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REMOVAL SUPPORT TEAM 3
EPA CONTRACT EP-S2-14-01

November 9, 2016

Mr. Daniel Gaughan, On-Scene Coordinator
U.S. Environmental Protection Agency, Region II
Removal Action Branch
2890 Woodbridge Avenue
Edison, New Jersey 08837

EPA CONTRACT NO: EP-S2-14-01
TDD No: TO-0007-0023
DC No: RST3-03-D-0296
SUBJECT: PHASE II REMOVAL ASSESSMENT TRIP REPORT – CANADIAN RADIUM AND URANIUM CORP. SITE, MOUNT KISCO, WESTCHESTER COUNTY, NEW YORK

Dear Mr. Gaughan,

Enclosed please find the Phase II Removal Assessment Trip Report for the on-site activities conducted at the Canadian Radium and Uranium Corp. Site located in Mount Kisco, Westchester County, New York. This phase of the Removal Assessment was conducted on April 4 through 6, 2016.

If you have any questions or comments, please contact me at (732) 585-4413.

Sincerely,

WESTON SOLUTIONS, INC.

Bernard Nwosu
RST 3 Site Project Manager

Enclosure
cc: TDD File: TO-0007-0023

REMOVAL ASSESSMENT TRIP REPORT

SITE NAME: Canadian Radium and Uranium Corp. Site
DC No.: RST3-03-D-0296
TDD No.: 0007-0023
CERCLIS ID: NYD987001468
EPA ID: A23P
EVENT DATES: April 4 through 6, 2016

1.0 Site Location: 103-105 Kisco Avenue
Mount Kisco, Westchester, New York
(Refer to Attachment A, Figure 1: Site Location Map)

2.0 Site History and Conditions

From 1943 until approximately 1966, the Canadian Radium and Uranium (CRU) facility operations at the Canadian Radium and Uranium Corporation Site (the Site) included the recovery of uranium and other radioactive elements from uranium-bearing sludge, old instrumentation, and watch dials. This work began as part of the federal government's Manhattan Engineering District (Manhattan Project). From 1943 to the 1950s, the primary product was uranium; subsequently, radium became the principal product until the facility's closure. According to a Village of Mount Kisco memorandum, in 1957, CRU pleaded guilty to charges of allowing three employees to be overexposed to radiation. From March 5, 1958, until sometime after May 19, 1961, decontamination procedures and expectations were established for the CRU facility.

In November and December 1966, the facility buildings (a two-story concrete block building and two smaller one-story concrete block buildings) were decontaminated and demolished. Removal of radioactive dirt to a depth of 12 inches was required on the CRU premises. The most contaminated demolition materials were disposed of by Nuclear Diagnostic Laboratories located in Peekskill, New York, while the less contaminated materials were disposed of at Croton Point Sanitary Landfill located in Croton-on-Hudson, New York. After demolition and decontamination, a post-operation survey was conducted by Isotopes, Inc. Two locations on the Haggerty Millwork wall, which originally shared a wall with the CRU facility that was demolished during the 1966 demolition and decontamination process, were found above specifications. One contaminated location was removed by chiseling out the masonry of a wall. The second was a result of tailings from a leaking waste drum, which CRU had stored on the second floor fire escape. Since contamination was low here, the area was sealed with 1 to 2 inches of mortar. Railroad Avenue was constructed where the main CRU building once stood and was put in place by the urban renewal efforts in the area. Between 1964 (pre-demolition/decontamination) and 1971 (post-demolition/decontamination), the building layout of the Site completely changed and it is believed that none of the original CRU facility buildings remained after the year 1971.

On April 5, 1979, a local newspaper reported the 1957 death of the CRU plant manager due to leukemia from high radioactivity levels found in his body. On April 20, 1979, a survey was performed by the Assistant Commissioner of Health for Environmental Quality, Westchester Department of Health. Based on the surveys, the highest dose rates were found in a small portion of a locked, chain-link fenced area south of the old wood freight station on Railroad Avenue and east of the L. B. Richard's Lumber yard (*i.e.*, an area located adjacent to the railroad). All other

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elevated dose rates were found in areas covered by soil and vegetative growth. The 1979 investigation reported that the high readings were obtained from an area covering approximately one square yard of the property within an area not being used by the public. In addition, the report indicated that the dose rates found did not pose a public health hazard to persons passing the fenced area, to persons working in buildings adjacent to the area, or to persons living across the railroad tracks to the east.

