	1.45		0.29	0.12	**7.19**		0.71	0.02	0.93		0.6	0.78	**7.17**		0.71	0.01
SIW-SS-044P-0.0-2.0	7/17/2011	5.5		1.2	0.8	1.77		0.27	0.17	0.22	U	0.12	0.36	1.26		0.18	0.03	0.078		0.042	0.024	1.28		0.18	0.02
SIW-SS-045P-0.0-2.0	7/17/2011	6.8		2.2	2.4	**15.8**		1.3	0.3	2.08		0.76	0.63	**8.13**		0.78	0.02	1.13		0.79	1.1	**7.78**		0.75	0.02
	Analyte	**K-40**				**Ra-226**				**Th-232**				**U-234**				**U-235**				**U- 238**			
	CAS#	**13966-00-2**				**13982-63-3**				**7440-29-1**				**13966-29-5**				**15117-96-1**				**7440-61-1**			
	Units	**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**				**pCi/g**			
	Screening Level	**None**				**1.96**				**3.07**				**4.02**				**3.95**				**1.96**			
	Source of Screening Level	**None**				**USEPA 2008 Background**				**Residential PRG**				**Residential PRG**				**Residential PRG**				**USEPA 2008 Background**			
	50	**18.4**				**42**				**3.37**				**58.4**				**3**				**56.6**			
USACE	7/17/2011	18.4		2.2		42		2.8		3.37		0.73		58.4		5.8		3		1.3		56.6		5.6	

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2011b)

2σ: total uncertainty; CAS: Chemical Abstract Service; ID: identification, MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; PRG: Preliminary Remediation Goal, Qual: Data Qualifer; UPL: Upper Prediction Limit; USEPA: U.S. Environmental Protection Agency, U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 5. Water quality parameters for groundwater samples collected from the Staten Island Warehouse Site.

Sample ID		Temperature (°C)		Specific Conductance (mS/cm)		Dissolved Oxygen (mg/L)		pH (S.U.)		ORP (mV)		Turbidity (NTU)		Salinity (PSS)	
Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
SIW-GW-010UFP	SIW-GW-010FP	22.84	24.62	346	344	4.39	3.93	6.18	6.24	48.2	47.4	57.6	55.3	21.66	21.67
SIW-GW-016UFP	SIW-GW-016FP	24.15	24.58	346	34.7	3.85	4.36	6.46	6.31	46.4	47.0	68.7	62.7	21.78	21.74
SIW-GW-023UFP	SIW-GW-023FP	22.46	22.42	348	351	4.71	4.04	6.55	6.66	43.9	46.6	75.8	52.3	21.79	21.99
SIW-GW-026UFP	SIW-GW-026FP	24.52	24.18	356	351.7	6.06	5.73	7.31	7.32	49.1	48.6	54.5	50.8	22.41	20.66
SIW-GW-005UFP	SIW-GW-005FP	22.89	21.84	333	339	3.17	3.59	6.31	6.25	50.1	50.3	56.0	50.0	20.84	21.23
SIW-GW-009UFP	SIW-GW-009FP	24.2	24.36	351	32.8	3.36	3.74	6.57	6.56	45.8	45.2	54.7	49.5	22.06	20.45

mg/L: milligrams/liter; ms/cm: milliSiemens per centimeter; mV: millivolts, NTU: Nephlometric Turbidity Unit, PSS: Practical Salinity Scale; S.U.: Standard Unit; °C: degrees Celsius

Table 6. Results of radiation groundwater samples for the Staten Island Warehouse Site.

		Analyte	Gross Alpha								Gross Beta								Ra-226								Ra-228							
		CAS#	12587-46-1								12587-47-2								13982-63-3								15262-20-1							
		Units	pCi/L								pCi/L								pCi/L								pCi/L							
		Screening Level	15								50								5								5							
Sample ID			Unfiltered				Filtered				Unfiltered				Filtered				Unfiltered				Filtered				Unfiltered				Filtered			
Unfiltered	Filtered	CollectedDate	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC
SIW-GW-010UFP	SIW-GW-010FP	7/17/2011	-10	U	120	230	-14	U	99.9	200	221		75	93	137		73	110	1.91		0.35	0.22	2.16		0.37	0.19	0.5		0.24	0.34	0.51		0.27	0.39
SIW-GW-016UFP	SIW-GW-016FP	7/17/2011	2	U	100	200	-35	U	52	130	181		81	110	158		59	80	0.73		0.23	0.19	0.91		0.23	0.17	0.31	U	0.33	0.53	0.32	U	0.23	0.36
SIW-GW-023UFP	SIW-GW-023FP	7/17/2011	8	U	69	140	24	U	84	150	109		54	79	140		49	60	0.27		0.14	0.18	0.35		0.16	0.18	0.25	U	0.27	0.43	0.13	U	0.27	0.46
SIW-GW-026UFP	SIW-GW-026FP	7/17/2011	-14	U	71	150	7	U	84	170	161		60	81	52	U	72	120	0.29		0.14	0.16	-0.03	U	0.11	0.21	0.02	U	0.25	0.44	0.16	U	0.25	0.42
SIW-GW-005UFP	SIW-GW-005FP	7/17/2011	29	U	93	170	30	U	100	190	89	U	62	94	66	U	46	71	0.74		0.21	0.17	0.52		0.19	0.2	0.07	U	0.26	0.45	0.46		0.27	0.4
SIW-GW-UFDUP*	SIW-GW-FDUP*	7/17/2011	2	U	62	130	64	U	82	130	171		61	80	114		58	84	0.29		0.16	0.22	0.61		0.2	0.18	0.47		0.3	0.45	0.38	U	0.29	0.45
SIW-GW-009UFP	SIW-GW-009FP	7/17/2011	-17	U	78	160	32	U	88	160	96		47	67	102		47	65	1.25		0.28	0.22	0.85		0.25	0.2	0.31	U	0.22	0.33	0.52		0.29	0.43

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2011b)

2σ: total uncertainty; CAS: Chemical Abstract Service; ID: identification, mrem/yr: millirems per year, MDC: Minimum Detectable Concentration; pCi/L: picocuries per liter; Qual: Data Qualifer; UPL: Upper Prediction Limit; USEPA: U.S. Environmental Protection Agency

J: Estimated value; R: rejected data point; U: not detected at the assocated level; UJ: not detected and associated value is estimated

See http://water-epa.gov/drink/contaminants/index.cfm#Radionuclides for gross alpha and beta MCLs.

		Analyte	U-234								U-235/236								U-238							
		CAS#	13966-29-5								15117-96-1								7440-61-1							
		Units	pCi/L								pCi/L								pCi/L							
		Screening Level	187000								64.8								10.1							
Sample ID			Unfiltered				Filtered				Unfiltered				Filtered				Unfiltered				Filtered			
Unfiltered	Filtered	CollectedDate	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC	Result	Qual	2 σ	MDC
SIW-GW-010UFP	SIW-GW-010FP	7/17/2011	0.98		0.2	0.07	0.78		0.2	0.06	0.055	U	0.1	0.065	0.055		0.1	0.037	0.73		0.18	0.05	0.62		0.17	0.03
SIW-GW-016UFP	SIW-GW-016FP	7/17/2011	0.51		0.1	0.05	0.59		0.15	0.02	0.045		0	0.03	0.066		0.1	0.03	0.57		0.15	0.04	0.61		0.16	0.02
SIW-GW-023UFP	SIW-GW-023FP	7/17/2011	0.95		0.2	0.05	0.91		0.21	0.07	0.052		0	0.05	0.013	U	0	0.034	0.67		0.16	0.05	0.85		0.2	0.05
SIW-GW-026UFP	SIW-GW-026FP	7/17/2011	0.84		0.2	0.04	0.76		0.18	0.07	0.01	U	0	0.028	0.012	U	0	0.075	0.65		0.16	0.02	0.75		0.18	0.08
SIW-GW-005UFP	SIW-GW-005FP	7/17/2011	1.5		0.3	0.03	0.96		0.2	0.04	0.05		0.1	0.034	0.053		0	0.029	1.5		0.28	0.05	0.83		0.18	0.02
SIW-GW-UFDUP*	SIW-GW-FDUP*	7/17/2011	1.08		0.2	0.03	1		0.22	0.04	0.045	U	0	0.054	0.037		0	0.033	1.05		0.22	0.03	0.91		0.2	0.03
SIW-GW-009UFP	SIW-GW-009FP	7/17/2011	2.15		0.3	0.05	1.78		0.29	0.02	0.085		0.1	0.029	0.095		0.1	0.029	1.93		0.3	0.05	1.61		0.27	0.02

VALUE Value exceeds the Screening Level as outlined in the QAPP (USACE 2011b)

2σ: total uncertainty; CAS: Chemical Abstract Service; ID: identification, mrem/yr: millirems per year, MDC: Minimum Detectable Concentration; pCi/L: picocuries per liter; Qual: Data Qualifer; UPL: Upper Prediction Limit; USEPA: U.S. Environmental Protection Agency

U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

An activity concentration of >50 pCi/L often is used as an indication of when specific beta-emitting isotopes should be analyzed.

See http://water-epa.gov/drink/contaminants/index.cfm#Radionuclides for gross alpha and beta MCLs.

Table 7. Test pit gamma scan results.

Note: See Figure 5-3 for test pit location.

Identification Number/Date Scanned	Total Depth (ft bgs)	Analytical Group	Gamma Scan Results
TP-01/07-16-2011	6	Gamma Survey	Background: 32 cpm
			Pile: 1300 cpm
			Pit walls: 32 cpm
TP-02/07-16-2011	6	Gamma Survey	Background: 32 cpm
			Surface: 8000-9000 cpm [1]
			Pile: 23000 cpm (~2 ft)
			Pit walls: 32 cpm
TP-03/07-16-2011	6	Gamma Survey	Background: 32 cpm
			Pile: 32 cpm
			Pit walls: 32 cpm
TP-04/07-16-2011	6	Gamma Survey	Background: 32 cpm
			Pile: 13000 cpm
			Pit walls: <32 cpm

bgs: below ground surface; cpm: counts per minute; ft: feet/foot

[1] Surface scan results were collected for additional data

[2] Highest scan counts of 13000 cpm were collected on excavated wood debris

Table 8. Results of metal characterization samples (Methods 6020A and 7471A) for the Staten Island Warehouse Site (2011).

	Analyte	**Arsenic**			**Barium**			**Cadmium**			**Chromium**			**Lead**			**Mercury**			**Selenium**			**Silver**		
	CAS#	**7440-38-2**			**7440-39-3**			**7440-43-9**			**7440-47-3**			**7439-92-1**			**7439-97-6**			**7782-49-2**			**7440-22-4**		
	Units	**mg/kg**			**mg/kg**			**mg/kg**			**mg/kg**			**mg/kg**			**mg/kg**			**mg/kg**			**mg/kg**		
Location ID	**Collected Date**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**	**Result**	**Qual**	**MDL**
SIW-SS-041PC-0.0-2.0	7/17/2011	5	J	0.23	48	=	0.065	0.058	=	0.018	19	=	0.51	202	J	0.11	0.036	J	0.013	1.8	=	0.18	0.043	U	0.016
SIW-SS-042PC-0.0-2.0	7/17/2011	2.9	J	0.21	39.3	=	0.059	0.16	=	0.017	21.6	=	0.46	30.4	J	0.1	0.048	J	0.012	0.95	=	0.16	0.076	U	0.014
SIW-SS-043PC-0.0-2.0	7/17/2011	29	J	0.22	963	=	0.062	4.4	=	0.017	76.4	=	0.49	2960	J	0.55	3.1	J	0.12	2.1	=	0.17	0.72	=	0.015
SIW-SS-044PC-0.0-2.0	7/17/2011	31.7	J	0.22	400	=	0.062	3.3	=	0.017	137	=	0.49	2590	J	0.54	0.28	J	0.012	0.83	=	0.17	0.58	=	0.015
SIW-SS-CDUP-001*	7/17/2011	27.1	J	0.22	601	=	0.062	2.8	=	0.017	119	=	0.49	2140	J	0.54	0.29	J	0.012	0.9	=	0.17	0.53	=	0.015

CAS: Chemical Abstract Service; ID: identification, MDL: Method Detection Limit, mg/kg: milligrams per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; *The DUP is a field duplicate of the preceding sample

Table 9. Results of SVOC characterization samples (Method 8270C) for the Staten Island Warehouse Site (2011).

	Analyte	2-Methylnaphthalene			Acenaphthene			Acenaphthylene			Anthracene			Benzo(a)anthracene			Benzo(a)pyrene		
	CAS#	91-57-6			83-32-9			208-96-8			120-12-7			56-55-3			50-32-8		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	380	U	380	380	U	380	150	J	380	160	J	380	260	J	380	400	=	380
SIW-SS-042PC-0.0-2.0	7/17/2011	110	J	340	130	J	340	350	=	340	830	=	340	1800	=	340	1200	=	340
SIW-SS-043PC-0.0-2.0	7/17/2011	51	J	360	360	U	360	650	=	360	610	=	360	1000	=	360	1300	=	360
SIW-SS-044PC-0.0-2.0	7/17/2011	170	J	360	360	U	360	1800	=	360	7700	J	1800	3000	=	360	4300	=	360
SIW-SS-CDUP-001*	7/17/2011	130	J	360	360	U	360	1300	=	360	36000	J	3600	1900	=	360	3000	=	360

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, SVOC: semi-volatile organic compound, µg/kg: micrograms per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

	Analyte	Benzo(b)fluoranthene			Benzo(g,h,i)perylene			Benzo(k)fluoranthene			bis(2-Ethylhexyl) phthalate			Butyl benzyl phthalate			Carbazole		
	CAS#	205-99-2			191-24-2			207-08-9			117-81-7			85-68-7			86-74-8		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	540	J	380	230	J	380	180	J	380	380	U	380	380	U	380	380	U	380
SIW-SS-042PC-0.0-2.0	7/17/2011	1900	J	340	690	J	340	720	=	340	340	U	340	340	U	340	330	J	340
SIW-SS-043PC-0.0-2.0	7/17/2011	2000	J	360	1400	J	360	720	=	360	390	=	360	66	J	360	160	J	360
SIW-SS-044PC-0.0-2.0	7/17/2011	6100	J	360	7200	J	360	2100	=	360	130	J	360	360	U	360	3800	=	360
SIW-SS-CDUP-001*	7/17/2011	4000	J	360	4600	J	360	1400	=	360	94	J	360	360	U	360	13000	J	3600

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, SVOC: semi-volatile organic compound, µg/kg: micrograms per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

	Analyte	Chrysene			Dibenz(a,h)anthracene			Dibenzofuran			Di-n-octyl phthalate			Fluoranthene			Fluorene		
	CAS#	218-01-9			53-70-3			132-64-9			117-84-0			206-44-0			86-73-7		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	310	J	380	380	U	380	380	U	380	380	U	380	300	J	380	380	U	380
SIW-SS-042PC-0.0-2.0	7/17/2011	1800	=	340	230	J	340	290	J	340	340	U	340	4600	J	340	490	=	340
SIW-SS-043PC-0.0-2.0	7/17/2011	1200	=	360	270	J	360	360	U	360	130	J	360	1600	J	360	69	J	360
SIW-SS-044PC-0.0-2.0	7/17/2011	4900	=	360	360	U	360	360	=	360	360	U	360	6200	J	360	480	=	360
SIW-SS-CDUP-001*	7/17/2011	4600	=	360	920	=	360	290	J	360	360	U	360	2800	J	360	540	=	360

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, SVOC: semi-volatile organic compound, µg/kg: micrograms per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

	Analyte	Hexachlorocyclopentadiene			Indeno(1,2,3-cd)pyrene			Naphthalene			Phenanthrene			Pyrene		
	CAS#	77-47-4			193-39-5			91-20-3			85-01-8			129-00-0		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	1800	UJ	1800	250	J	380	380	U	380	97	J	380	200	J	380
SIW-SS-042PC-0.0-2.0	7/17/2011	1700	UJ	1700	790	=	340	99	J	340	3600	=	340	3200	=	340
SIW-SS-043PC-0.0-2.0	7/17/2011	1700	UJ	1700	1100	=	360	56	J	360	580	=	360	1300	=	360
SIW-SS-044PC-0.0-2.0	7/17/2011	1700	U	1700	5300	=	360	230	J	360	4100	=	360	4500	=	360
SIW-SS-CDUP-001*	7/17/2011	1700	UJ	1700	3200	=	360	210	J	360	2600	=	360	2700	=	360

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, SVOC: semi-volatile organic compound, µg/kg: micrograms per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

Table 10. Results of VOC characterization samples (Method 8260B) for the Staten Island Warehouse Site (2011).

	Analyte	1,3-Dichlorobenzene			1,4-Dichlorobenzene			2-Butanone			Acetone			Benzene			Ethylbenzene		
	CAS#	541-73-1			106-46-7			78-93-3			67-64-1			71-43-2			100-41-4		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	5.7	UJ	5.7	5.7	UJ	5.7	10	J	23	27	J	23	5.7	UJ	5.7	5.7	UJ	5.7
SIW-SS-042PC-0.0-2.0	7/17/2011	5.2	UJ	5.2	5.2	UJ	5.2	21	UJ	21	21	UJ	21	5.2	UJ	5.2	0.61	J	5.2
SIW-SS-043PC-0.0-2.0	7/17/2011	0.95	J	5.5	0.94	J	5.5	22	UJ	22	14	J	22	5.5	UJ	5.5	5.5	UJ	5.5
SIW-SS-044PC-0.0-2.0	7/17/2011	5.4	UJ	5.4	5.4	UJ	5.4	22	UJ	22	7.3	J	22	0.39	J	5.4	0.48	J	5.4
SIW-SS-CDUP-001*	7/17/2011	5.4	UJ	5.4	5.4	UJ	5.4	22	UJ	22	22	UJ	22	5.4	UJ	5.4	5.4	UJ	5.4

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, VOC: volatile organic compound, µg/kg: micrograms per kilogram
=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated;
*The DUP is a field duplicate of the preceding sample

	Analyte	Methylene chloride			Styrene			Tetrachloroethene			Toluene			Xylenes (total)		
	CAS#	75-09-2			100-42-5			127-18-4			108-88-3			1330-20-7		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	Collected Date	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ	Result	Qual	LOQ
SIW-SS-041PC-0.0-2.0	7/17/2011	5.7	UJ	5.7	5.7	UJ	5.7	5.7	UJ	5.7	5.7	UJ	5.7	11	UJ	11
SIW-SS-042PC-0.0-2.0	7/17/2011	1.5	J	5.2	5.2	UJ	5.2	5.2	UJ	5.2	0.86	J	5.2	2.3	J	10
SIW-SS-043PC-0.0-2.0	7/17/2011	1.1	J	5.5	5.5	UJ	5.5	0.58	J	5.5	5.5	UJ	5.5	1.2	J	11
SIW-SS-044PC-0.0-2.0	7/17/2011	0.92	J	5.4	0.58	J	5.4	1.5	J	5.4	1.3	J	5.4	0.99	J	11
SIW-SS-CDUP-001*	7/17/2011	5.4	UJ	5.4	5.4	UJ	5.4	0.94	J	5.4	5.4	UJ	5.4	1.1	J	11

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, VOC: volatile organic compound, µg/kg: micrograms per kilogram
=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated;
*The DUP is a field duplicate of the preceding sample

Table 11. Results of pesticide characterization samples (Method 8081A) for the Staten Island Warehouse Site (2011).

	Analyte	4,4'-DDD			4,4'-DDE			4,4'-DDT			Aldrin			alpha-BHC			alpha-Chlordane			beta-BHC			Chlordane (technical)		
	CAS#	72-54-8			72-55-9			50-29-3			309-00-2			319-84-6			5103-71-9			319-85-7			57-74-9		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
SIW-SS-041PC-0.0-2.0	7/17/2011	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	16	UJ	16
SIW-SS-042PC-0.0-2.0	7/17/2011	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	8.8	UJ	8.8
SIW-SS-043PC-0.0-2.0	7/17/2011	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	5	J	1.9	0.91	UJ	0.91	110	J	19
SIW-SS-044PC-0.0-2.0	7/17/2011	0.9	UJ	0.9	0.9	UJ	0.9	6.3	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	9.2	UJ	9.2
SIW-SS-CDUP-001*	7/17/2011	0.9	UJ	0.9	0.9	UJ	0.9	4.7	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	9.2	UJ	9.2

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, VOC: volatile organic compound, µg/kg: micrograms per kilogram
=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated;
*The DUP is a field duplicate of the preceding sample

	Analyte	delta-BHC			Dieldrin			Endosulfan I			Endosulfan II			Endosulfan sulfate			Endrin			Endrin aldehyde			Endrin ketone		
	CAS#	319-86-8			60-57-1			959-98-8			33213-65-9			1031-07-8			72-20-8			7421-93-4			53494-70-5		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
SIW-SS-041PC-0.0-2.0	7/17/2011	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6
SIW-SS-042PC-0.0-2.0	7/17/2011	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86	0.86	UJ	0.86
SIW-SS-043PC-0.0-2.0	7/17/2011	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	3.6	J	1.9	0.91	UJ	0.91
SIW-SS-044PC-0.0-2.0	7/17/2011	0.9	UJ	0.9	0.9	UJ	0.9	0.74	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	9.8	J	1.8	0.9	UJ	0.9
SIW-SS-CDUP-001*	7/17/2011	0.9	UJ	0.9	2.5	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	0.9	UJ	0.9	14	J	1.8	0.9	UJ	0.9

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, VOC: volatile organic compound, µg/kg: micrograms per kilogram
=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated;
*The DUP is a field duplicate of the preceding sample

	Analyte	gamma-BHC (Lindane)			gamma-Chlordane			Heptachlor			Heptachlor epoxide			Methoxychlor			Toxaphene		
	CAS#	58-89-9			5103-74-2			76-44-8			1024-57-3			72-43-5			8001-35-2		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
SIW-SS-041PC-0.0-2.0	7/17/2011	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	1.6	UJ	1.6	62	UJ	62
SIW-SS-042PC-0.0-2.0	7/17/2011	0.86	UJ	0.86	0.86	UJ	0.86	1.8	UJ	1.8	0.86	UJ	0.86	0.86	UJ	0.86	35	UJ	35
SIW-SS-043PC-0.0-2.0	7/17/2011	0.91	UJ	0.91	6.2	J	1.9	0.91	UJ	0.91	0.91	UJ	0.91	0.91	UJ	0.91	37	UJ	37
SIW-SS-044PC-0.0-2.0	7/17/2011	0.9	UJ	0.9	0.9	UJ	0.9	4.6	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	36	UJ	36
SIW-SS-CDUP-001*	7/17/2011	0.9	UJ	0.9	0.9	UJ	0.9	4	J	1.8	0.9	UJ	0.9	0.9	UJ	0.9	36	UJ	36

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, VOC: volatile organic compound, µg/kg: micrograms per kilogram
=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated;
*The DUP is a field duplicate of the preceding sample

Table 12. Results of PCB characterization samples (Method 8082) for the Staten Island Warehouse Site (2011).