In a memorandum dated February 7, 1980, the Westchester County Health Department described investigation findings in more detail. The area in question was approximately 78 feet by 60 feet, enclosed by a chain-link fence located between the railroad tracks and a concrete paved area. The most significant contaminated area was a strip 15 feet by 5 feet, containing two separate "hot spots". A surface reading using an alpha probe survey meter measured 50 disintegrations per minute (dpm). Elevated readings several times above background were reported for an area extending about 50 feet south from the chain-link fence. The memorandum stated that the origin of this contamination was unknown and that it was not discovered in previous surveys.

In September 1993, the Bureau of Environmental Radiation Protection of the New York State Department of Health (NYSDOH) completed a survey of the Site; indoor radon measurements were collected (*i.e.*, office, show room, storage/sale floor) which documented a maximum concentration of 9.8 picocuries per liter (pCi/L), and the average of the different detectors was approximately 8.1 pCi/L. The NYSDOH also identified two outdoor areas where presence of radioactive materials were indicated at the back of Richard's Lumber, and the road that runs next to the railroad tracks and adjacent to a fence post inside the fenced portion of what appeared to be Richard's Lumber property on the south side of Railroad Avenue.

In 1994, the U.S. Environmental Protection Agency (EPA) conducted an on-site inspection to measure radon levels, collect air and soil samples, and measure exposure rates. The purpose of the investigation was to determine if conditions required immediate action and if the Site was eligible for long-term remediation under the federal Superfund Program. Elevated exposure rate measurements were observed on both the northern [10–700 microroentgens per hour (μR/hr)] and southern (10 –240 μR/hr) portions of the Site property. Radium-226 (Ra-226) concentrations in soil samples taken from the top 1.5 feet ranged from 3 to 150 picocuries per gram (pCi/g). All of the radon measurements were below EPA's guideline (*i.e.*, 4 pCi/L) and the air samples collected at the Site did not detect any radioactive contamination. The EPA concluded that the Site was not a potential candidate for inclusion in the National Priorities List (NPL) and, therefore, was not eligible for long-term remediation.

In July 1998, a complete radiological survey of the Village of Mt. Kisco and Richard's Lumber (former CRU) was conducted by New York State Department of Environmental Conservation (NYSDEC). The property owned by the Village of Mount Kisco (103 Kisco Avenue) was found to have contamination over one large unpaved area [about 4,000 to 5,000 square feet (sq. ft)] and a few smaller areas. The July 1998 report stated that, on the Mt. Kisco property, the highest concentrations of radium observed were a few hundred pCi/g and that most of the contamination was in the top one foot of soil. The report stated that the distribution suggests that uranium-containing material was placed on the surface and then the area was leveled. A new road (Railroad Avenue) had been built where the CRU facility once stood; soil sampling completed near the road showed elevated levels of radium a few feet below the surface. The NYSDEC reported that the

distribution of radioactive material near the road appeared to be consistent with movement of soil as part of the building demolition and subsequent construction of the road. Sampling beneath the road surface was not performed. There is no documentation of shielding or other control measures implemented on the 103 Kisco Avenue property, though current conditions suggest that the property was recently paved with asphalt (of an unknown depth) or other cover materials.

The 1998 report further stated that the survey of the Richard's Lumber (105 Kisco Avenue) property indicated that radioactive materials were present under the parking lot, but no samples were taken beneath the asphalt. The highest concentration of radium at the Site was found just north of Railroad Avenue (about 6,000 pCi/g). A large part of the main outside storage area was reported to be contaminated with radium near the surface as well as within some soil profiles to depths of about 4 feet. Survey data suggested that the contamination stopped abruptly at the edges of the paved areas. Railroad Avenue showed count rates that were lower than background soils; NYSDEC attributed these results to absorption by the road surface material (*i.e.*, shielding). The July 1998 report indicated that radiation doses to workers or visitors to the Site as it was used at the time were not significant. The Site location where the dose rate was highest was a small area near Richard's Lumber, just north of Railroad Avenue. Time spent at this location was small; therefore, the accumulated dose was also estimated to be small. The July 1998 report suggested that significant radium contamination was present on both Mt. Kisco and Richard's Lumber properties. The NYSDEC did not consider the Site to be fully characterized at the completion of the survey.

In September 2013, Weston Solutions, Inc., Site Assessment Team (SAT), performed an on-site reconnaissance and gamma radiation screening of the historic CRU property and other possible areas of contamination. Based upon SAT's *Final Site Reassessment Summary Letter Report,* dated June 11, 2014, background readings taken north and northeast of the Site in the right-of-way (ROW) area alongside Kisco Avenue showed background gamma radiation levels of approximately 7,500 counts per minute (cpm). The highest reading of 73,637 cpm was located on the 105 Kisco Avenue property. Most readings were below 2 times (2x) background. There were three areas with readings that exceeded 2x background, ranging from 30,000 cpm to 73,637 cpm. All three areas above 2x background were located in the back portion of the 105 Kisco Avenue property, east of the historic CRU facility. No signs of ground discoloration were observed.

Site conditions during SAT's radiological reconnaissance of the 105 Kisco Avenue property, New York Stone and Masonry Supply, were typical for a stone, masonry, and landscaping business and had not changed significantly since the 1998 report. In the back portion of the property, surplus materials were stored in corrals, separating different materials such as gravel, sand, wood chips, etc. The most southeastern portion of the property consisted of a newly paved asphalt parking area for customers. Although historical redevelopment activities at the Site were unclear, it is believed that none of the current buildings are part of the original CRU facility. Materials and heavy machinery were present throughout the property, including the concrete corrals for materials. Many areas were not accessible for screening due to obstructions (*e.g.*, wood piles, heavy machinery, roll-offs). The property owner did not allow SAT to perform gamma screenings inside the main building; however, the owner allowed SAT to perform screenings in outdoor sheds and other storage warehouse-type buildings.

Site conditions during SAT's radiological reconnaissance of the 103 Kisco Avenue property, Hickory Homes and Properties, Inc., were typical for a landscaping supply and material storage facility. The property was semi-paved (during the 1998 report, the property was not paved), and completely fenced with an access gate. The access gate was closed and locked when employees were not on site. There was one small work trailer located at the northernmost portion of the property which included an employee break room, office, and reception area. Trucks, forklifts, and other heavy machinery were parked on the property. Various on-site roll-offs were filled with debris and materials. Cement corrals for materials were also located on-site. A manhole was located at the northeast corner of the Site, although no elevated gamma screenings were detected. Many areas were not accessible for screening due to obstructions (*e.g.*, wood piles, heavy machinery, roll-offs). No elevated gamma radiation was observed on the 103 Kisco Avenue property. Gamma screenings of Railroad Avenue and the ROW area bordering Railroad Avenue showed gamma screening readings ranging from background (~7,500 cpm) to 15,000 cpm, with one elevated area located at the corner of the 105 Kisco Avenue property, which had readings ranging from 15,000 cpm to 30,000 cpm.

In November 2013, SAT conducted a soil screening and sampling event. Eight boreholes were advanced to depth of 10 feet at the Site. During the event a gamma scintillation meter (Ludlum-2221 Scaler Ratemeter) was utilized for field gamma screening. Field screening data was collected to document the gamma exposure rates at 6-inch depth intervals vertically down each sample location borehole. The soil samples collected represent the highest levels of gamma radiation recorded for each borehole. All the soil samples were analyzed for radionuclides and target analyte list (TAL) metals.