	Analyte	Aroclor 1016			Aroclor 1221			Aroclor 1232			Aroclor 1242			Aroclor 1248			Aroclor 1254			Aroclor 1260		
	CAS#	12674-11-2			11104-28-2			11141-16-5			53469-21-9			12672-29-6			11097-69-1			11096-82-5		
	Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
SIW-SS-041PC-0.0-2.0	7/17/2011	15	U	15	15	U	15	15	U	15	15	U	15	15	U	15	15	U	15	15	UJ	15
SIW-SS-042PC-0.0-2.0	7/17/2011	8.3	U	8.3	8.3	U	8.3	8.3	U	8.3	8.3	U	8.3	8.3	U	8.3	8.3	U	8.3	8.3	UJ	8.3
SIW-SS-043PC-0.0-2.0	7/17/2011	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	450	J	36
SIW-SS-044PC-0.0-2.0	7/17/2011	11	U	11	11	U	11	11	U	11	11	U	11	11	U	11	11	U	11	69	J	47
SIW-SS-CDUP-001*	7/17/2011	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	8.7	U	8.7	37	J	36

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, PCB: polychlorinated biphenyl, µg/kg: micrograms per kilogram

=: Detection confirmed by validator; J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

Table 13. Results of herbicide characterization samples (Method 8051A) for the Staten Island Warehouse Site (2011).

	Analyte	2,4,5-T			2,4,5-TP (Silvex)			2,4-D			2,4-DB		
	CAS#	93-76-5			93-72-1			94-75-7			94-82-6		
	Units	µg/kg			µg/kg			µg/kg			µg/kg		
Location ID	**Collected Date**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**	**Result**	**Qual**	**LOQ**
SIW-SS-041PC-0.0-2.0	7/17/2011	7.6	UJ	7.6	7.6	UJ	7.6	76	UJ	76	76	UJ	76
SIW-SS-042PC-0.0-2.0	7/17/2011	4.1	U	4.1	4.1	UJ	4.1	41	UJ	41	41	UJ	41
SIW-SS-043PC-0.0-2.0	7/17/2011	6.8	U	6.8	6.8	UJ	6.8	68	UJ	68	68	UJ	68
SIW-SS-044PC-0.0-2.0	7/17/2011	7.2	U	7.2	7.2	UJ	7.2	72	UJ	72	72	UJ	72
SIW-SS-CDUP-001*	7/17/2011	5.3	U	5.3	5.3	UJ	5.3	53	UJ	53	53	UJ	53

CAS: Chemical Abstract Service; ID: identification, LOQ: Limit of Quantification, µg/kg: micrograms per kilogram

J: Detection confirmed by validator, but estimated value; U: not detected at the assocated level; UJ: not detected and associated value is estimated; *The DUP is a field duplicate of the preceding sample

Table 14. Results of radiation soil samples (alpha and gamma spectroscopy) taken outside of the Radiologically Contaminated Area for the Staten Island Warehouse Site.

	Analyte	Potassium 40				Radium (226)				Thorium 232				Uranium 234				Uranium 235				Uranium 238			
	CAS#	13966-00-2				13982-63-3				7440-29-1				13966-29-5				15117-96-1				7440-61-1			
	Units	pCi/g				pCi/g				pCi/g				pCi/g				pCi/g				pCi/g			
Sample ID	**Sample Date**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**
Surface Soil																									
SIW-SS-003P-0.0-2.0	7/15/11 18:nn	10.2		1.5	0.7	0.38		0.1	0.1	0.69		0.17	0.15	0.287		0.072	0.018	0.11	U	0.2	0.31	0.283		0.073	0.032
SIW-SS-004P-0.0-2.0	7/15/11 16:nn	9.5		2	1	0.72		0.19	0.14	0.56		0.2	0.35	0.65		0.11	0.03	0.09	U	0.13	0.51	0.475		0.094	0.024
SIW-SS-006P-0.0-2.0	7/15/11 16:nn	6.9		1.2	0.8	0.23		0.11	0.12	0.45		0.14	0.13	0.233		0.062	0.017	0.17	U	0.17	0.25	0.233		0.063	0.024
SIW-SS-007P-0.0-2.0	7/15/11 18:nn	9.2		1.4	0.7	0.38		0.12	0.12	0.49		0.14	0.08	0.361		0.085	0.031	0.11	U	0.14	0.41	0.314		0.078	0.029
SIW-SS-011P-0.0-2.0	7/16/11 8:nn	10.4		1.7	1.1	1.27		0.25	0.19	0.64		0.22	0.3	1.13		0.16	0.03	0.18	U	0.33	0.59	0.96		0.15	0.01
SIW-SS-019P-0.0-2.0	7/15/11 18:nn	4.3		1.3	1.1	0.47		0.13	0.09	0.19	U	0.19	0.33	0.277		0.069	0.017	-0.02	U	0.47	0.29	0.291		0.071	0.017
SIW-SS-021P-0.0-2.0	7/15/11 16:nn	12.1		2	1.2	1.49		0.3	0.24	2.01		0.37	0.22	1.73		0.24	0.04	0.38	U	0.35	0.63	1.7		0.23	0.04
SIW-SS-DUP-001	7/15/11 0:nn	11		1.9	0.7	1.82		0.29	0.17	1.46		0.32	0.13	1.85		0.26	0.03	0.14	U	0.28	0.52	1.9		0.26	0.04
SIW-SS-022P-0.0-2.0	7/16/11 8:nn	10.1		1.5	0.7	0.49		0.12	0.11	0.4		0.15	0.31	0.328		0.075	0.021	0.05	U	0.19	0.34	0.331		0.075	0.021
SIW-SS-025P-0.0-2.0	7/16/11 16:nn	7		1.3	1	0.91		0.19	0.19	0.76		0.21	0.22	2.85		0.33	0.02	0.42		0.34	0.41	2.72		0.32	0.01
SIW-SS-027P-0.0-2.0	7/15/11 16:nn	18.4		2.2	0.5	1.03		0.2	0.15	1.79		0.29	0.16	0.84		0.14	0.03	0.24	U	0.31	0.58	0.85		0.14	0.04
SIW-SS-028P-0.0-2.0	7/15/11 16:nn	9.4		1.6	1	1.52		0.24	0.16	1.37		0.24	0.17	1.78		0.22	0.02	0.09	U	0.22	0.58	1.64		0.21	0.02
SIW-SS-029P-0.0-2.0	7/16/11 16:nn	7.5		1.3	0.8	1.37		0.22	0.16	0.87		0.22	0.21	2.19		0.27	0.03	0.19	U	0.28	0.48	2.14		0.26	0.02
SIW-SS-042P-0.0-2.0	7/17/11 10:nn	6.1		1.1	0.4	0.33		0.12	0.13	0.28		0.14	0.17	0.254		0.07	0.025	0.04	U	0.12	0.3	0.278		0.073	0.012
Subsurface Soil																									
SIW-SB-003P-0.0-5.0	7/12/2011	14.9		2.1	1	1.07		0.22	0.17	1.3		0.28	0.18	0.65		0.12	0.03	0.43	U	0.36	0.44	0.66		0.12	0.04
SIW-SB-003P-5.0-8.0	7/12/2011	9.2		2.2	1.6	0.97		0.21	0.11	1.07		0.25	0.26	0.64		0.12	0.02	0.11	U	0.28	0.48	0.456		0.094	0.024
SIW-SB-004P-0.0-5.0	7/12/2011	10.4		1.6	0.5	1.22		0.21	0.16	0.65		0.22	0.25	0.71		0.12	0.03	0.16	U	0.23	0.59	0.64		0.12	0.02
SIW-SB-DUP-001	7/12/2011	7.7		1.7	0.9	1.06		0.25	0.18	0.54		0.29	0.4	0.78		0.13	0.01	0.15	U	0.3	0.51	0.79		0.13	0.01
SIW-SB-004P-5.0-10.0	7/12/2011	11.2		1.7	0.9	0.93		0.18	0.14	1.24		0.24	0.24	0.55		0.1	0.01	-0.08	U	1.3	0.5	0.64		0.11	0.02
SIW-SB-006P-0.0-5.0	7/13/2011	10.8		1.7	0.5	0.72		0.16	0.13	0.54		0.19	0.27	0.67		0.12	0.02	0.06	U	0.29	0.5	0.65		0.12	0.01
SIW-SB-006P-5.0-8.0	7/13/2011	11.1		1.6	0.8	0.7		0.16	0.14	0.74		0.2	0.09	0.48		0.094	0.022	0.11	U	0.27	0.47	0.431		0.088	0.02
SIW-SB-007P-0.0-5.0	7/13/2011	10.3		1.7	0.9	0.96		0.17	0.11	0.65		0.23	0.35	0.82		0.13	0.02	0.17	U	0.33	0.52	0.87		0.14	0.02
SIW-SB-007P-5.0-8.0	7/13/2011	11		1.8	1.1	2.8		0.36	0.2	1.17		0.33	0.29	3.93		0.42	0.01	0.2	U	0.32	0.71	3.59		0.39	0.01
SIW-SB-011P-0.0-5.0	7/13/2011	15.8		2.9	1.2	1.79		0.34	0.19	1.72		0.4	0.47	0.9		0.14	0.01	0.21	U	0.47	0.73	1		0.15	0.02
SIW-SB-011P-5.0-8.0	7/13/2011	17.8		2.6	1.3	1.29		0.27	0.22	1.73		0.32	0.3	0.75		0.13	0.02	0.27	U	0.47	0.69	0.65		0.12	0.01
SIW-SB-019P-0.0-5.0	7/13/2011	6.7		1.6	1.3	0.46		0.15	0.14	0.13	U	0.14	0.34	0.447		0.09	0.028	0.12	U	0.11	0.33	0.473		0.094	0.032
SIW-SB-019P-5.0-8.0	7/13/2011	8		1.4	0.6	0.26		0.12	0.15	0.49		0.16	0.1	0.246		0.061	0.022	0.11	U	0.24	0.34	0.273		0.064	0.009
SIW-SB-021P-0.0-5.0	7/15/2011	14.9		2.2	1.1	1.5		0.28	0.2	1.47		0.27	0.19	1.15		0.17	0.02	0.26	U	0.36	0.61	1.15		0.17	0.01
SIW-SB-021P-5.0-8.0	7/15/2011	9.8		1.8	1.3	0.71		0.18	0.16	0.61		0.25	0.41	0.92		0.14	0.02	0.21	U	0.2	0.49	0.96		0.14	0.02
SIW-SB-022P-0.0-5.0	7/14/2011	16.4		2.4	0.7	1.15		0.25	0.21	1.63		0.34	0.14	0.78		0.16	0.03	0.26	U	0.45	0.72	0.92		0.18	0.02
SIW-SB-022P-5.0-8.0	7/14/2011	19.6		2.5	1.1	1.25		0.26	0.2	1.5		0.35	0.29	0.67		0.14	0.03	0.28	U	0.38	0.72	0.73		0.14	0.03
SIW-SB-025P-0.0-5.0	7/15/2011	10.6		2	1.5	1.09		0.23	0.18	1.51		0.32	0.14	1.08		0.16	0.01	0.18	U	0.18	0.63	1.03		0.15	0.01
Previous Data (USEPA 2008, USEPA 2009)																									
ST 2	7/10/1980	--				1.2				--				--				N/A				1.1			
ST 3	7/10/1980	--				0.62				--				--				N/A				0.62			
NR-2-92-003-072201	7/14/1992	--				0.53				--				--					U			1.7	U		
NR-2-92-003-072202	7/14/1992	--				0.9				--				--					U			1.9	U		
NR-2-92-003-072203	7/14/1992	--				0.87				--				--					U			1.6	U		
NR-2-92-003-072204	7/14/1992	--				1.06				--				--				N/A				2.8	U		
NR-2-92-003-072205	7/14/1992	--				1.95				--				--				N/A				3			
885062	2/1/2008	--				1.333				--				--				0.12	U			1.03	U		
	Minimum	4.3				0.23				0.28				0.233				0.42				0.233			
	Mean	10.92				1				1				0.947				0.42				0.977			
	Maximum	19.6				2.8				1.79				3.93				0.42				3.59			
	Distribution	Lognormal				Lognormal				Lognormal				Lognormal				N/A				Lognormal			
	95% UPL	18.81				2.294				2.993				2.524				N/A				2.462			
	Current Investigation Background	18.81				2.294				1.79				2.524				ND				2.462			
	Previous Investigation Background	NA				1.96				2.25				NA				ND (<0.1)				1.96			

2σ: total uncertainty; CAS: Chemical Abstract Service; ID: identification, MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; Qual: Data Qualifer; UPL: Upper Prediction Limit; USEPA: U.S. Environmental Protection Agency

J: Estimated value; R: rejected data point; U: not detected at the assocated level; UJ: not detected and associated value is estimated

Table 15. Evaluation of Surface Soil Samples from the Staten Island Warehouse Site (2011).

	Ra-226			U-234			U-235				U- 238			U-238/U-234		U-238/Ra-226	
Sample ID	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Ratio**	**2σ**	**Ratio**	**2σ**
SIW-SS-001P-0.0-2.0	5.72	0.61	0.3	1.78	0.22	0.02	0.45	U	0.59	1	1.94	0.23	0.009	1.09	0.19	0.34	0.05
SIW-SS-002P-0.0-2.0	1.74	0.33	0.25	1.23	0.17	0.02	0.35	U	0.43	0.69	1.37	0.19	0.02	1.11	0.22	0.79	0.18
SIW-SS-003P-0.0-2.0	0.38	0.1	0.1	0.287	0.072	0.018	0.11	U	0.2	0.31	0.283	0.073	0.032	0.99	0.35	0.74	0.27
SIW-SS-004P-0.0-2.0	0.72	0.19	0.14	0.65	0.11	0.03	0.09	U	0.13	0.51	0.475	0.094	0.024	0.73	0.19	0.66	0.22
SIW-SS-005P-0.0-2.0	2.81	0.38	0.22	3.16	0.35	0.02	0.3	U	0.41	0.68	2.88	0.33	0.02	0.91	0.15	1.02	0.18
SIW-SS-006P-0.0-2.0	0.23	0.11	0.12	0.233	0.062	0.017	0.17	U	0.17	0.25	0.233	0.063	0.024	1.00	0.38	1.01	0.56
SIW-SS-007P-0.0-2.0	0.38	0.12	0.12	0.361	0.085	0.031	0.11	U	0.14	0.41	0.314	0.078	0.029	0.87	0.30	0.83	0.33
SIW-SS-008P-0.0-2.0	2.96	0.37	0.21	1.77	0.24	0.04	0.48	U	0.46	0.6	2.04	0.26	0.01	1.15	0.21	0.69	0.12
SIW-SS-009P-0.0-2.0	36.3	2.6	0.6	33.9	3	0.05	2.9		1.2	1.7	33.4	3	0.06	0.99	0.12	0.92	0.11
SIW-SS-010P-0.0-2.0	2.88	0.36	0.21	2.68	0.3	0.03	0.2	U	0.49	0.75	2.8	0.31	0.03	1.04	0.16	0.97	0.16
SIW-SS-011P-0.0-2.0	1.27	0.25	0.19	1.13	0.16	0.03	0.18	U	0.33	0.59	0.96	0.15	0.01	0.85	0.18	0.76	0.19
SIW-SS-012P-0.0-2.0	3.29	0.48	0.26	1.91	0.24	0.03	0.4	U	0.42	0.69	1.88	0.23	0.02	0.98	0.17	0.57	0.11
SIW-SS-013P-0.0-2.0	19.1	1.4	0.4	9.11	0.87	0.02	1.09	U	0.92	1.7	9.48	0.9	0.02	1.04	0.14	0.50	0.06
SIW-SS-014P-0.0-2.0	5.28	0.52	0.24	1.75	0.22	0.03	-0.008	U	0.044	0.7	1.58	0.21	0.02	0.90	0.17	0.30	0.05
SIW-SS-015P-0.0-2.0	19.5	1.6	0.4	10.3	0.97	0.02	0.77	U	0.96	1.6	10.1	0.96	0.02	0.98	0.13	0.52	0.07
SIW-SS-016P-0.0-2.0	42	2.8	0.5	11.9	1.1	0.03	1.2	U	1.5	2.3	11.5	1.1	0.01	0.97	0.13	0.27	0.03
SIW-SS-DUP-002*	33.2	2.2	0.5	11.8	1.1	0.04	1.1	U	1.1	1.9	11.8	1.1	0.04	1.00	0.13	0.36	0.04
SIW-SS-017P-0.0-2.0	6.97	0.66	0.29	1.78	0.23	0.02	0.44	U	0.56	0.94	1.82	0.23	0.01	1.02	0.18	0.26	0.04
SIW-SS-018P-0.0-2.0	35.2	2.3	0.5	58.4	5.8	0.2	3		1.3	1.6	56.6	5.6	0.2	0.97	0.14	1.61	0.19
SIW-SS-DUP-004*	36.5	2.5	0.6	38	3.4	0.05	2.7		1.3	1.7	31.2	7.2	8.1	0.82	0.20	0.85	0.21
SIW-SS-019P-0.0-2.0	0.47	0.13	0.09	0.277	0.069	0.017	-0.02	U	0.47	0.29	0.291	0.071	0.017	1.05	0.37	0.62	0.23
SIW-SS-020P-0.0-2.0	2.46	0.34	0.19	1.65	0.21	0.02	0.21	U	0.34	0.58	1.72	0.22	0.02	1.04	0.19	0.70	0.13
SIW-SS-021P-0.0-2.0	1.49	0.3	0.24	1.73	0.24	0.04	0.38	U	0.35	0.63	1.7	0.23	0.04	0.98	0.19	1.14	0.28
SIW-SS-DUP-001*	1.82	0.29	0.17	1.85	0.26	0.03	0.14	U	0.28	0.52	1.9	0.26	0.04	1.03	0.20	1.04	0.22
SIW-SS-022P-0.0-2.0	0.49	0.12	0.11	0.328	0.075	0.021	0.05	U	0.19	0.34	0.331	0.075	0.021	1.01	0.32	0.68	0.23
SIW-SS-023P-0.0-2.0	3.77	0.5	0.23	2.19	0.27	0.03	0.34	U	0.4	0.75	2.21	0.27	0.02	1.01	0.18	0.59	0.11
SIW-SS-024P-0.0-2.0	1.75	0.26	0.16	1.87	0.24	0.01	0.09	U	0.22	0.49	1.79	0.23	0.02	0.96	0.17	1.02	0.20
SIW-SS-DUP-003*	1.49	0.27	0.15	1.69	0.22	0.03	0.017	U	0.083	0.55	1.72	0.22	0.01	1.02	0.19	1.15	0.26
SIW-SS-025P-0.0-2.0	0.91	0.19	0.19	2.85	0.33	0.02	0.42		0.34	0.41	2.72	0.32	0.01	0.95	0.16	2.99	0.72
SIW-SS-026P-0.0-2.0	1.86	0.33	0.24	1.72	0.22	0.02	0.31	U	0.42	0.82	1.58	0.21	0.01	0.92	0.17	0.85	0.19
SIW-SS-027P-0.0-2.0	1.03	0.2	0.15	0.84	0.14	0.03	0.24	U	0.31	0.58	0.85	0.14	0.04	1.01	0.24	0.83	0.21
SIW-SS-028P-0.0-2.0	1.52	0.24	0.16	1.78	0.22	0.02	0.09	U	0.22	0.58	1.64	0.21	0.02	0.92	0.16	1.08	0.22
SIW-SS-029P-0.0-2.0	1.37	0.22	0.16	2.19	0.27	0.03	0.19	U	0.28	0.48	2.14	0.26	0.02	0.98	0.17	1.56	0.31
SIW-SS-030P-0.0-2.0	1.64	0.28	0.19	1.64	0.22	0.01	0.07	U	0.41	0.62	1.6	0.22	0.02	0.98	0.19	0.98	0.21
SIW-SS-031P-0.0-2.0	2.19	0.35	0.24	0.81	0.14	0.02	0.37	U	0.48	0.8	0.75	0.13	0.01	0.93	0.23	0.34	0.08
SIW-SS-032P-0.0-2.0	0.57	0.13	0.11	0.5	0.1	0.01	0.07	U	0.22	0.38	0.412	0.091	0.011	0.82	0.25	0.72	0.23
SIW-SS-033P-0.0-2.0	2.2	0.37	0.2	1.94	0.25	0.03	0.015	U	0.069	0.79	2.25	0.28	0.01	1.16	0.21	1.02	0.21
SIW-SS-034P-0.0-2.0	2.32	0.33	0.19	1.9	0.24	0.01	0.15	U	0.35	0.79	1.72	0.22	0.02	0.91	0.16	0.74	0.14
SIW-SS-035P-0.0-2.0	1.93	0.3	0.19	2.09	0.26	0.01	0.24	U	0.31	0.56	2.12	0.27	0.02	1.01	0.18	1.10	0.22
SIW-SS-036P-0.0-2.0	2.21	0.32	0.2	1.71	0.23	0.02	0.13	U	0.37	0.68	1.67	0.23	0.01	0.98	0.19	0.76	0.15
SIW-SS-037P-0.0-2.0	2.66	0.39	0.27	3.22	0.36	0.03	0.02	U	0.47	0.82	3.38	0.37	0.01	1.05	0.16	1.27	0.23
SIW-SS-038P-0.0-2.0	1.89	0.35	0.19	0.94	0.15	0.03	-0.04	U	4.1	0.6	1.04	0.16	0.02	1.11	0.25	0.55	0.13
SIW-SS-039P-0.0-2.0	2.59	0.35	0.21	1.45	0.19	0.02	0.2	U	0.42	0.71	1.37	0.19	0.02	0.94	0.18	0.53	0.10
SIW-SS-040P-0.0-2.0	1.65	0.32	0.26	1.91	0.24	0.03	0.31	U	0.39	0.62	1.98	0.25	0.02	1.04	0.18	1.20	0.28
SIW-SS-DUP-005*	1.49	0.26	0.19	1.66	0.22	0.03	0.24	U	0.35	0.66	1.44	0.2	0.04	0.87	0.17	0.97	0.22
SIW-SS-041P-0.0-2.0	1.39	0.29	0.18	0.77	0.17	0.04	0.23	U	0.43	0.6	0.9	0.19	0.04	1.17	0.36	0.65	0.19
SIW-SS-042P-0.0-2.0	0.33	0.12	0.13	0.254	0.07	0.025	0.04	U	0.12	0.3	0.278	0.073	0.012	1.09	0.42	0.84	0.38
SIW-SS-043P-0.0-2.0	6.18	0.6	0.25	7.19	0.71	0.02	0.93		0.6	0.78	7.17	0.71	0.01	1.00	0.14	1.16	0.16
SIW-SS-044P-0.0-2.0	1.77	0.27	0.17	1.26	0.18	0.03	0.3	U	0.23	0.45	1.28	0.18	0.02	1.02	0.20	0.72	0.15
SIW-SS-045P-0.0-2.0	15.8	1.3	0.3	8.13	0.78	0.02	1.13		0.79	1.1	7.78	0.75	0.02	0.96	0.13	0.49	0.06
	6.51			**5.01**							**4.81**			**0.99**	**0.20**	**0.85**	**0.19**