Based upon SAT's June 2014 report of the November 2013 event, all analytical results for the thorium-232 (Th-232) decay series (Th-232, Th-228, and Ra-228) ranged from 0.6 to 1.2 pCi/g, and were therefore considered to be at background levels. In addition, all of the individual radioisotopes in this decay series were observed to be in equilibrium in each sample. Analytical results reported for the uranium-238 (U-238) decay series (U-238, U-234, Th-230, and Ra-226) did not appear to be in equilibrium. Concentrations of the parent isotopes U-238 and U-234 were at background levels ranging from 0.4 pCi/g to 0.8 pCi/g. The Th-230 concentrations in three of the samples [S01(24-36), S07(12-24), and S08(24-36)] were at background concentrations. The Th-230 concentrations in samples S02(0-12), S03(0-12), S04(36-48), S06(0-12), and S09(36-48) exhibited significantly elevated levels ranging from 4.6 to 83.3 pCi/g. It was also reported that the Th-230 analytical results for sample S05(0-12) may or may not be elevated, as the measured result was 1.8 +/- 0.3 pCi/g. Based upon the above, SAT concluded that the contaminants represent residual contamination from processed material and not uranium ore.

In addition, SAT reported that Ra-226 analytical results in samples S01(24-36), S02(0-12), S03(0-12), S04(36-48), S05(0-12), S06(0-12), and S09(36-48) were all significantly elevated, ranging from 15.4 pCi/g to 135 pCi/g. Sample location S07(12-24) was, as expected, at a background level of 0.9 pCi/g. Sample S08(24-36), which was collected at an assumed background location near the northeast corner of the 105 Kisco Avenue property, showed a Ra-226 concentration of 3.4 pCi/g, which is slightly elevated above the background level. In all instances, when an elevated concentration of Th-230 was detected in a sample, the Ra-226 was also elevated.

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Lead and thallium isotopes are a result of the decay chain of U-238 and Th-232. SAT reported that sample location S04(36-48)/S09(36-48) [duplicate] exhibited greater than 3x times the highest background level of lead with concentrations at 1,000 milligrams per kilogram (mg/kg) and 440 mg/kg, respectively; and that it is unknown if this exceedance is linked to the residual radioactive contamination on the CRU site. There were no detections of thallium at the Site. Mercury concentrations greater than 3x the highest background level were also documented at locations S01, S03, and S04. It is unknown if this elevated concentration of mercury can be linked to the former CRU site operations; however, all the analytical data from this event suggested that there is measureable residual contamination remaining at the CRU site.

In August 2015, Weston Solutions, Inc., Removal Support Team 3 (RST 3) was tasked by EPA to provide support for a Removal Assessment of the Site and on-site properties, including Metropolitan Transit Authority (MTA), Milepost 136, 103 Kisco Avenue (Property C001), Hickory Homes and Properties, Inc., 103 Kisco Avenue (Property C002), New York Stone and Building Supply, 105 Kisco Avenue (Property C003), and a background location (comprising a strip mall), 145-159 Kisco Avenue (Property C004). As part of the Removal Assessment, EPA and RST 3 conducted radiological surveys within living spaces of on-site buildings, exterior areas throughout the Site, and specifically, soil sample locations selected by the EPA On-Scene Coordinator (OSC). Gamma survey was conducted using a Ludlum Model 2241 (Ludlum-2241), Fluke Pressurized Ionization Chamber (FPIC) Model 451P, and Reuter-Stokes RSS-131ER High Pressure Ion Chamber (HPIC) gamma survey meter. Specific radioisotopes were identified using a Berkeley Nucleonics Corporation (BNC) SAM 940™ (SAM 940) portable radioisotope identification system. Radon/thoron survey was conducted using RAD7 radon/thoron detectors.

Based upon the results of the radiological survey conducted with Ludlum-2241, above-background gamma readings ranging from 12,000 – 15,000 cpm were identified at the southeast corner of one on-site warehouse (Warehouse-2) located further northeast in Property C003. More than 2x background gamma values were identified at soil sample locations throughout the Site with concentrations ranging from 20,000 – 180,000 cpm). It is suspected that the elevated gamma readings (20,000 – 22,000 cpm) observed at one location next to the shared perimeter fence on Property C001 side of the fence, may have be due to leaching from bagged contaminated soil staged on Property C002 side of the fence which had a gamma reading of 80,000 – 120,000 cpm. According to the tenant of Property C002 at the time of this event, the bagged soils were removed from a previous 3-feet deep excavation across Railroad Avenue (where the CRU main building once stood) created to allow for the installation of an electrical line to provide power supply to Property C002. The highest gamma readings (140,000 – 180,000 cpm) were observed at a soil sample location at the northwest corner of Warehouse-2. Survey was not conducted with the FPIC inside any buildings at Properties C001 and C002 and at any exterior locations throughout the Site. However, at Property C003, FPIC gamma survey conducted in the main building and two warehouses (Warehouses 1 & 2) located on the northeast portion indicated above-background gamma values in the Electrical Room of the main building and at the southeast corner of Warehouse-2 which is located further northeast from Warehouse-1. Survey conducted with the HPIC in the Electrical Room of the main building at Property C003 and at all the soil sample locations throughout the Site indicated above-background gamma values in the Electrical Room, the location of the bagged contaminated soil on Property C002, the location on the opposite side of the fence at Property C001 next to the bagged contaminated soil, one location along the ROW area northwest of Property C002, and all three soil sample locations on Property C003. Survey

conducted with the SAM-940 identified Ra-226 and potassium-40 (K-40) at the location on the opposite side of the fence on Property C001 next to the bagged contaminated soil. Ra-226 was also identified in jarred soil samples collected from Property C002 and Property C003. Radon/thoron survey indicated normal levels inside the office and storage trailer at Property C002. Radon and/or thoron concentrations were above background values in nine of the 13 locations surveyed in the main building of Property C003.

During the August 2015 Removal Assessment event, RST 3 utilized the services of a National Radon Proficiency Program (NRPP)-certified company to conduct radon sampling within living spaces of on-site properties. Radon sampling was conducted in Building B36 at Property C001, in the office and storage trailers at Property C002, and in the main building, Warehouse-1 and Warehouse-2 at Property C003. On August 3, 2015, a total of 33 activated charcoal canisters (radon canisters), including two field duplicates and two field blanks, were deployed in on-site buildings at Property C003. On August 4, 2015, five radon canisters were deployed in Property C001 and six radon canisters were deployed in Property C002. Analytical results were compared with the EPA Site-Specific Action Level (SSAL) of 4 pCi/L. Analytical results indicated normal radon levels in all the living spaces sampled at Properties C001, C002, and Warehouse-1 in Property C003. Analytical results were above the EPA SSAL in 11 of the 13 samples, including one field duplicate, collected from the main building at Property C003 with concentrations as high as 19.5 pCi/L in sample C003-AA024-01 collected from a location in the southwest area of a lobby located on the second floor. Analytical results were above EPA SSAL in two of the four samples collected in Warehouse-2 at Property C003 with concentrations as high as 4.6 pCi/L in C003-AA001-01 and 5.2 pCi/L in C003-AA007-01. Both samples were collected at locations in proximity of each other at the southeast corner of the warehouse where prior radiological survey also indicated elevated gamma readings. Following the installation of a radon mitigation system in the main building of Property C003, on October 23, 2015, a post-remedial radon sampling event was conducted by a NRPP-certified company under RST 3 and EPA oversight. A total of 27 radon canisters, including two field duplicates and two field blanks were deployed in the main building. Analytical results indicated normal levels of radon in the main building of Property C003.

On August 5, 2015, utilizing Geoprobe® technology, RST 3 collected four soil samples from Property C002, four soil samples, including one field duplicate from Property C003, and one aqueous rinsate blank. On August 7, 2015, utilizing a post digger and shovel, RST 3 collected one soil sample from a background location at Property C004. On August 18, 2015, following a limited access agreement between MTA and EPA, MTA's subcontractor provided soil sampling support to RST 3. A total of four soil samples, including one field duplicate, and one aqueous rinsate blank were collected from Property C001. All the soil sample locations were selected by the EPA OSC based on information from prior SAT site investigation and from radiological survey measurements collected during the event. Locations exhibiting elevated radioactivity measurements were selected for soil sampling. All the soil samples were analyzed for TAL metals and total mercury in accordance with EPA SW846 Methods 6010C and 7471B, respectively; isotopic thorium and isotopic uranium, in accordance with U.S. Department of Energy (DOE) alpha spectroscopy Health and Safety Laboratory (HASL)-300 Method A-01-R; Ra-226 (21-day ingrowth), Ra-228, and other gamma emitting radioisotopes, in accordance with DOE gamma spectroscopy HASL-300 Method GA-01-R. Aqueous rinsate blanks, collected to demonstrate adequate decontamination of non-dedicated sampling equipment (*i.e.* Geoprobe® cutting shoe), were analyzed for TAL metals, total mercury, isotopic thorium and isotopic uranium, and other