2σ: total propagated uncertainty; MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; *The DUP is a field duplicate of the preceding sample

Table 16. Evaluation of Subsurface Soil Samples from the Staten Island Warehouse Site (2011).

	Ra-226			U-234			U-235				U- 238						
Sample ID	**Result**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**Result**	**Qual**	**2 σ**	**MDC**	**Result**	**2 σ**	**MDC**	**U-238/U-234 Ratio**	**2σ**	**U-238/Ra-226 Ratio**	**2σ**
SIW-SB-001P-0.0-5.0	1.76	0.31	0.14	1.73	0.23	0.02	0.11	U	0.38	0.67	1.6	0.22	0.01	0.92	0.18	0.91	0.20
SIW-SB-001P-5.0-10.0	0.74	0.19	0.16	1.7	0.26	0.02	0.11	U	0.29	0.5	1.89	0.27	0.02	1.11	0.23	2.55	0.75
SIW-SB-002P-0.0-5.0	0.86	0.21	0.18	0.66	0.12	0.02	0.11	U	0.27	0.46	0.66	0.11	0.01	1.00	0.25	0.77	0.23
SIW-SB-003P-0.0-5.0	1.07	0.22	0.17	0.65	0.12	0.03	0.43	U	0.36	0.44	0.66	0.12	0.04	1.02	0.26	0.62	0.17
SIW-SB-003P-5.0-8.0	0.97	0.21	0.11	0.64	0.12	0.02	0.11	U	0.28	0.48	0.456	0.094	0.024	0.71	0.20	0.47	0.14
SIW-SB-004P-0.0-5.0	1.22	0.21	0.16	0.71	0.12	0.03	0.16	U	0.23	0.59	0.64	0.12	0.02	0.90	0.23	0.52	0.13
SIW-SB-DUP-001*	1.06	0.25	0.18	0.78	0.13	0.01	0.15	U	0.3	0.51	0.79	0.13	0.01	1.01	0.24	0.75	0.21
SIW-SB-004P-5.0-10.0	0.93	0.18	0.14	0.55	0.1	0.01	-0.08	U	1.3	0.5	0.64	0.11	0.02	1.16	0.29	0.69	0.18
SIW-SB-005P-0.0-5.0	1.8	0.27	0.16	2.73	0.32	0.02	0.12	U	0.35	0.66	2.67	0.32	0.01	0.98	0.16	1.48	0.28
SIW-SB-005P-5.0-8.0	1.58	0.3	0.14	1.42	0.27	0.03	0.15	U	0.41	0.69	1.42	0.27	0.03	1.00	0.27	0.90	0.24
SIW-SB-DUP-002*	1.7	0.29	0.21	1.38	0.19	0.02	-0.03	U	1.3	0.8	1.26	0.18	0.01	0.91	0.18	0.74	0.16
SIW-SB-006P-0.0-5.0	0.72	0.16	0.13	0.67	0.12	0.02	0.06	U	0.29	0.5	0.65	0.12	0.01	0.97	0.25	0.90	0.26
SIW-SB-006P-5.0-8.0	0.7	0.16	0.14	0.48	0.094	0.022	0.11	U	0.27	0.47	0.431	0.088	0.02	0.90	0.25	0.62	0.19
SIW-SB-007P-0.0-5.0	0.96	0.17	0.11	0.82	0.13	0.02	0.17	U	0.33	0.52	0.87	0.14	0.02	1.06	0.24	0.91	0.22
SIW-SB-007P-5.0-8.0	2.8	0.36	0.2	3.93	0.42	0.01	0.2	U	0.32	0.71	3.59	0.39	0.01	0.91	0.14	1.28	0.22
SIW-SB-008P-0.0-5.0	1.57	0.29	0.2	1.24	0.19	0.02	0.06	U	0.39	0.68	0.92	0.15	0.01	0.74	0.17	0.59	0.14
SIW-SB-008P-5.0-8.0	2.04	0.31	0.19	2.06	0.25	0.02	0.38	U	0.41	0.68	1.82	0.23	0.02	0.88	0.15	0.89	0.18
SIW-SB-009P-0.0-5.0	47.6	3.1	0.5	40.7	4.3	0.3	4.5		1.6	1.9	40.9	4.3	0.2	1.00	0.15	0.86	0.11
SIW-SB-009P-5.0-8.0	2.13	0.34	0.23	4.08	0.45	0.01	0.7		0.5	0.63	3.99	0.45	0.01	0.98	0.15	1.87	0.37
SIW-SB-010P-0.0-5.0	1.77	0.42	0.32	1.53	0.2	0.02	0.11	U	0.42	0.76	1.28	0.18	0.01	0.84	0.16	0.72	0.20
SIW-SB-DUP-005*	1.72	0.35	0.22	1.75	0.22	0.03	0.16	U	0.32	0.75	1.84	0.23	0.02	1.05	0.19	1.07	0.26
SIW-SB-010P-5.0-8.0	0.6	0.17	0.17	0.73	0.13	0.01	0.05	U	0.13	0.54	0.66	0.12	0.02	0.90	0.23	1.10	0.37
SIW-SB-011P-0.0-5.0	1.79	0.34	0.19	0.9	0.14	0.01	0.21	U	0.47	0.73	1	0.15	0.02	1.11	0.24	0.56	0.14
SIW-SB-011P-5.0-8.0	1.29	0.27	0.22	0.75	0.13	0.02	0.27	U	0.47	0.69	0.65	0.12	0.01	0.87	0.22	0.50	0.14
SIW-SB-012P-0.0-5.0	1.22	0.24	0.19	0.75	0.13	0.03	0.24	U	0.33	0.62	0.86	0.14	0.01	1.15	0.27	0.70	0.18
SIW-SB-012P-5.0-8.0	0.97	0.2	0.17	0.83	0.15	0.01	0.016	U	0.081	0.52	0.82	0.14	0.01	0.99	0.25	0.85	0.23
SIW-SB-013P-0.0-5.0	95.8	5.9	0.7	37.3	3.4	0.05	4.6		2.3	2.8	36.6	3.3	0.03	0.98	0.13	0.38	0.04
SIW-SB-013P-5.0-8.0	3.7	0.44	0.24	6.77	0.68	0.03	0.35	U	0.67	0.94	6.15	0.63	0.03	0.91	0.13	1.66	0.26
SIW-SB-014P-0.0-5.0	0.102	0.024	0.017	0.74	0.13	0.02	0.021	U	0.023	0.038	0.73	0.13	0.03	0.99	0.25	7.16	2.11
SIW-SB-014P-5.0-8.0	1.02	0.24	0.2	1.91	0.25	0.04	0.21	U	0.39	0.67	1.88	0.25	0.03	0.98	0.18	1.84	0.50
SIW-SB-015P-0.0-5.0	54.4	3.5	0.6	65.4	6.4	0.2	4.2		1.3	1.9	63	6.2	0.3	0.96	0.13	1.16	0.14
SIW-SB-016P-0.0-5.0	8.29	0.73	0.26	9.68	0.93	0.02	0.69	U	0.58	1	9.63	0.92	0.03	0.99	0.13	1.16	0.15
SIW-SB-016P-5.0-8.0	1.27	0.31	0.22	2.2	0.26	0.03	0.08	U	0.13	0.67	2.12	0.26	0.03	0.96	0.16	1.67	0.46
SIW-SB-017P-0.0-5.0	3.84	0.44	0.22	1.83	0.23	0.03	0.31	U	0.51	0.85	1.9	0.24	0.01	1.04	0.19	0.49	0.08
SIW-SB-018P-0.0-5.0	26.1	1.8	0.5	34.5	3.1	0.05	2.9		1.4	1.6	34.2	3.1	0.06	0.99	0.13	1.31	0.15
SIW-SB-DUP-003*	20.5	1.5	0.4	24.6	2.2	0.06	1.32		0.76	1.3	24	2.2	0.07	0.98	0.12	1.17	0.14
SIW-SB-019P-0.0-5.0	0.46	0.15	0.14	0.447	0.09	0.028	0.12	U	0.11	0.33	0.473	0.094	0.032	1.06	0.30	1.03	0.39
SIW-SB-019P-5.0-8.0	0.26	0.12	0.15	0.246	0.061	0.022	0.11	U	0.24	0.34	0.273	0.064	0.009	1.11	0.38	1.05	0.54
SIW-SB-020P-0.0-5.0	1.41	0.24	0.17	1.98	0.26	0.03	0.03	U	0.35	0.61	2.01	0.26	0.02	1.02	0.19	1.43	0.30
SIW-SB-020P-5.0-8.0	1.08	0.18	0.11	1.06	0.17	0.03	0.28	U	0.3	0.54	1	0.16	0.02	0.94	0.21	0.93	0.21
SIW-SB-021P-0.0-5.0	1.5	0.28	0.2	1.15	0.17	0.02	0.26	U	0.36	0.61	1.15	0.17	0.01	1.00	0.21	0.77	0.18
SIW-SB-021P-5.0-8.0	0.71	0.18	0.16	0.92	0.14	0.02	0.21	U	0.2	0.49	0.96	0.14	0.02	1.04	0.22	1.35	0.40
SIW-SB-022P-0.0-5.0	1.15	0.25	0.21	0.78	0.16	0.03	0.26	U	0.45	0.72	0.92	0.18	0.02	1.18	0.33	0.80	0.23
SIW-SB-022P-5.0-8.0	1.25	0.26	0.2	0.67	0.14	0.03	0.28	U	0.38	0.72	0.73	0.14	0.03	1.09	0.31	0.58	0.17
SIW-SB-023P-0.0-5.0	2.48	0.36	0.23	2.54	0.3	0.02	0.25	U	0.46	0.81	2.62	0.31	0.02	1.03	0.17	1.06	0.20
SIW-SB-023P-5.0-8.0	0.78	0.18	0.11	1.28	0.18	0.02	-0.04	U	9.3	0.4	1.19	0.17	0.02	0.93	0.19	1.53	0.41
SIW-SB-024P-0.0-5.0	1.63	0.28	0.2	1.61	0.21	0.01	0.18	U	0.35	0.73	1.69	0.21	0.01	1.05	0.19	1.04	0.22
SIW-SB-DUP-004*	1.63	0.28	0.2	1.85	0.24	0.02	0.29	U	0.45	0.71	1.89	0.24	0.02	1.02	0.19	1.16	0.25
SIW-SB-025P-0.0-5.0	1.09	0.23	0.18	1.08	0.16	0.01	0.18	U	0.18	0.63	1.03	0.15	0.01	0.95	0.20	0.94	0.24
SIW-SB-026P-0.0-5.0	1.87	0.37	0.29	1.9	0.24	0.02	0.1	U	0.29	0.95	1.77	0.23	0.02	0.93	0.17	0.95	0.22
	6.28			**5.53**							**5.42**			**0.98**	**0.21**	**1.13**	**0.28**

2σ: total propagated uncertainty; MDC: Minimum Detectable Concentration; pCi/g: picocuries per gram; *The DUP is a field duplicate of the preceding sample

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APPENDIX L

SURVEYS OF THE SIW SITE

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Appendix L1

2021 CIVIL AND HYDROGRAPHIC SURVEY OF THE SIW SITE

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"UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY NOT BEARING A LICENSED LAND SURVEYOR'S SEAL IS A VIOLATION OF SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW."

"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S IMPRESSION SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES."

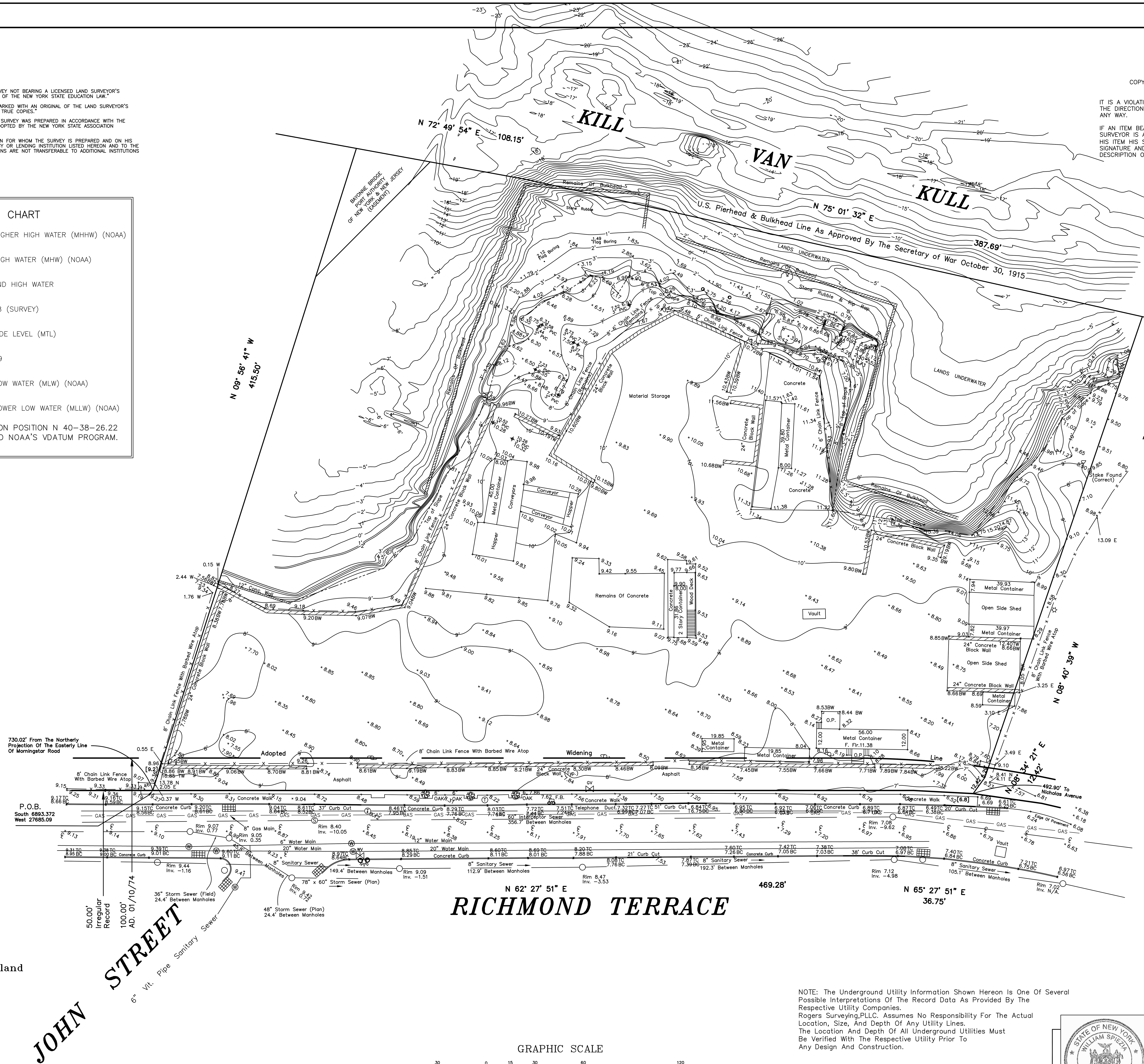
"CERTIFICATIONS INDICATED HEREON SIGNIFY THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE FOR LAND SURVEYORS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS."

"SAID CERTIFICATIONS SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY OR LENDING INSTITUTION LISTED HEREON AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS."

DATUM CHART

2.55	MEAN HIGHER HIGH WATER (MHHW) (NOAA)
2.23	MEAN HIGH WATER (MHW) (NOAA)
2.09	RICHMOND HIGH WATER
0.00	NAVD 88 (SURVEY)
−0.25	MEAN TIDE LEVEL (MTL)
−1.10	NGVD 29
−2.72	MEAN LOW WATER (MLW) (NOAA)
−2.93	MEAN LOWER LOW WATER (MLLW) (NOAA)

VALUES SHOWN ARE BASED ON POSITION N 40–38–26.22 W 074–08–31.17 CALCULATED NOAA'S VDATUM PROGRAM.



U.S. PIERHEAD & BULKHEAD LINE AS PER SHEET No. "13 T" ENTITLED "PIER HEAD and BULKHEAD LINES FOR BOTH SHORES OF KILL VAN KULL, BAYONNE, N.J. and STATEN ISLAND, N.Y." DATED 1940

PROPERTY LINES AS PER MAP SUPPLIED BY THE PORT AUTHORITY ENTITLED "KILL VAN KULL BRIDGE, BAYONNE–PORT RICHMOND, RESUME OF CALCULATIONS" DATED DECEMBER 28, 1928.

TOTAL UPLAND AREA = 132,144 SQ. FT.

TOTAL AREA OF LANDS UNDERWATER = 45,805 SQ. FT.

DATUM NOTE:

COORDINATES AND BEARINGS SHOWN ARE REFERENCED TO THE BOROUGH OF STATEN ISLAND, AS ESTABLISHED BY THE U.S. COAST & GEODETIC SURVEY BOGART SYSTEM)

ELEVATIONS SHOWN ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)

LEGAL GRADE SHOWN THUS . . . . . . [X.X]
EXISTING GRADES SHOWN THUS . . . . (X.X)
PROPOSED GRADES SHOWN THUS . . . <X.X>
GROUND ELEVATIONS SHOWN THUS . . . X.X

NAVD 88

Note :

The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

G–001.

Map of Survey
Port Richmond
September 23, 2021
Tax Lots 26
Tax Block 1105
Filed Map Lots
Filed Map Block
Filed Map
Deed
Borough of Staten Island
County of Richmond
New York, NY

GRAPHIC SCALE

(IN FEET)
1 inch = 30 ft.

NOTE: The Underground Utility Information Shown Hereon Is One Of Several Possible Interpretations Of The Record Data As Provided By The Respective Utility Companies.
Rogers Surveying,PLLC. Assumes No Responsibility For The Actual Location, Size, And Depth Of Any Utility Lines.
The Location And Depth Of All Underground Utilities Must Be Verified With The Respective Utility Prior To Any Design And Construction.

REVISIONS	JOB #	DATE	FB. / PG.

2351 Richmond Terrace

Staten Island, New York

Drafted by: RY	ROGERS SURVEYING, PLLC 2420 Arthur Kill Road Staten Island, N.Y. 10309 (718) 447-7311 www.rogerssurveying.net	Date : 11/2/21
Checked by: DD		Scale : 1"=30'
Dwg. File: 14243–NAVD88		Job No. : 14243
Disk No. P:/	Topographical & Hydrographical Survey	F.B./Pg. 1163/33–37

STATE OF NEW YORK · WILLIAM SPIEZIA · LICENSED LAND SURVEYOR · No. 050106

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Appendix L2

1999 CIVIL SURVEY OF THE SIW SITE

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"UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY NOT BEARING A LICENSED LAND SURVEYOR'S SEAL IS A VIOLATION OF SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW."

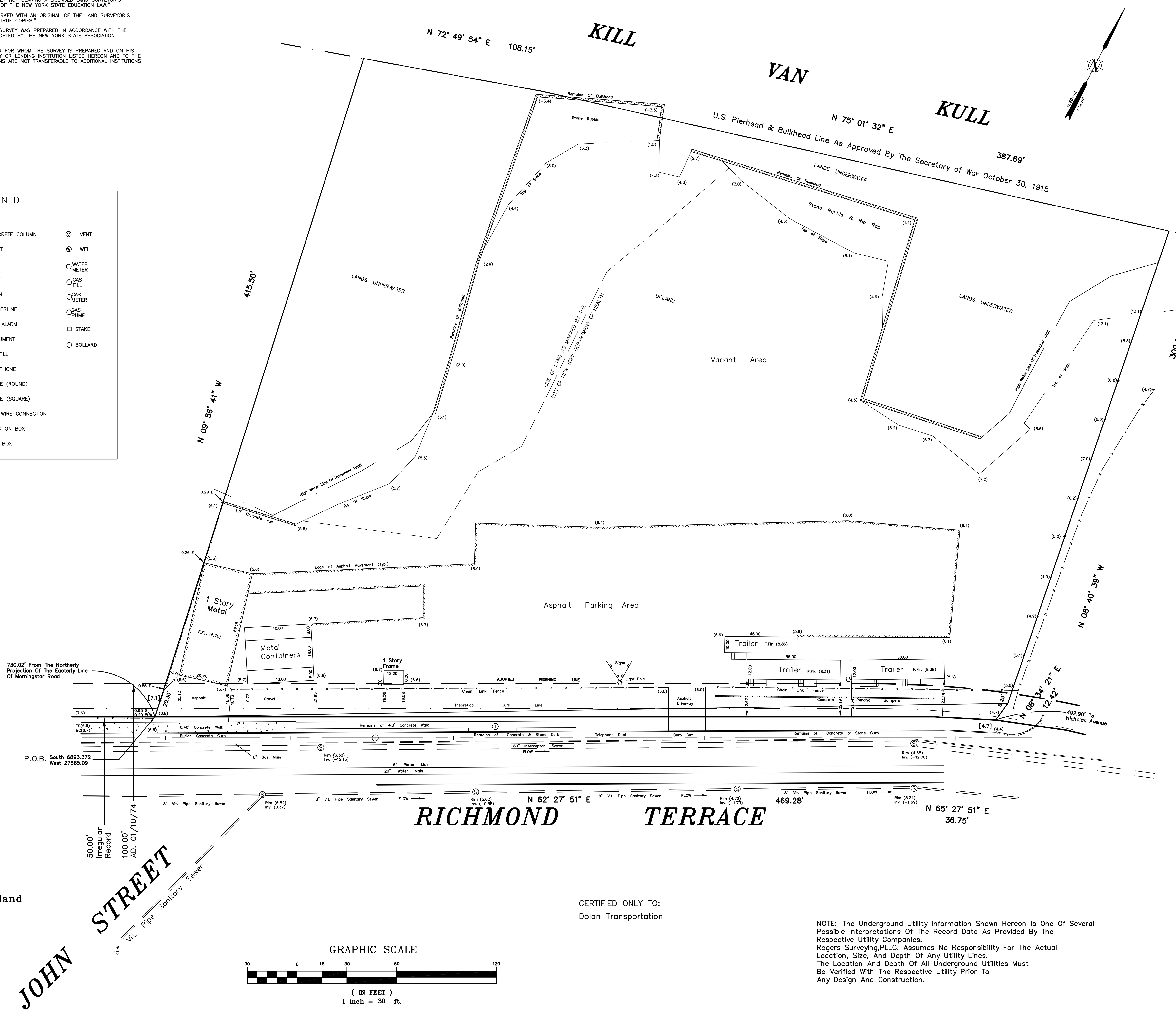
"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S IMPRESSION SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES."

"CERTIFICATIONS INDICATED HEREON SIGNIFY THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE FOR LAND SURVEYORS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS."

"SAID CERTIFICATIONS SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY OR LENDING INSTITUTION LISTED HEREON AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS."

LEGEND

UTILITY POLE	CONCRETE COLUMN	VENT
GAS VALVE	VAULT	WELL
WATER VALVE	SIGN	WATER METER
HYDRANT	POST	GAS FILL
WATER SHUT OFF	BASIN	GAS METER
CATCH BASIN	CENTERLINE	GAS PUMP
GUY WIRE	FIRE ALARM	STAKE
MAN HOLE	MONUMENT	BOLLARD
MAN HOLE (SANITARY)	OIL FILL	
MAN HOLE (STORM)	TELEPHONE	
MAN HOLE (TELEPHONE)	GRATE (ROUND)	
MAN HOLE (ELECTRIC)	GRATE (SQUARE)	
MAN HOLE (WATER)	GUY WIRE CONNECTION	
GAS LINE MARKER	JUNCTION BOX	
LIGHT POLE	MAIL BOX	



TOTAL UPLAND AREA = 132,144 SQ. FT.

TOTAL AREA OF LANDS UNDERWATER = 45,805 SQ. FT.

NOTE :

COORDINATES AND BEARINGS SHOWN ARE REFERENCED TO THE BOROUGH OF STATEN ISLAND, AS ESTABLISHED BY THE U.S. C. & G. SURVEY FOR THE BORO OF STATEN ISLAND.

ELEVATIONS SHOWN ARE REFERENCED TO STATEN ISLAND BORO DATUM. WHICH IS 3.19 ABOVE MEAN SEA LEVEL SANDY HOOK, N.J. (US C&G SURVEY) NGVD29.

LEGAL GRADE SHOWN THUS . . . . . . [X.X]
EXISTING GRADES SHOWN THUS . . . . (X.X)
PROPOSED GRADES SHOWN THUS . . . <X.X>
GROUND ELEVATIONS SHOWN THUS . . . X.X

Note :

The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

Map of Survey
Port Richmond
September 15, 1999
Tax Lots 26
Tax Block 1105
Filed Map Lots
Filed Map Block
Filed Map
Deed
Borough of Staten Island
County of Richmond
New York, NY

CERTIFIED ONLY TO:
Dolan Transportation

NOTE: The Underground Utility Information Shown Hereon Is One Of Several Possible Interpretations Of The Record Data As Provided By The Respective Utility Companies.
Rogers Surveying,PLLC. Assumes No Responsibility For The Actual Location, Size, And Depth Of Any Utility Lines.
The Location And Depth Of All Underground Utilities Must Be Verified With The Respective Utility Prior To Any Design And Construction.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

REVISIONS	JOB #	DATE	FB. / PG.

Richmond Terrace
Dolan Transportation Property
STATEN ISLAND, NEW YORK

Drafted by: RL	ROGERS SURVEYING,PLLC 1632 Richmond Terr., Staten Island, NY 10310 (718) 447 7311 Fax (718) 273 3560	Date : 9/15/99
Checked by: JL		Scale : 1"=30'
Dwg. File: 14243-1		Job No. : 21787
Disk No. 213	Topographical Survey	F.B./Pg. 214/63

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APPENDIX M

GEOTECHNICAL ANALYSIS DATA

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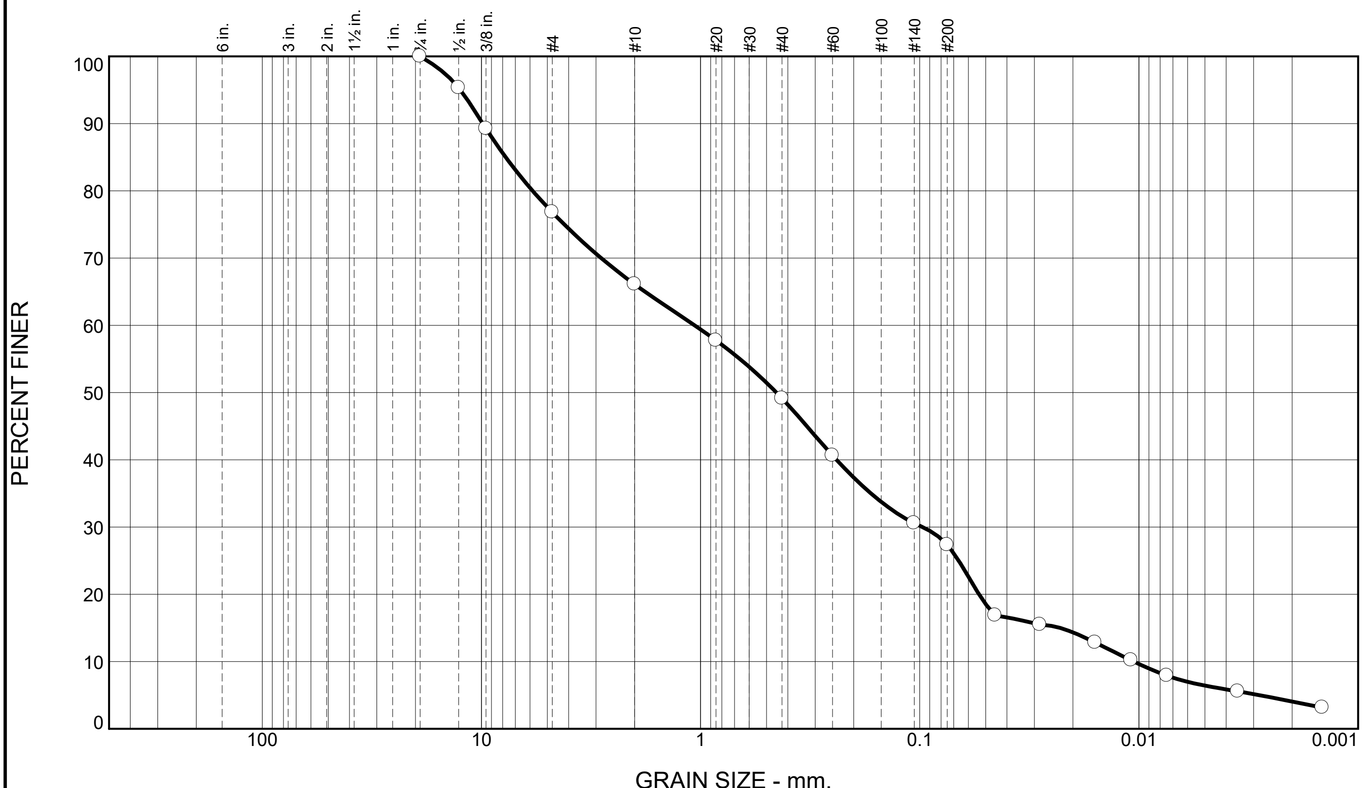
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	23	11	17	22	21	6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100		
.5	95		
.375	89		
#4	77		
#10	66		
#20	58		
#40	49		
#60	41		
#140	31		
#200	27		

* (no specification provided)

Material Description

Silty Sand with Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 9.8653 D_{85}= 7.7516 D_{60}= 1.0650
D_{50}= 0.4509 D_{30}= 0.0974 D_{15}= 0.0229
D_{10}= 0.0106 C_u= 100.86 C_c= 0.84

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content: 20.9%

Source of Sample: SB-06 **Depth:** 0.0-2.0'

Date: 10/15/2021

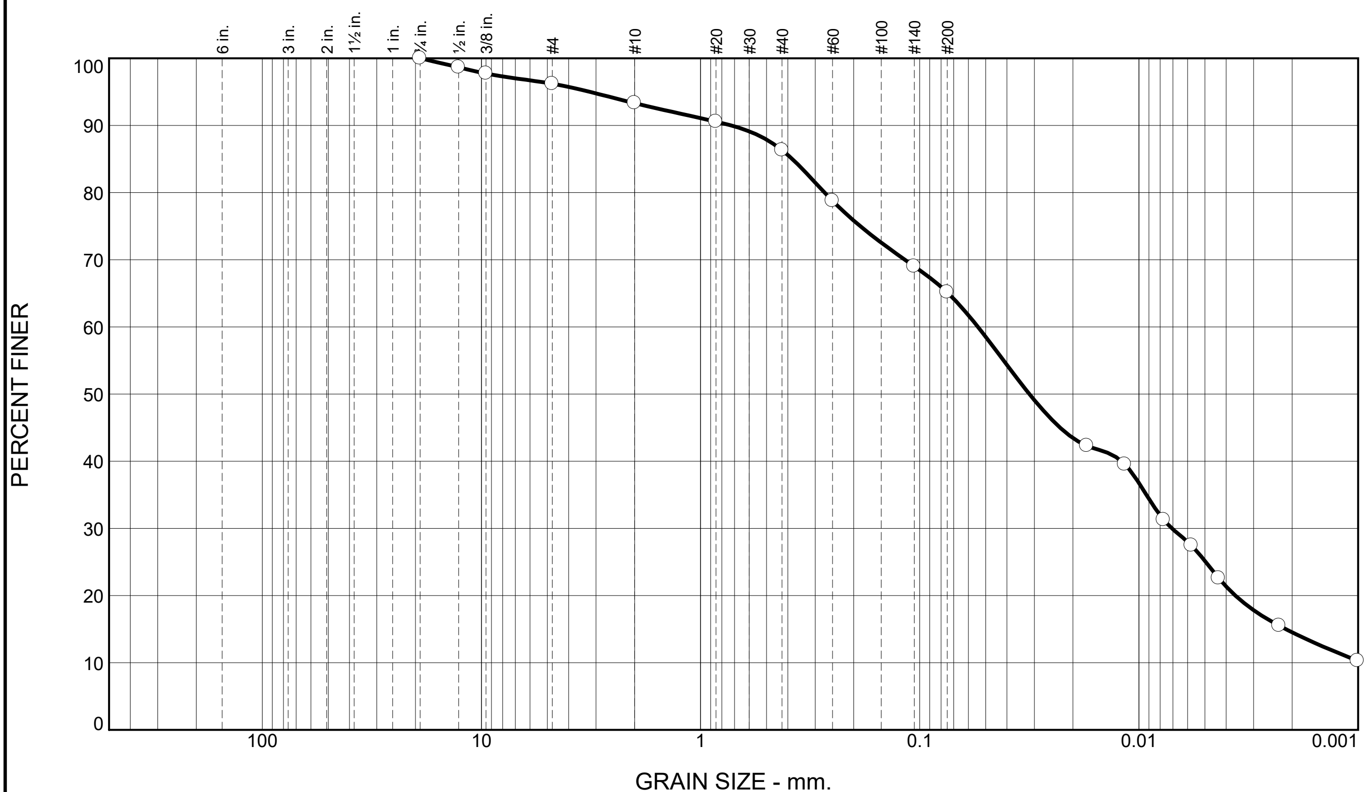
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** KA

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	4	3	7	21	40	25

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100		
.5	99		
.375	98		
#4	96		
#10	93		
#20	91		
#40	86		
#60	79		
#140	69		
#200	65		

* (no specification provided)

Material Description

SANDY LEAN CLAY

Atterberg Limits

PL= 19 LL= 27 PI= 8

Coefficients

D_{90}= 0.7277 D_{85}= 0.3820 D_{60}= 0.0543
D_{50}= 0.0316 D_{30}= 0.0071 D_{15}= 0.0021
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(3)

Remarks

Moisture Content - 18.7%

Source of Sample: SB-06 **Depth:** 2.0-5.0'

Date: 10-14-21

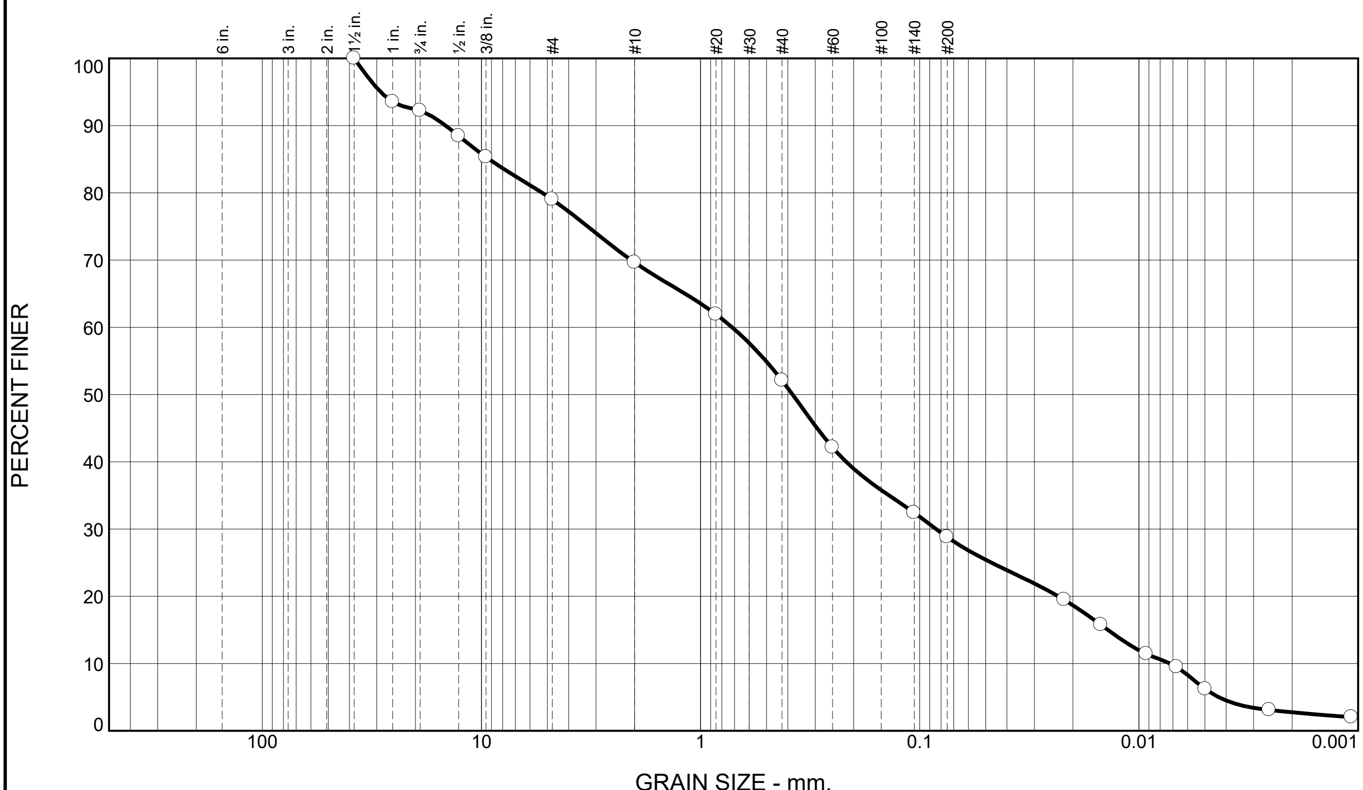
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	8	13	9	18	23	23	6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	94		
.75	92		
.5	88		
.375	85		
#4	79		
#10	70		
#20	62		
#40	52		
#60	42		
#140	32		
#200	29		

* (no specification provided)

Material Description

SILTY SAND WITH GRAVEL

Atterberg Limits

PL= 26 LL= 24 PI= 2

Coefficients

D_{90}= 14.5874 D_{85}= 9.2327 D_{60}= 0.7179
D_{50}= 0.3805 D_{30}= 0.0843 D_{15}= 0.0138
D_{10}= 0.0072 C_u= 99.55 C_c= 1.37

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content - 12.5%

Source of Sample: SB-10 **Depth:** 0-4.0'

Date: 10-14-21

Terracon, Inc.