gamma emitting radioisotopes by the same methods as the soil samples. In addition, aqueous rinsate blanks were analyzed for Ra-226 in accordance with EPA SW-846 Method 9315 and Ra-228 by Gas Flow Proportional Counter (GFPC), in accordance with EPA SW-846 Method 9320. The soil analytical results for radioisotopes were compared with the respective EPA SSALs. The analytical results for TAL metals and mercury were compared with the EPA Removal Management Levels (RMLs).

Based upon validated analytical results, Ra-226 was detected above the EPA SSAL of 2.52 pCi/g in one of the four soil samples, C001-SS001-0012-01 (3.43 J (estimated result) pCi/g) and its field duplicate, C001-SS001-0012-02 (3.64 J pCi/g), both collected from Property C001. Ra-226 was detected above the EPA SSAL in two of the four soil samples, C002-SS003-2448-01 (9.84 J pCi/g) and C002-TRENCH-0036-01 (10.4 J pCi/g), collected from Property C002. Ra-226 was detected above the EPA SSAL in all four soil samples, C003-SS001-2448-01 (10.3 J pCi/g), C003-SS001-2448-02 (11.3 J pCi/g), C003-SS002-0024-01 (129 J pCi/g), and C003-SS003-2448-01 (15.1 J pCi/g), collected from Property C003. No radioisotope was detected above the EPA SSAL in soil samples collected from the background location at Property C004. Although no SSAL was provided by EPA for the aqueous samples, based on the analytical results, radioisotope concentrations were generally not detected. At the request of EPA, the analytical results of nine soil samples collected by SAT during the November 2013 site investigation were compared against the EPA SSAL. It is noteworthy that the laboratory analyses of SAT's soil samples, specifically for Ra-226, was not performed by 21-days ingrowth method; however, with the exception of the background soil sample collected from S07, Ra-226 was detected at concentrations above the EPA SSAL in the remaining eight soils samples collected during the sampling event. Soil sample S08(24-36), which was collected by SAT at an assumed background location near the northeast corner of Property C003 indicated concentration of Ra-226 at 3.44 pCi/g which exceeds the EPA SSAL. Based on analytical results, the concentration of TAL metals were below the respective EPA RMLs except for lead which exceeded the EPA RML of 400 mg/kg in C002-SS003-2448-01 (510 mg/kg).

On August 18, 2015, EPA collected three wipe samples, including one field blank, from Property C001, one wipe sample from Property C002, and four wipe samples from Property C003. The wipe samples were collected from locations biased towards floor cracks and entryways. All the wipe samples were analyzed by EPA's Radiation Health Physicist (RHP) for the presence of radioactivity using a Ludlum-3030. Based on the analytical results of the wipe samples for the selected counting durations, the minimum detectable activity (MDA) for 100 square centimeters (cm^2) was determined as 0.80 dpm and 29.50 dpm, respectively for alpha and beta particle counts. These levels were below 100 dpm and 1,000 dpm, respectively for alpha and beta counts as outlined in New York City Department of Health and Mental Hygiene (NYC DOHMH) Article 175 of the NYC Health Code, "Radiation Control", §175.03 - Release of Materials or Facilities, which was adopted by EPA as the SSAL for alpha and beta counts. Alpha and beta counts for all the wipe samples were at the natural background level conservatively estimated by counting a blank wipe.