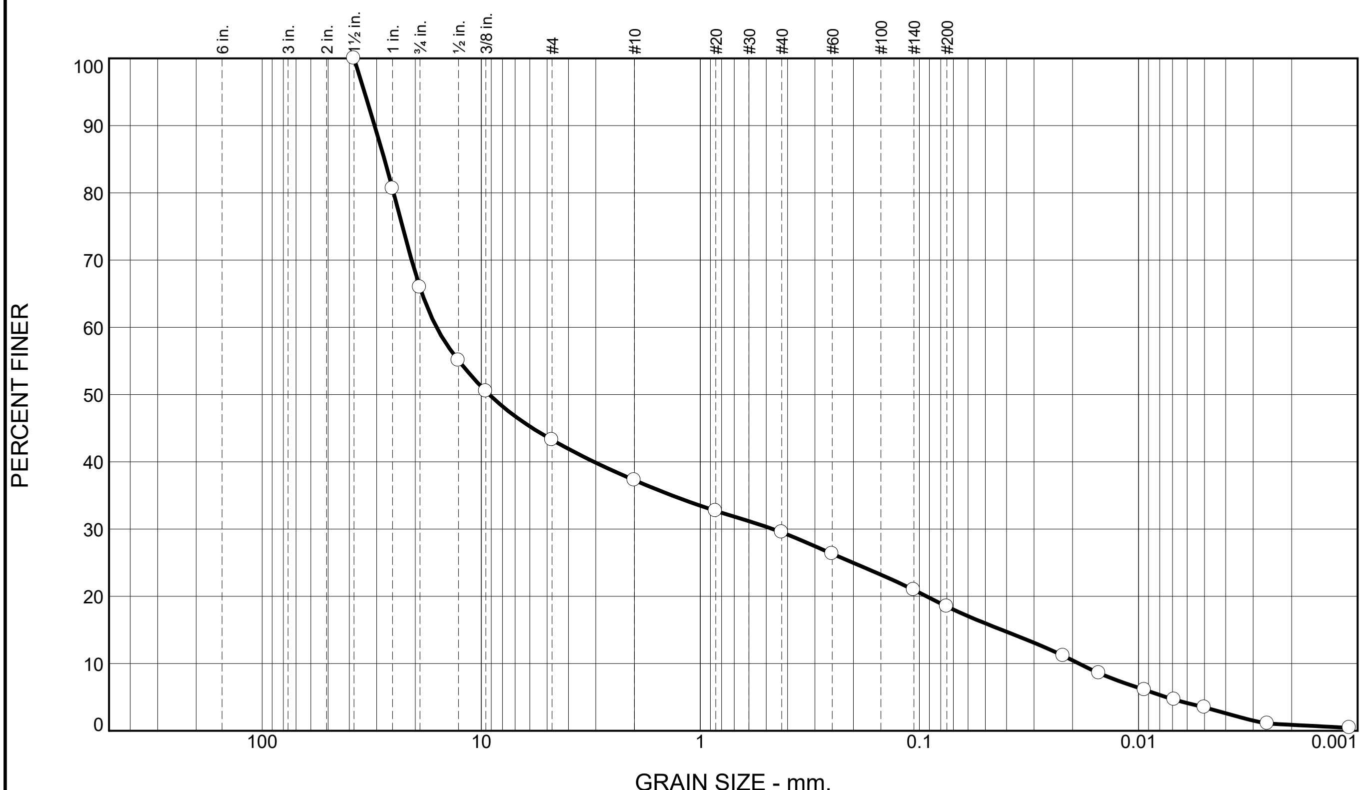
Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse

Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	34	23	6	7	12	15	3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	81		
.75	66		
.5	55		
.375	50		
#4	43		
#10	37		
#20	33		
#40	30		
#60	26		
#140	21		
#200	18		

* (no specification provided)

Material Description

SILTY GRAVEL WITH SAND

Atterberg Limits

PL= 18 LL= 21 PI= 3

Coefficients

D_{90}= 30.6609 D_{85}= 27.6642 D_{60}= 15.9999
D_{50}= 9.1913 D_{30}= 0.4676 D_{15}= 0.0421
D_{10}= 0.0187 C_u= 854.85 C_c= 0.73

Classification

USCS= GM AASHTO= A-1-b

Remarks

Moisture Content: 11.0%

Source of Sample: SB-10 **Depth:** 4.0-8.0'

Date: 10-14-21

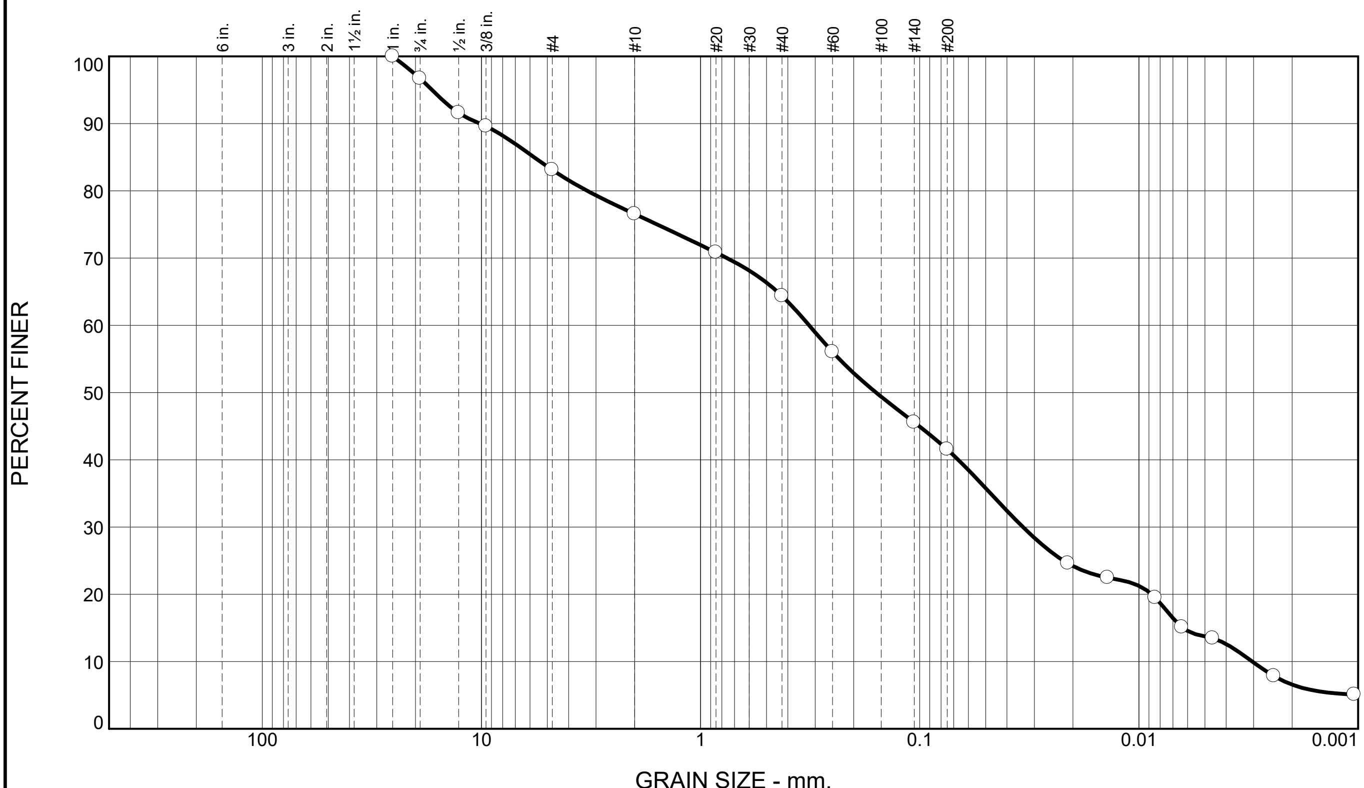
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	3	14	6	13	22	28	14

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	97		
.5	92		
.375	90		
#4	83		
#10	77		
#20	71		
#40	64		
#60	56		
#140	46		
#200	42		

* (no specification provided)

Material Description

SILTY, CLAYEY SAND WITH GRAVEL

Atterberg Limits

PL= 17 LL= 21 PI= 4

Coefficients

D_{90}= 10.1635 D_{85}= 5.7508 D_{60}= 0.3198
D_{50}= 0.1582 D_{30}= 0.0338 D_{15}= 0.0063
D_{10}= 0.0030 C_u= 105.27 C_c= 1.18

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Moisture Conent - 21.7%

Source of Sample: SB-12 **Depth:** 6.0-8.0'

Date: 10-11-21

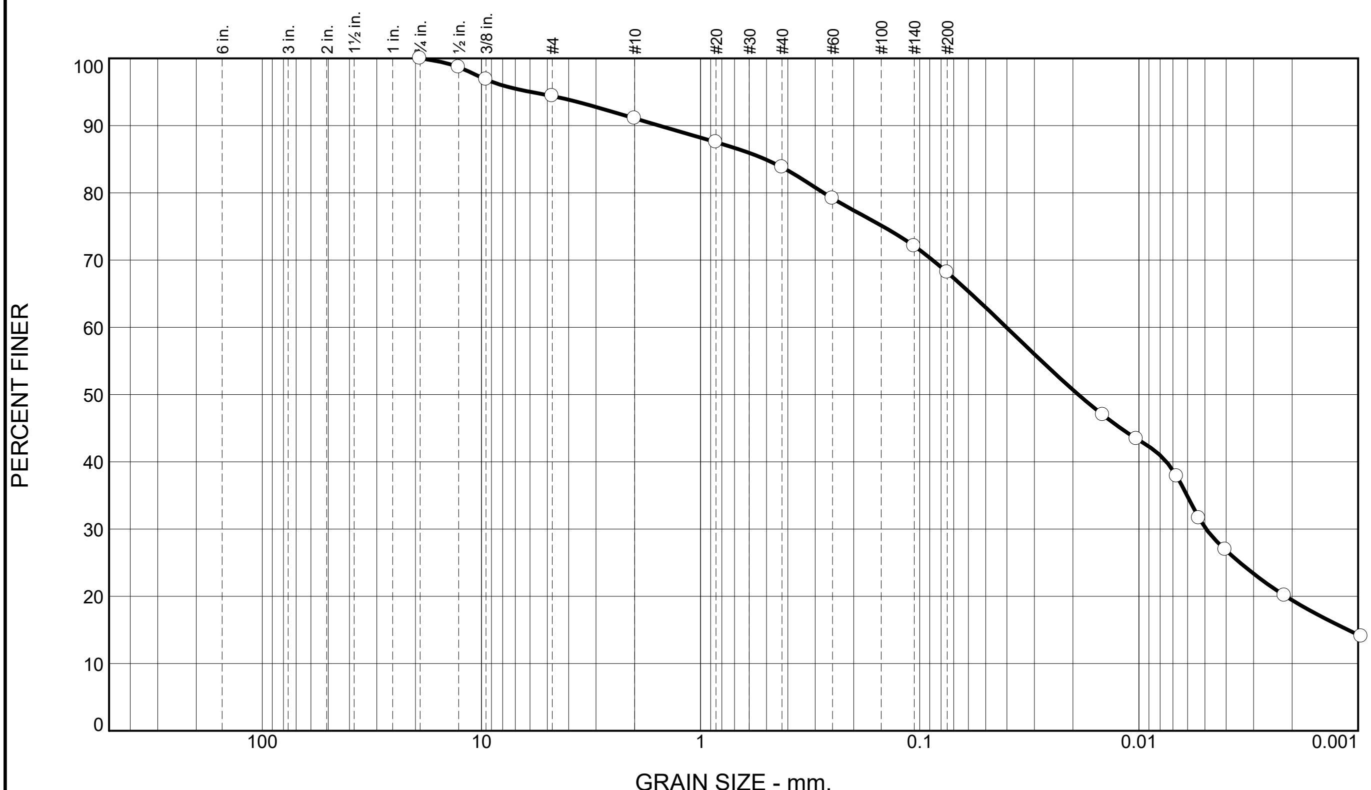
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	6	3	7	16	38	30

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100		
.5	99		
.375	97		
#4	94		
#10	91		
#20	88		
#40	84		
#60	79		
#140	72		
#200	68		

* (no specification provided)

Material Description

SANDY SILTY CLAY

Atterberg Limits

PL= 17 LL= 24 PI= 7

Coefficients

D_{90}= 1.5471 D_{85}= 0.5076 D_{60}= 0.0402
D_{50}= 0.0189 D_{30}= 0.0049 D_{15}= 0.0011
D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(2)

Remarks

Moisture Content - 16.0%

Source of Sample: SB-12 **Depth:** 11.0-12.0'

Date: 10-14-21

Terracon, Inc.

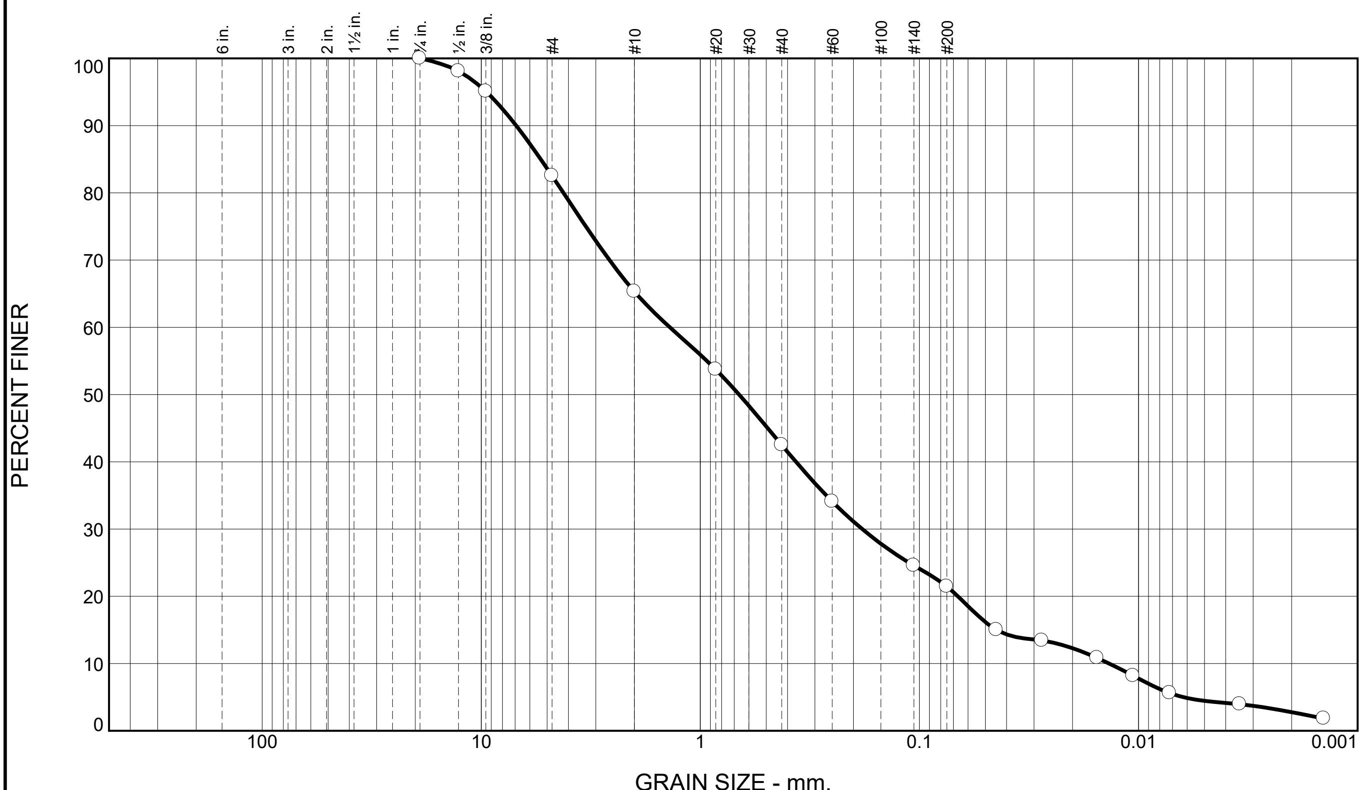
Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse

Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	17	18	23	21	17	4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100		
.5	98		
.375	95		
#4	83		
#10	65		
#20	54		
#40	42		
#60	34		
#140	25		
#200	21		

* (no specification provided)

Material Description

Silty Sand with Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 6.9255 D_{85}= 5.3537 D_{60}= 1.3784
D_{50}= 0.6659 D_{30}= 0.1825 D_{15}= 0.0445
D_{10}= 0.0136 C_u= 101.14 C_c= 1.77

Classification

USCS= SM AASHTO= A-1-b

Remarks

Moisture Content: 19.6%

Source of Sample: SB-14 **Depth:** 4.0-6.0'

Date: 10/15/2021

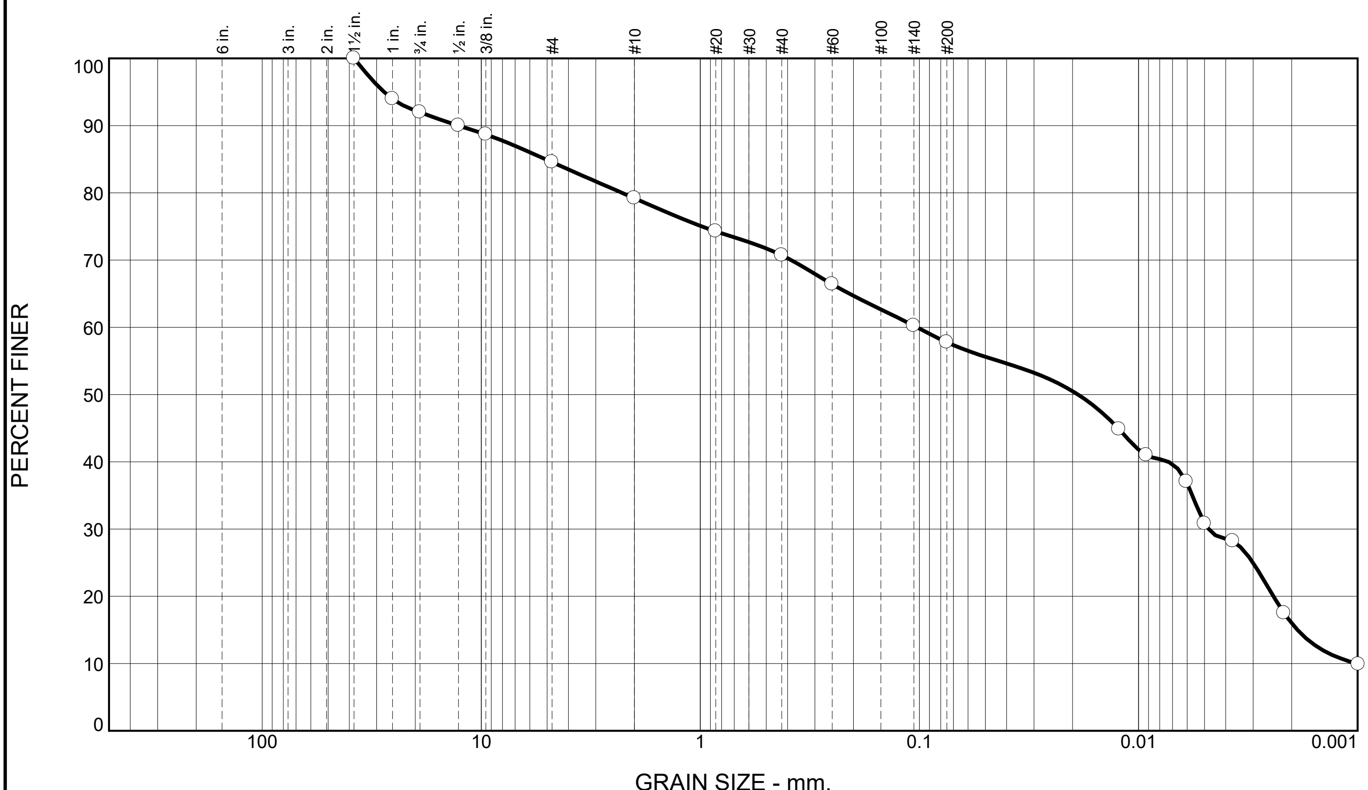
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** KA

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	8	7	6	8	13	27	31

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	94		
.75	92		
.5	90		
.375	89		
#4	85		
#10	79		
#20	74		
#40	71		
#60	66		
#140	60		
#200	58		

* (no specification provided)

Material Description

Sandy Lean Clay with Gravel

Atterberg Limits

PL= 22 LL= 34 PI= 12

Coefficients

D_{90}= 12.7493 D_{85}= 5.0953 D_{60}= 0.1026
D_{50}= 0.0189 D_{30}= 0.0048 D_{15}= 0.0019
D_{10}= 0.0010 C_u= 100.84 C_c= 0.22

Classification

USCS= CL AASHTO= A-6(5)

Remarks

Moisture Content - 52.0%

Source of Sample: SB-14 **Depth:** 8.0-12.0'

Date: 10/21/2021

Terracon, Inc.

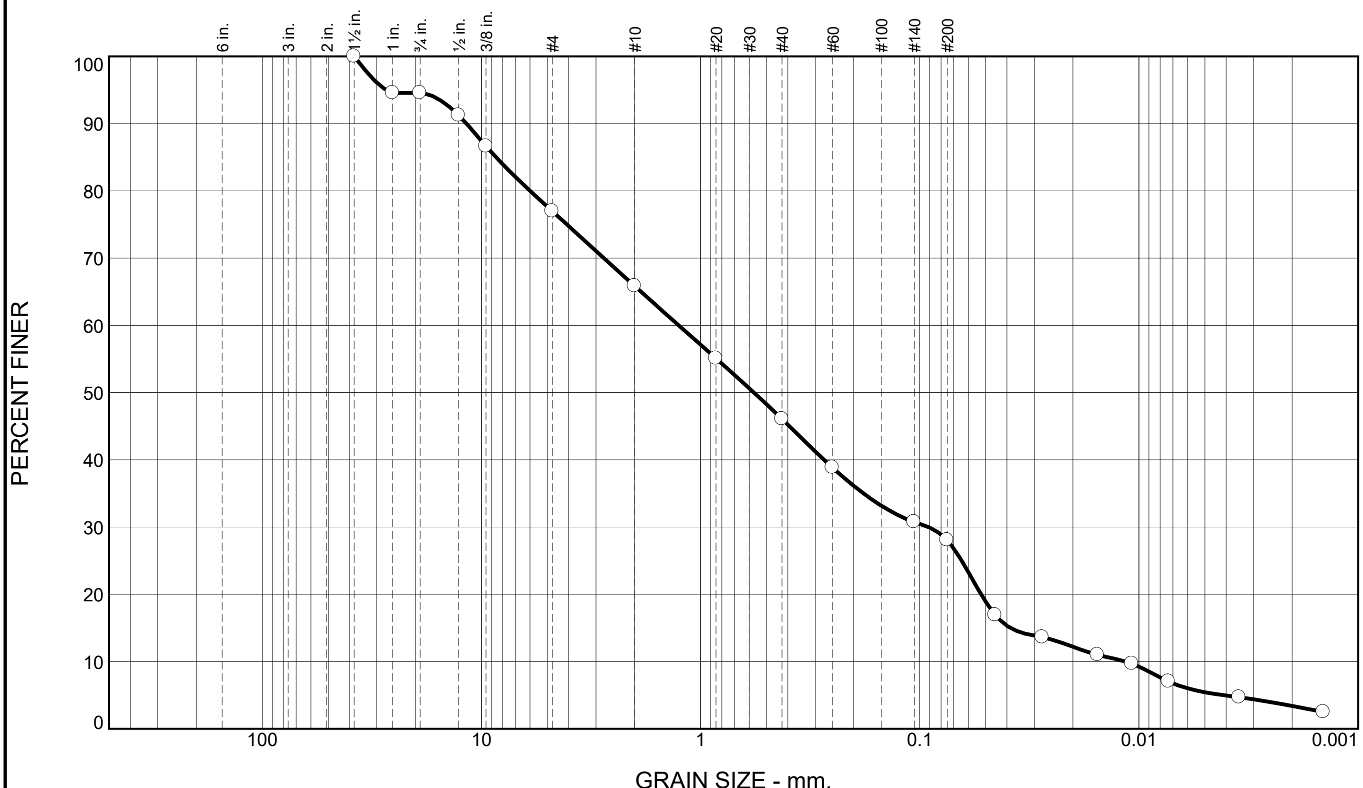
Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse

Project No: N1211568 **Figure**

Tested By: CS **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	5	18	11	20	18	23	5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	95		
.75	95		
.5	91		
.375	87		
#4	77		
#10	66		
#20	55		
#40	46		
#60	39		
#140	31		
#200	28		

* (no specification provided)

Material Description

Silty Sand with Gravel

Atterberg Limits

PL= 36 LL= 41 PI= 5

Coefficients

D_{90}= 11.7080 D_{85}= 8.5767 D_{60}= 1.2588
D_{50}= 0.5715 D_{30}= 0.0914 D_{15}= 0.0386
D_{10}= 0.0115 C_u= 109.17 C_c= 0.58

Classification

USCS= SM AASHTO= A-2-5(0)

Remarks

Moisture Content: 22.3%

Source of Sample: SB-16 **Depth:** 0.0-2.0'

Date: 10/15/2021

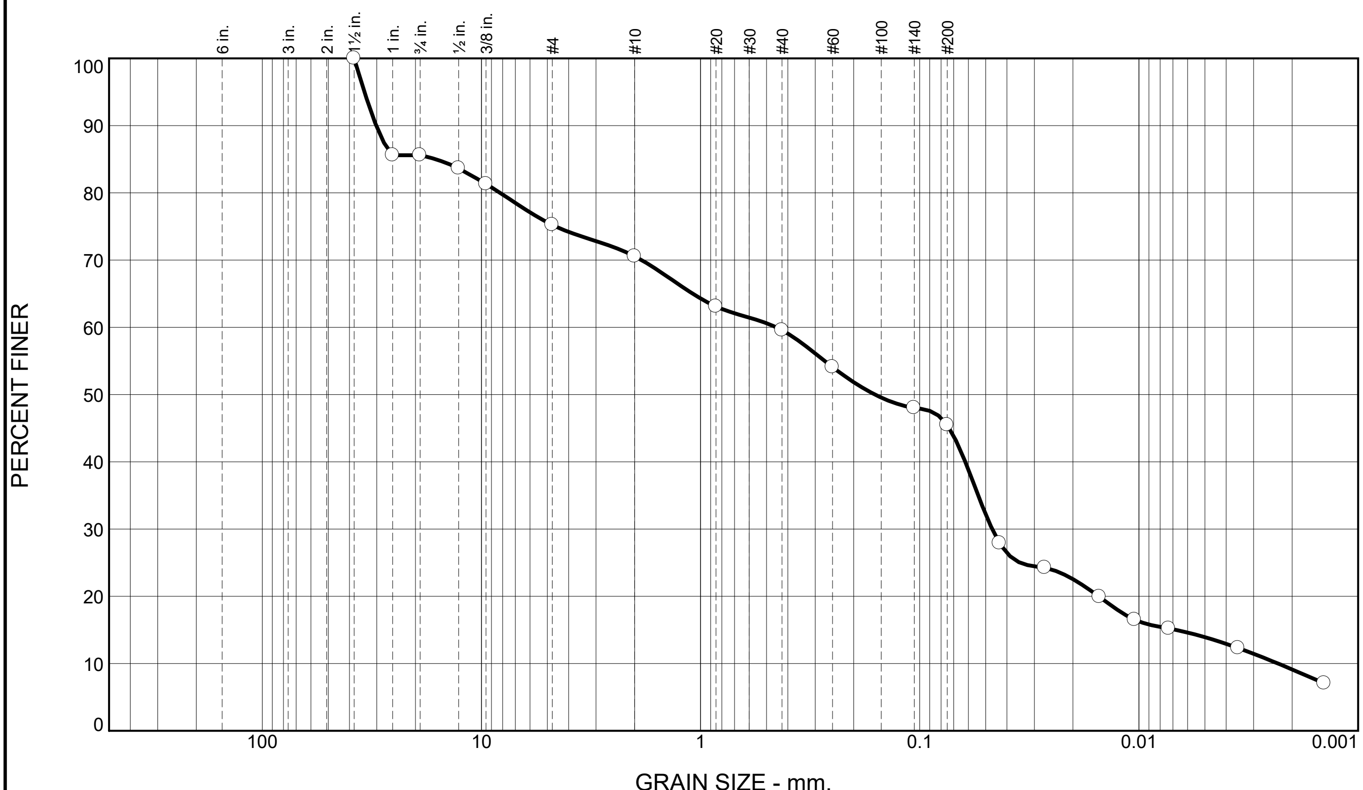
Terracon, Inc.

Cincinnati, Ohio

Client: Geo Consultants
Project: Staten Island Warehouse
Project No: N1211568 **Figure**

Tested By: CS **Checked By:** KA

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	14	11	4	11	15	31	14

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50	100		
1	86		
.75	86		
.5	84		
.375	81		
#4	75		
#10	71		
#20	63		
#40	60		
#60	54		
#140	48		
#200	45		

* (no specification provided)

Material Description

Silty, clayey sand with gravel

Atterberg Limits

PL= 22 LL= 27 PI= 5

Coefficients

D_{90}= 30.1988 D_{85}= 16.2004 D_{60}= 0.4513
D_{50}= 0.1603 D_{30}= 0.0468 D_{15}= 0.0068
D_{10}= 0.0023 C_u= 194.49 C_c= 2.09

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Moisture Content: 14%

Source of Sample: SB-16 **Depth:** 2.0-4.0'

Date: 10/18/2021

Terracon, Inc.

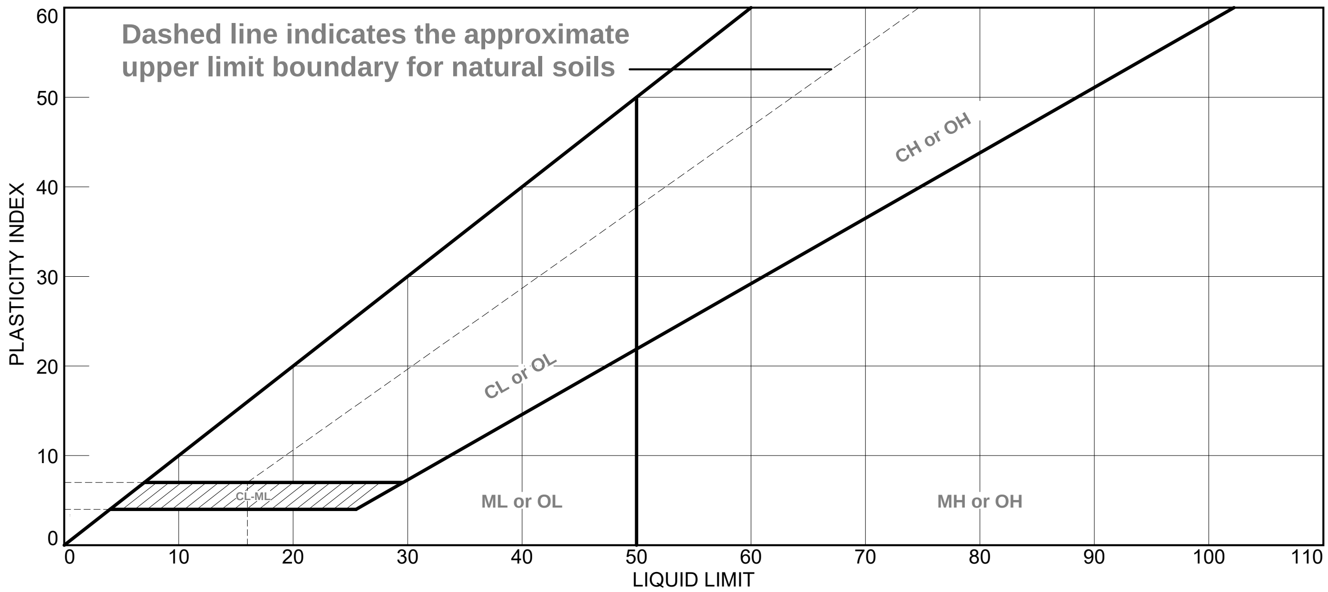
Cincinnati, Ohio

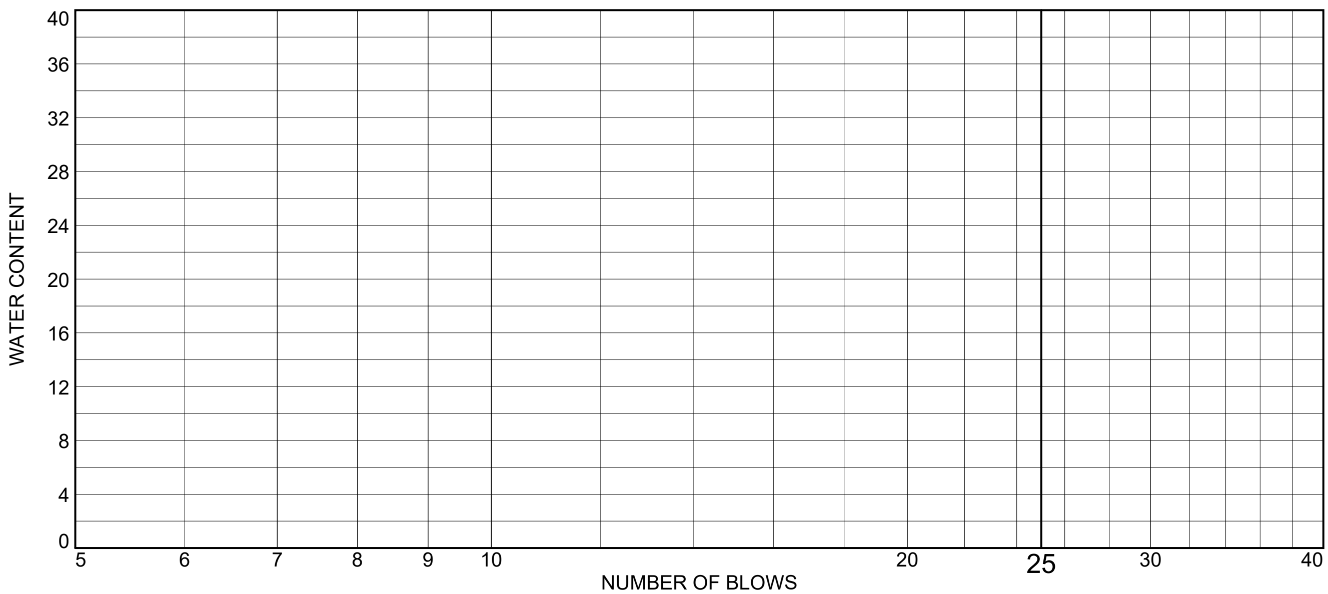
Client: Geo Consultants
Project: Staten Island Warehouse

Project No: N1211568 **Figure**

Tested By: CS **Checked By:** KA

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand with Gravel	NV	NP	NP	49	27	SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-06 **Depth:** 0.0-2.0'

Remarks:

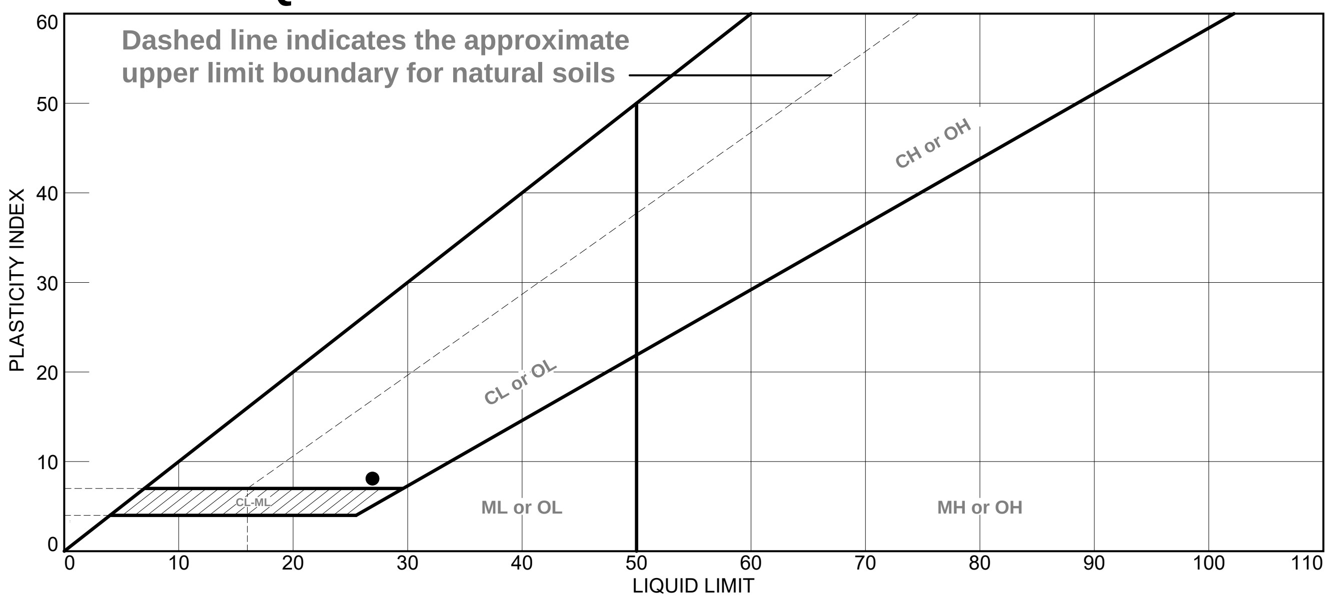
Terracon, Inc.

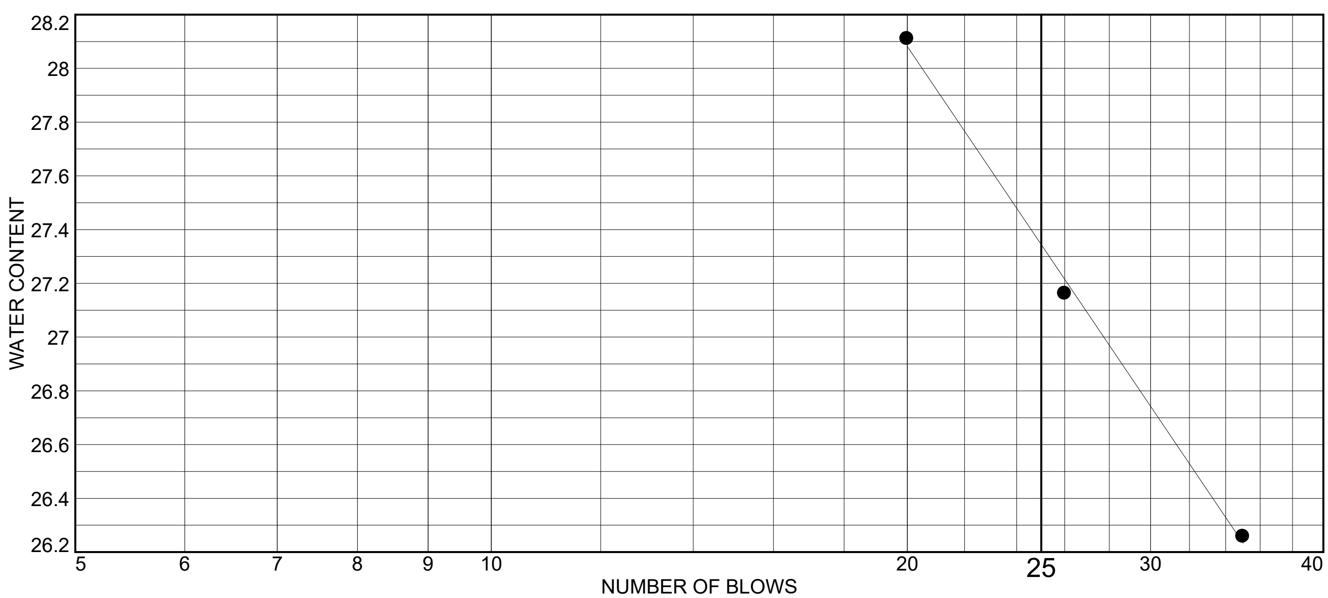
Cincinnati, Ohio

Figure

Tested By: FCE **Checked By:** KA **Date:** 10/15/2021

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY LEAN CLAY	27	19	8	86	65	CL

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-06 **Depth:** 2.0-5.0'

Remarks:

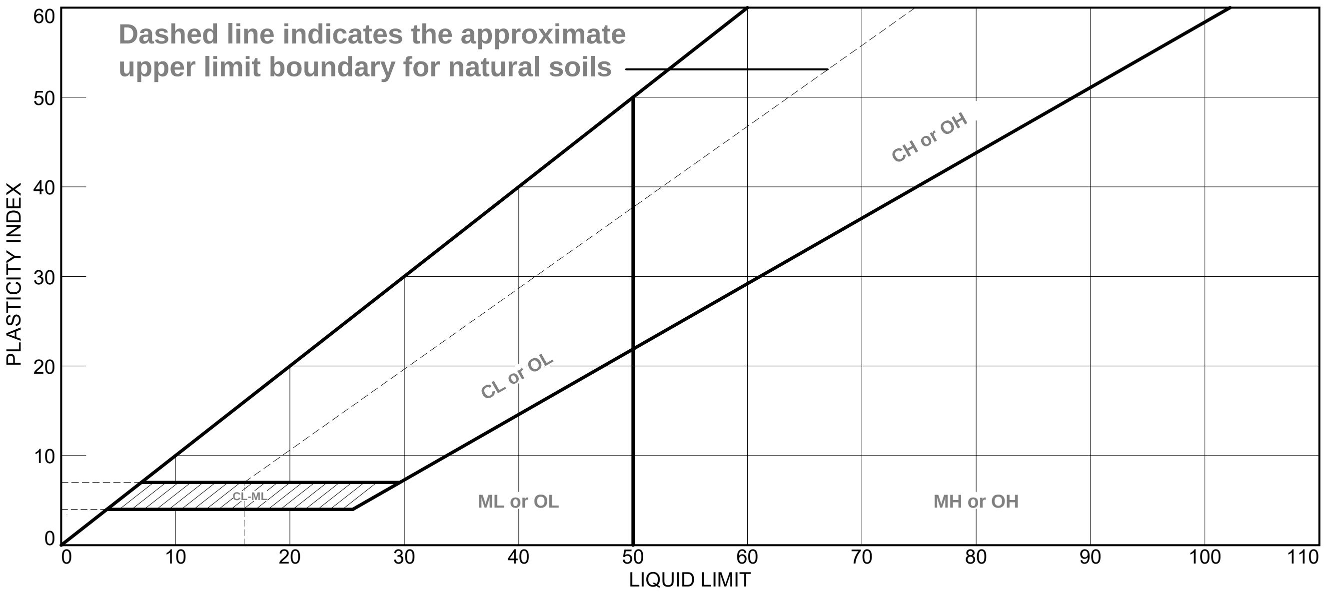
Terracon, Inc.

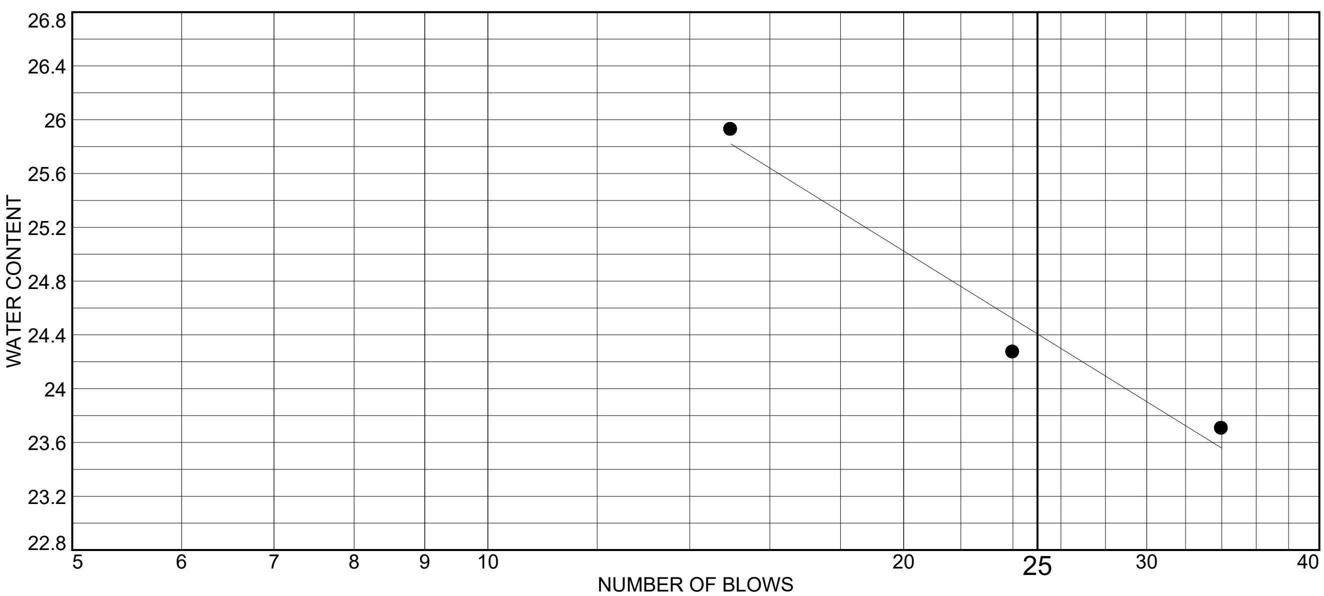
Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY SAND WITH GRAVEL	24	26	2	52	29	SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-10 **Depth:** 0-4.0'

Remarks:

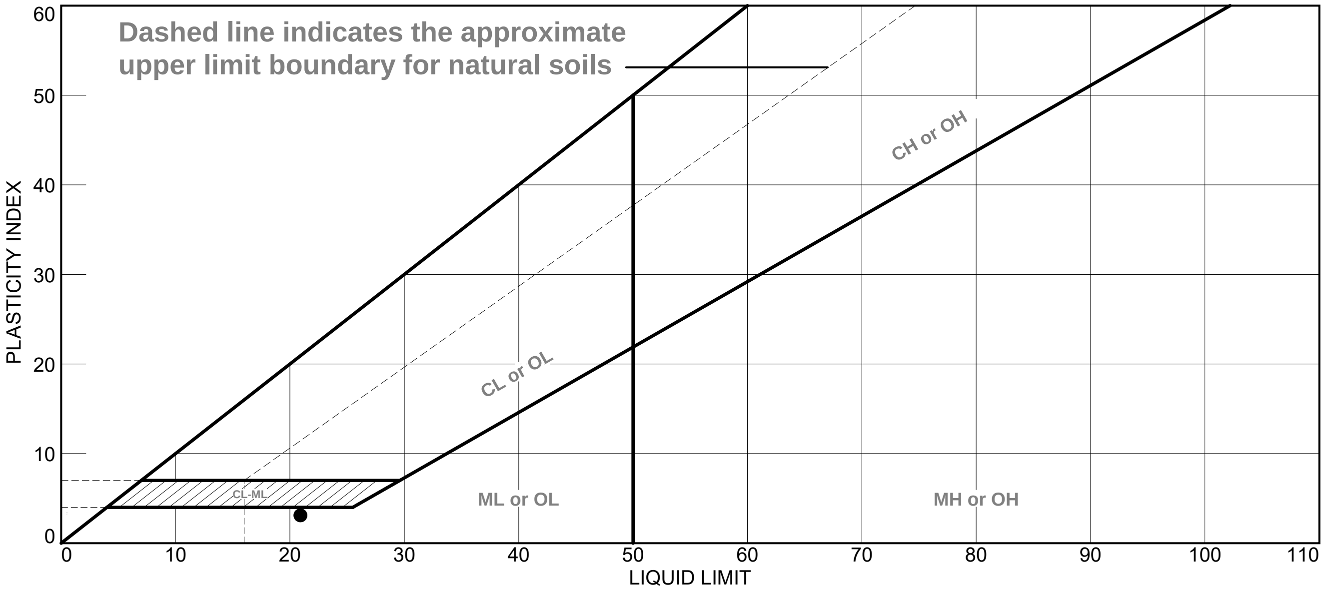
Terracon, Inc.

Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS **Date:** 10/14/2021

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY GRAVEL WITH SAND	21	18	3	30	18	GM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-10 **Depth:** 4.0-8.0'

Remarks:

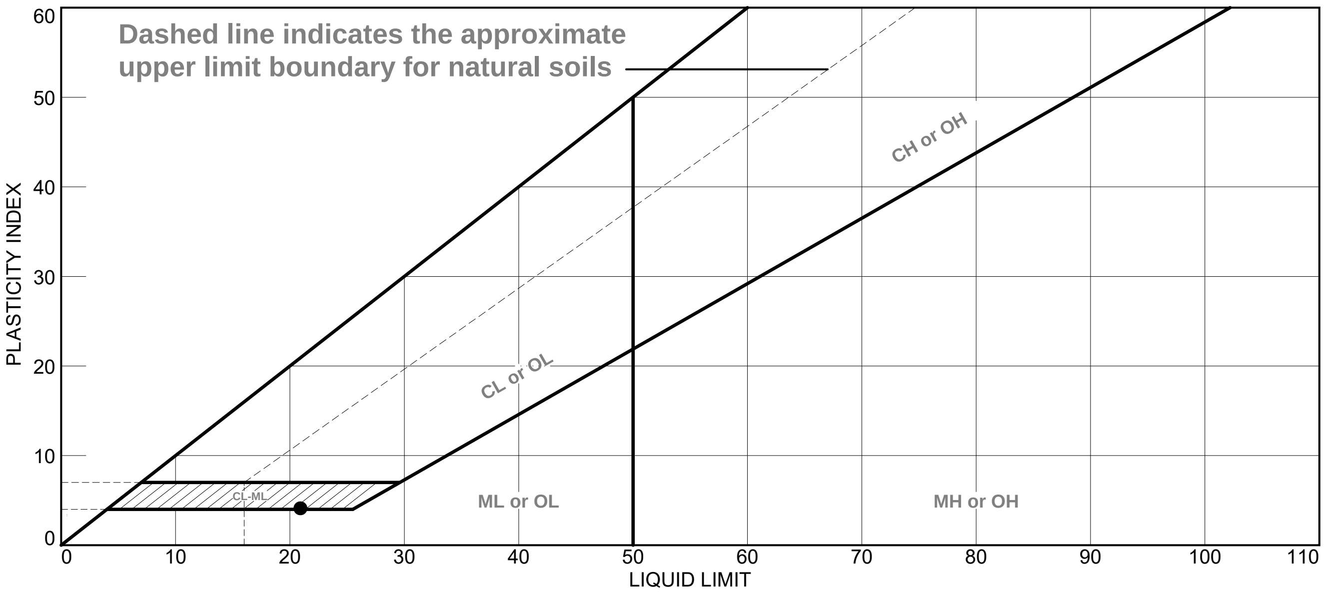
Terracon, Inc.

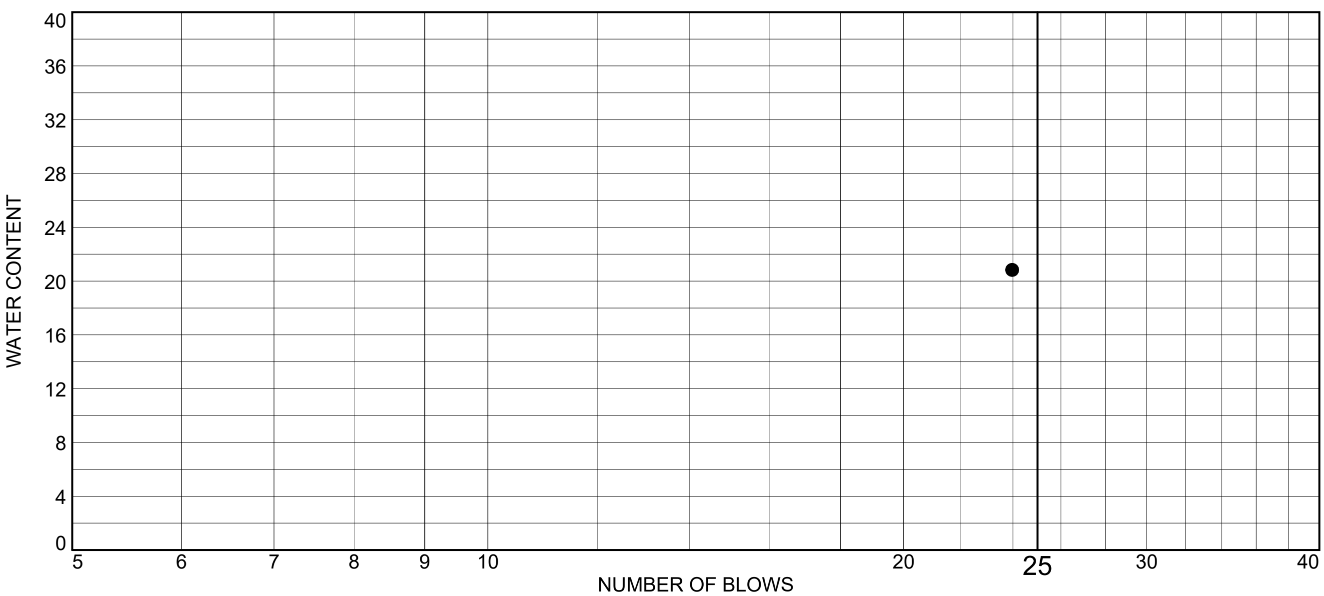
Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY, CLAYEY SAND WITH GRAVEL	21	17	4	64	42	SC-SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-12 **Depth:** 6.0-8.0'

Remarks:

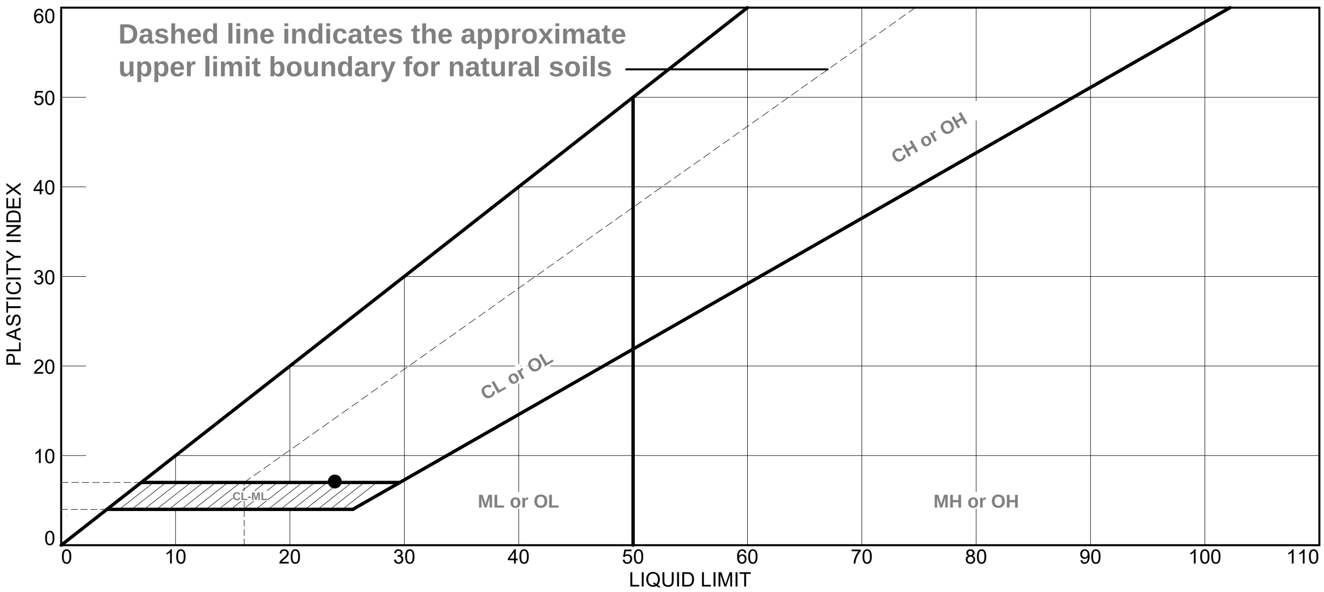
Terracon, Inc.

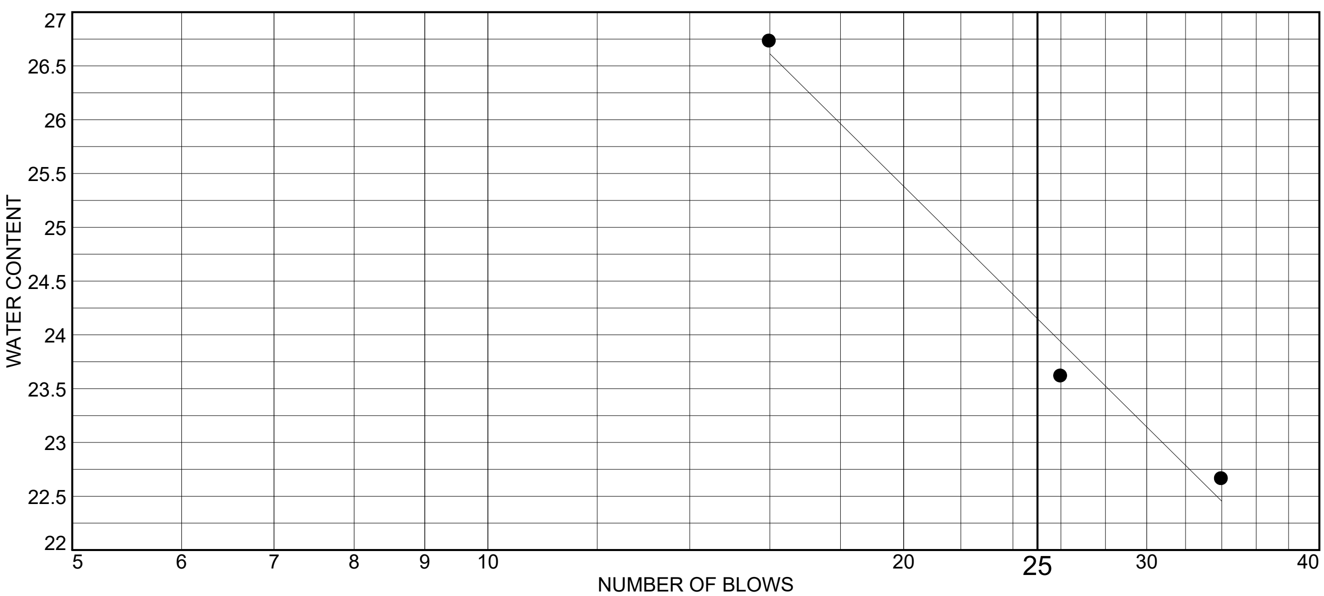
Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY SILTY CLAY	24	17	7	84	68	CL-ML

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-12 **Depth:** 11.0-12.0'

Remarks:

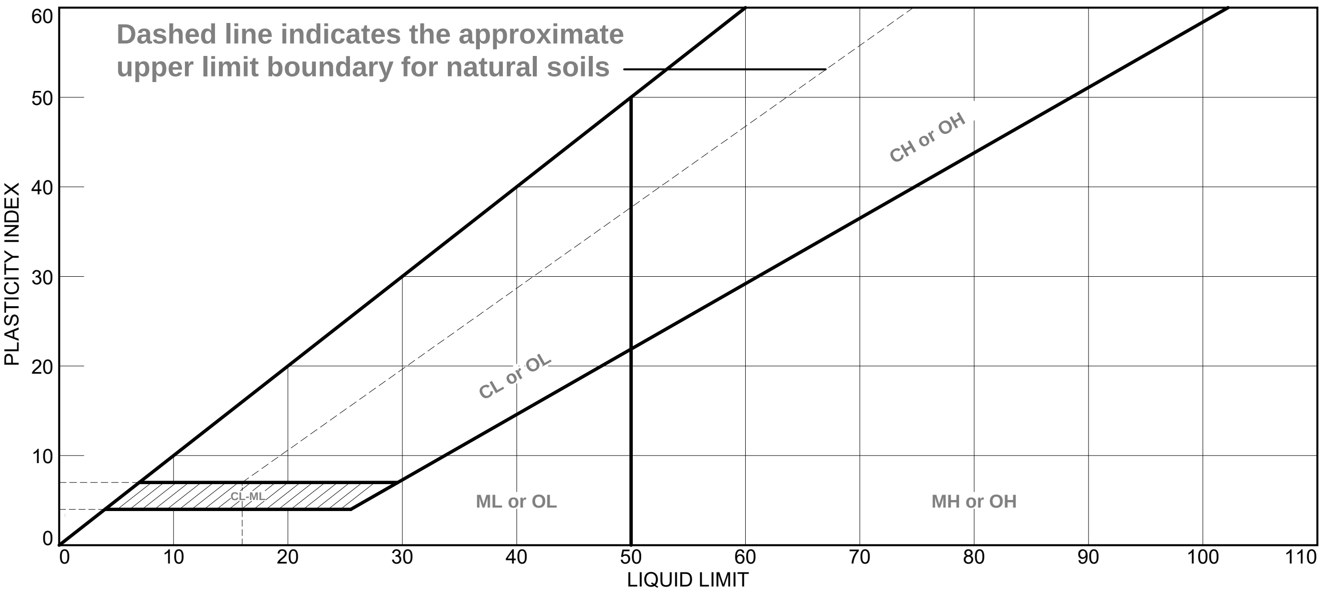
Terracon, Inc.

Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand with Gravel	NV	NP	NP	42	21	SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-14 **Depth:** 4.0-6.0'

Remarks:

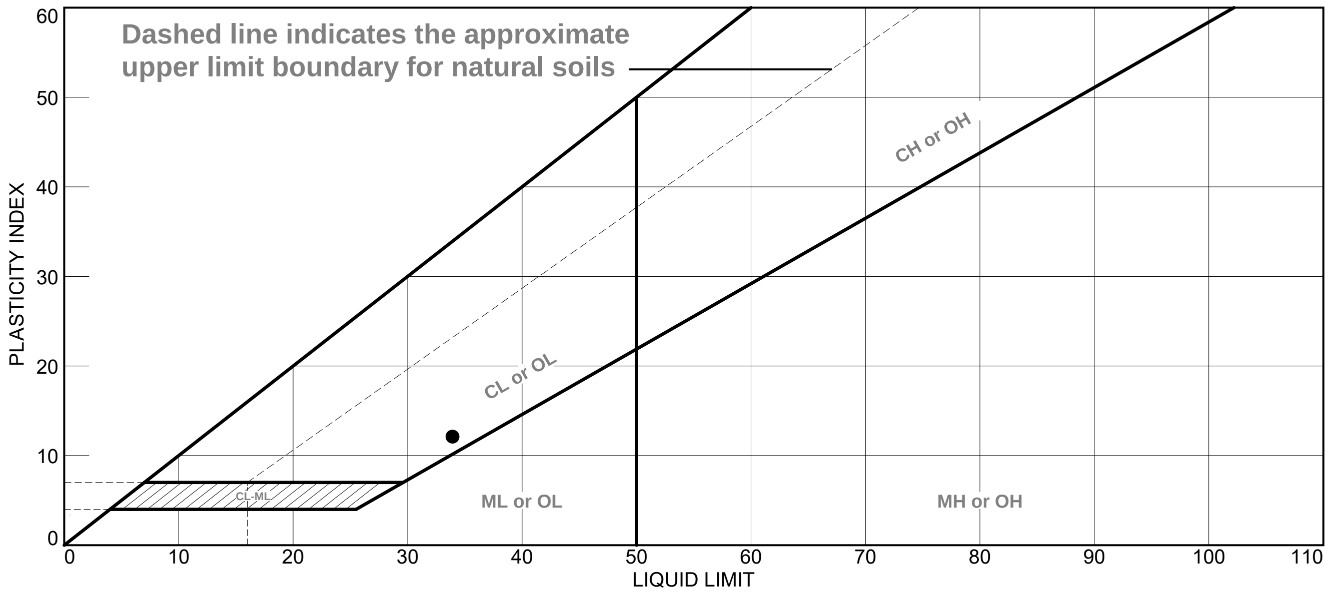
Terracon, Inc.

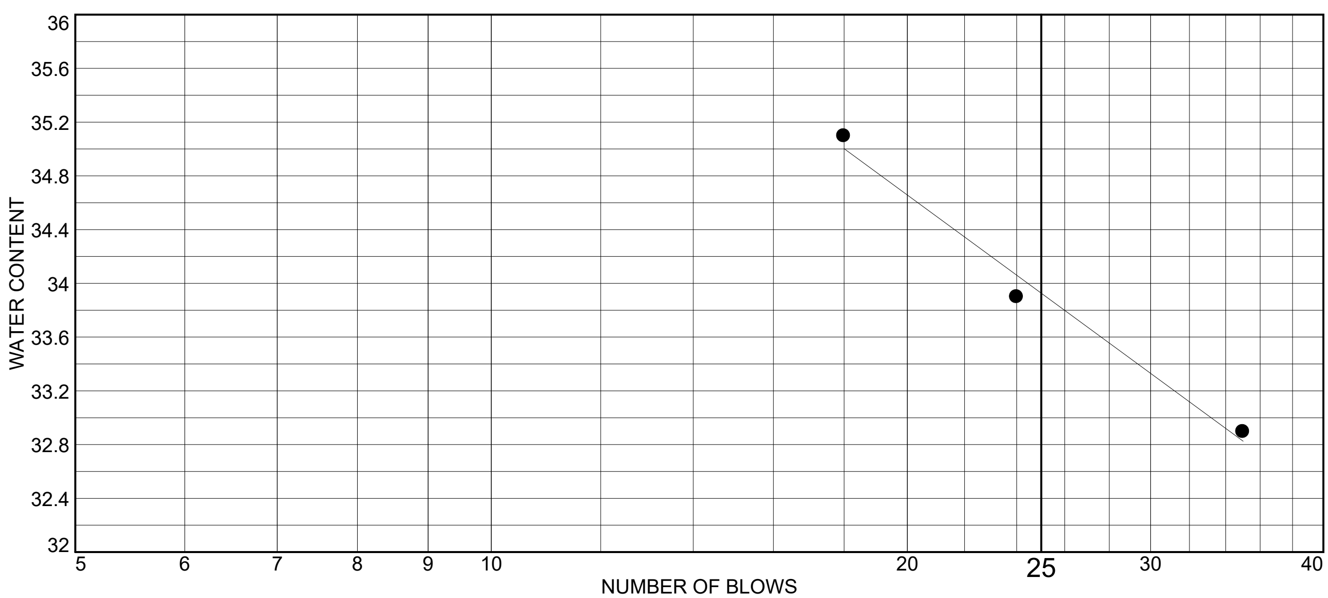
Cincinnati, Ohio

Figure

Tested By: FCE **Checked By:** KA **Date:** 10/15/2021

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Lean Clay with Gravel	34	22	12	71	58	CL

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-14 **Depth:** 8.0-12.0'

Remarks:

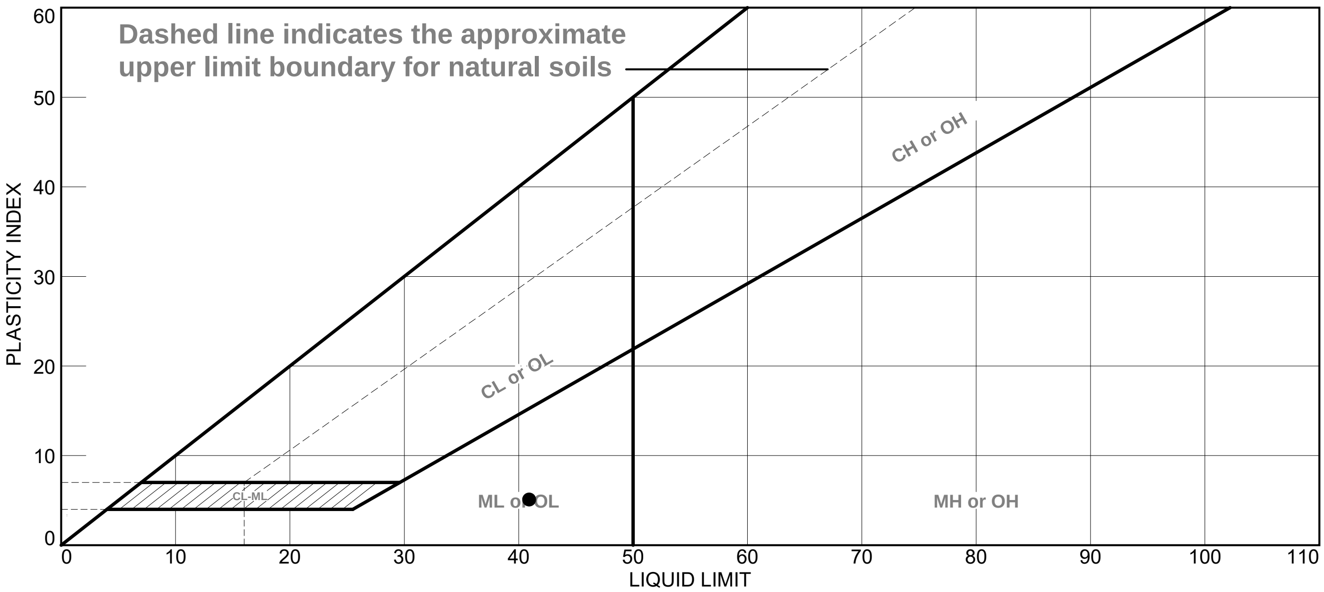
Terracon, Inc.

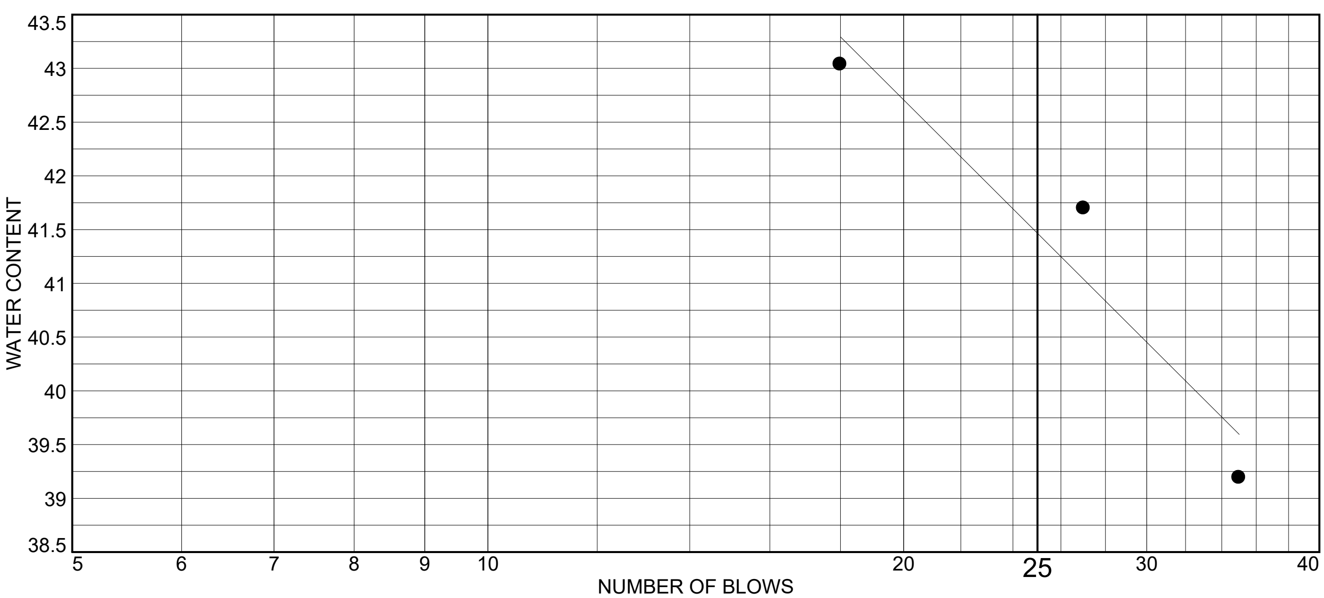
Cincinnati, Ohio

Figure

Tested By: CS **Checked By:** GS **Date:** 10/21/2021

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand with Gravel	41	36	5	46	28	SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-16 **Depth:** 0.0-2.0'

Remarks:

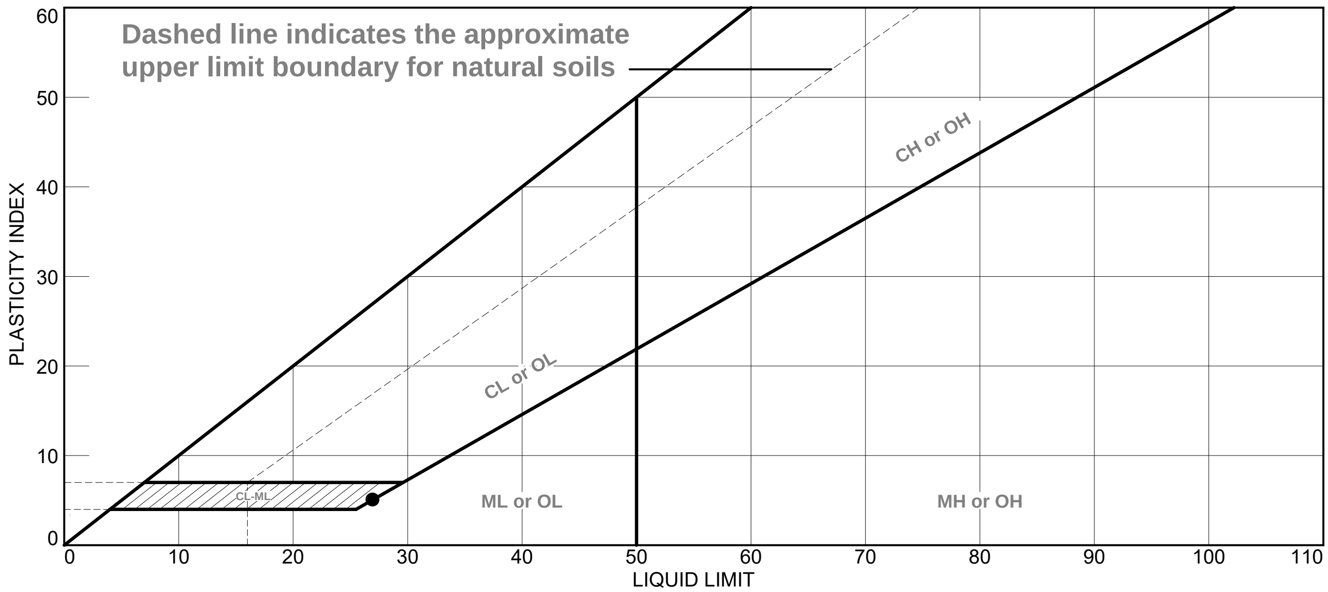
Terracon, Inc.

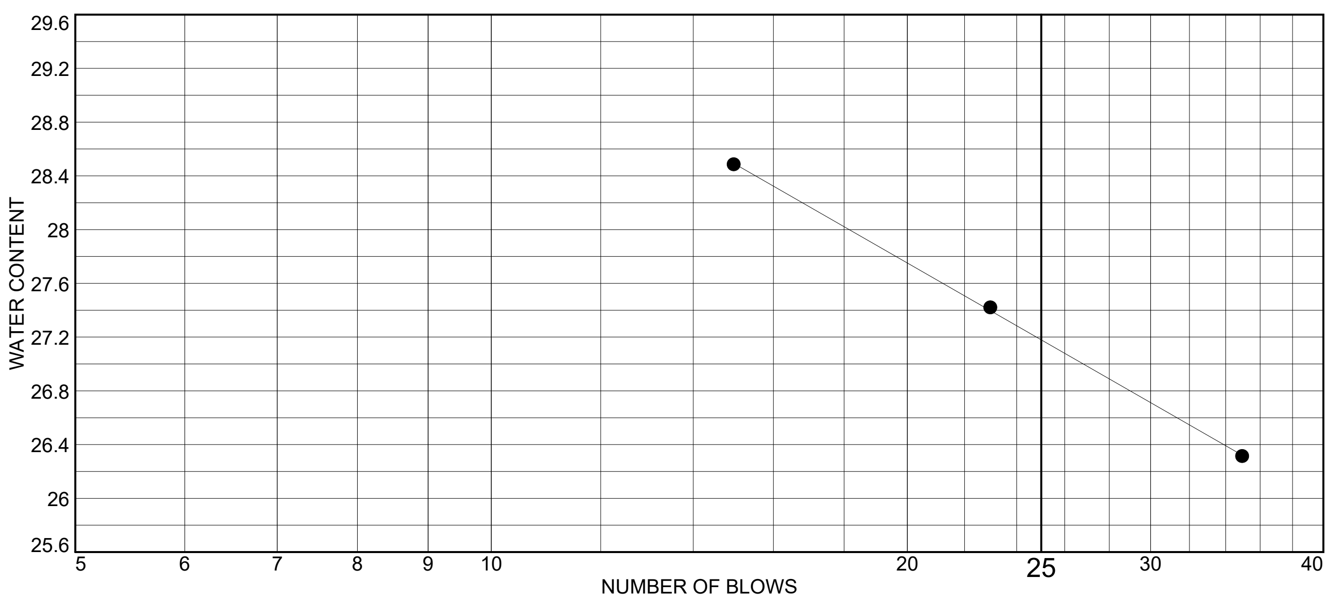
Cincinnati, Ohio

Figure

Tested By: FCE **Checked By:** KA **Date:** 10/15/2021

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty, clayey sand with gravel	27	22	5	60	45	SC-SM

Project No. N1211568 **Client:** Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-16 **Depth:** 2.0-4.0'

Remarks:

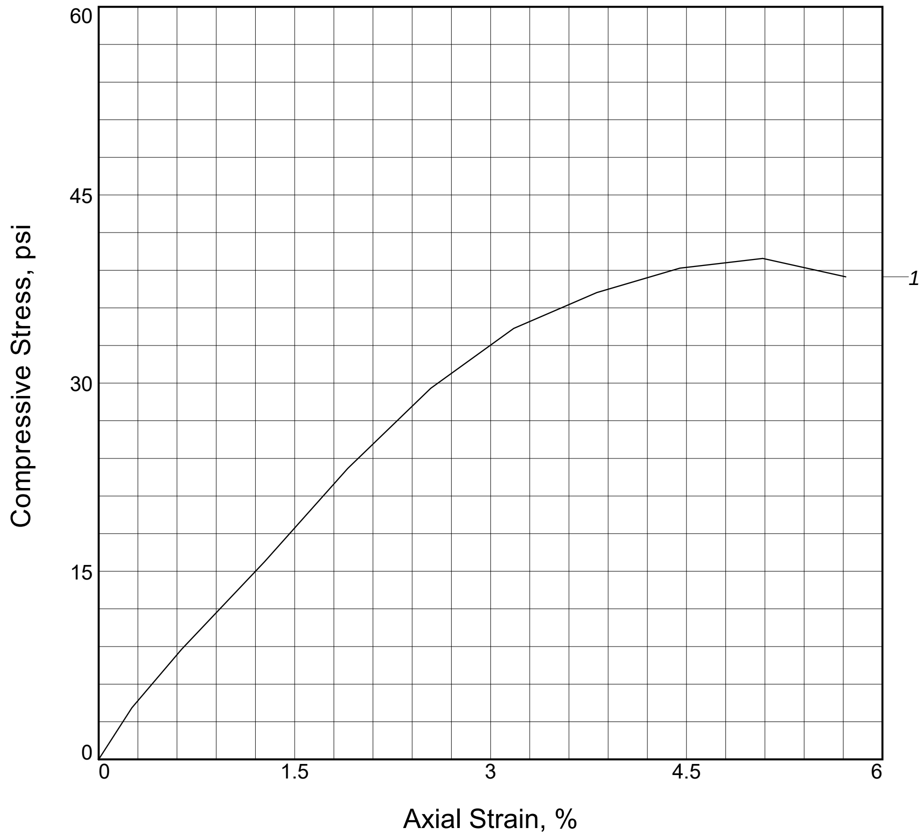
Terracon, Inc.

Cincinnati, Ohio

Figure

Tested By: FCE **Checked By:** KA **Date:** 10/18/2021

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	39.941			
Undrained shear strength, psi	19.971			
Failure strain, %	5.1			
Strain rate, in./min.	0.039			
Water content, %	13.4			
Wet density, pcf	140.1			
Dry density, pcf	123.5			
Saturation, %	99.2			
Void ratio	0.3646			
Specimen diameter, in.	1.635			
Specimen height, in.	3.934			
Height/diameter ratio	2.41			

Description: SILTY, CLAYEY SAND WITH GRAVEL

LL = 21	**PL =** 17	**PI =** 4	**Assumed GS=** 2.70	**Type:** Split Spoon

Project No.: N1211568

Date Sampled: 10-11-21

Remarks:

Figure ________

Client: Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-12 **Depth:** 6.0-8.0'

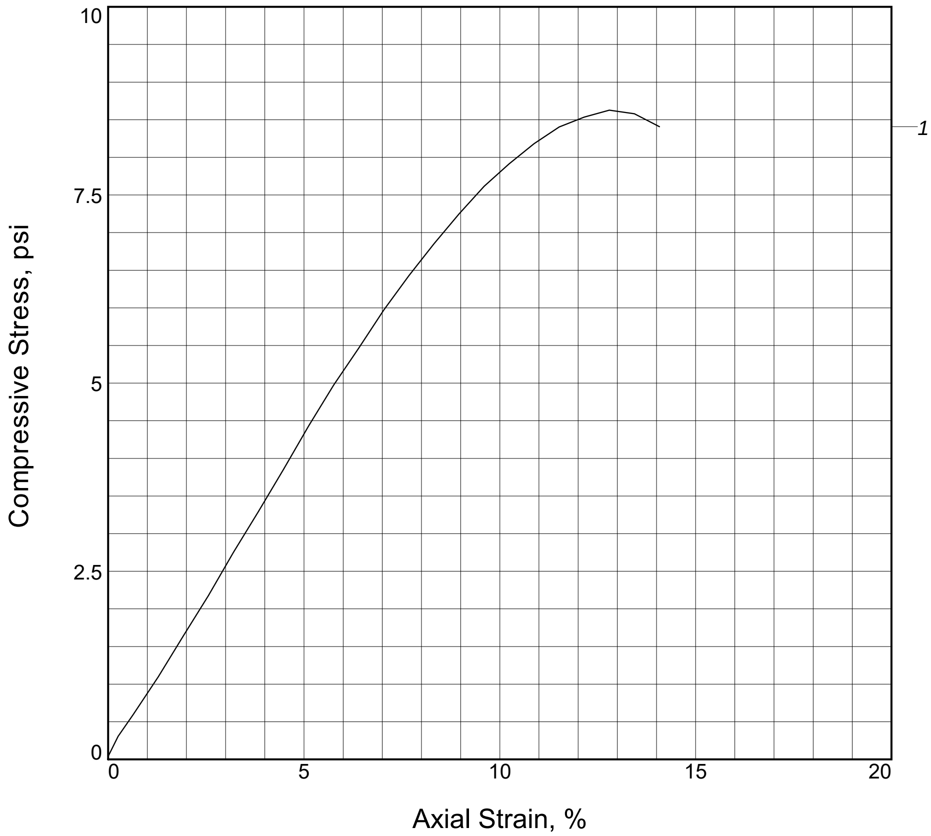
UNCONFINED COMPRESSION TEST

Terracon, Inc.

Cincinnati, Ohio

Tested By: FCE **Checked By:** GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	8.627			
Undrained shear strength, psi	4.313			
Failure strain, %	12.8			
Strain rate, in./min.	0.039			
Water content, %	20.9			
Wet density, pcf	126.0			
Dry density, pcf	104.2			
Saturation, %	91.2			
Void ratio	0.6173			
Specimen diameter, in.	1.616			
Specimen height, in.	3.907			
Height/diameter ratio	2.42			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Tube

Project No.: N1211568

Date Sampled: 10/8/2021

Remarks:
7594

Figure ________

Client: Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-14 **Depth:** 8.0-12.0'

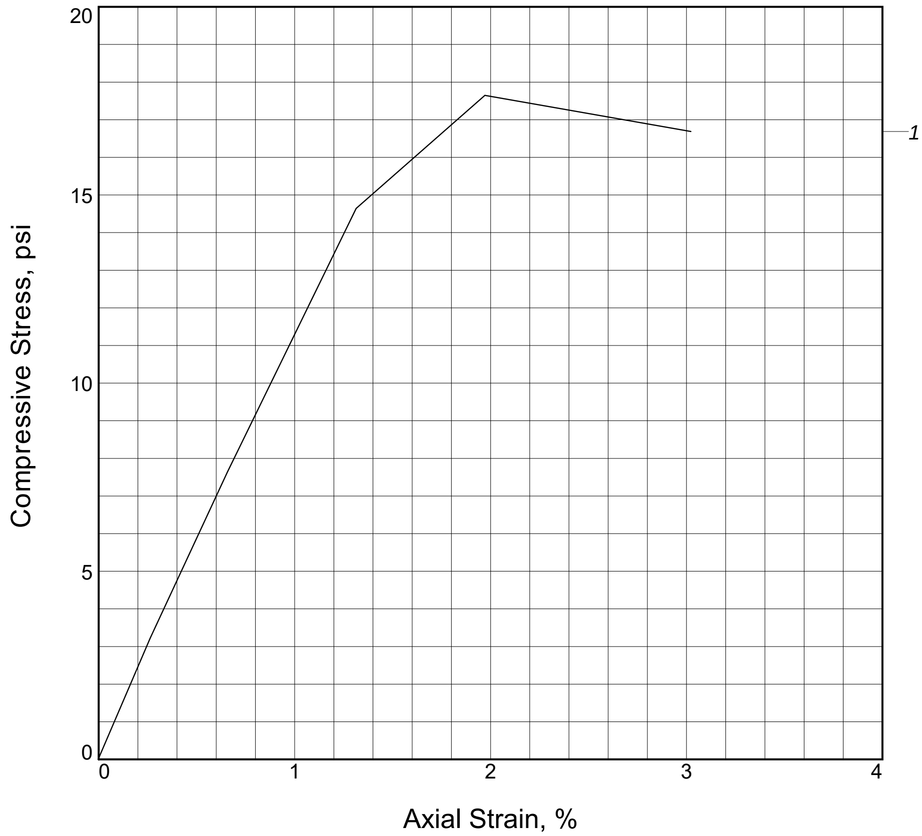
UNCONFINED COMPRESSION TEST

Terracon, Inc.

Cincinnati, Ohio

Tested By: FCE **Checked By:** KA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	17.649			
Undrained shear strength, psi	8.824			
Failure strain, %	2.0			
Strain rate, in./min.	0.038			
Water content, %	18.9			
Wet density, pcf	120.9			
Dry density, pcf	101.7			
Saturation, %	77.5			
Void ratio	0.6579			
Specimen diameter, in.	1.643			
Specimen height, in.	3.805			
Height/diameter ratio	2.32			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Tube

Project No.: N1211568
Date Sampled: 10/8/2021
Remarks:
7596

Figure ________

Client: Geo Consultants

Project: Staten Island Warehouse

Source of Sample: SB-16 **Depth:** 2.0-4.0'

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Cincinnati, Ohio

Tested By: FCE **Checked By:** KA

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