3.0 Removal Assessment Objectives

As part of the Phase II Removal Assessment of the Site, RST 3 was tasked with providing support to EPA for additional ground radiological survey and providing a drilling subcontractor to advance 20 soil borings at locations throughout the Site for soil sample collection. In addition, RST 3 was

tasked with utilizing Global Positioning System (GPS) technology to record soil sample locations, utilizing VIPER technology to document mobile radiological survey data, performing photographic documentation, and maintaining a site logbook to document all site activities throughout the Removal Assessment. The radiological survey and soil sampling event was conducted in order to identify additional source areas and to further delineate on-site radioactive contamination. The results obtained from this event would assist EPA in determining the extent of the radiological contamination and to ascertain if a Removal Action would be necessary in the future.

4.0 On-Site Personnel

Name	Affiliation	Duties On-Site
Daniel Gaughan	U.S. EPA, Region II	On-Scene Coordinator
Lyndsey Nguyen	U.S. EPA, Region II	Radiation Health Physicist
Bernard Nwosu	RST 3, Region II	Team Lead, Site Health & Safety, Written and Photographic Documentation
Joel Siegel	RST 3, Region II	Field Support
Lionel Montanez	RST 3, Region II	Field Support
John Rush	TPI Environmental, Inc.	Geoprobe® Operator
Nicholas Lippincott	TPI Environmental, Inc.	GPR Operator

5.0 Radiological Survey and Screening Methodology

On April 4 through 6, 2016, EPA and RST 3 with remote support from EPA's Emergency Response Team (ERT), conducted radiological survey throughout the Site, including on-site Property C002, Property C003, and a new offsite background location, Mt. Kisco Truck and Auto Parts, 123-135 Kisco Avenue (Property C005). It is noteworthy that during this event, RST 3 inadvertently reported the sample numbers for this property with a leading C004 instead of C005.

Mobile gamma survey was conducted using a Ludlum-2241 with a sodium iodide (NaI) 3x3 scintillator. Static gamma screening for soil sample locations was conducted using a HPIC. Static gamma screening for soil borings and soil samples was conducted using a Ludlum-2241 with a NaI 2x2 scintillator.

Refer to Attachment A, Figure 2: Site Overview Map and Attachment C: Photographic Documentation of Site Activities.

5.1 Radiological Survey

The radiological survey instrument setup comprised of a Ludlum-2241 [Serial Number (No.): 198269] Scaler Ratemeter with a NaI 3x3 scintillator [Model: 44-20 (Serial No.: PR330005)] attached. A baby buggy stroller was utilized to provide mobility for the survey instrumentation setup. A Life-line Interoperable Network Communicator (LINC) was attached and connected to the Ludlum-2241 which was placed on a wooden platform fitted to the sitting area of the buggy. The Ludlum-2241 was connected via data cable to the NaI 3x3 scintillator which was placed in a sagging position approximately 6 inches above the ground surface in the bottom storage

compartment of the buggy. A Trimble® GPS unit, laptop computer, and Gateway (internet source) were placed on a wooden platform constructed above the buggy's hood. The LINC, GPS unit, and laptop computer were connected to the internet via the Gateway. Gamma readings in μR/hr generated by the Ludlum-2241 setup was transmitted through the LINC via the Gateway to the VIPER system (a wireless network-based communication system). VIPER provided instantaneous gamma readings through a computer server [Viper Deployment Manager (VDM)]. The GPS unit provided geographical reference of the gamma readings by transmitting the locational data of the Ludlum-2241 setup through the Gateway and VIPER to VDM. The instantaneous gamma readings along with the geographical locations were viewed online on the VDM webpage via the laptop computer screen. Based on the background gamma reading (9 μR/hr) obtained with the Ludlum-2241 setup, alarms were set up by ERT on VIPER and programed to send electronic mail (email) alerts to the mobile phones of the OSC, RHP, and RST 3 Site Project Manager (SPM) when gamma readings exceeded background levels. With this mobile setup, RST 3 conducted radiological survey throughout the Site, walking along predetermined paths with the buggy as directed by the RHP and OSC.

5.2 Radiological Screening

A HPIC [Model S131-110-ER2500 (Serial No.: 11J01SDW)] was utilized to collect more precise gamma measurements at locations where elevated gamma readings were identified when using the Ludlum-2241. Prior to utilizing the HPIC for radiological screening, the instrument was turned on and allowed to warmup for approximately 60 minutes at the offsite background location. The instrument was then connected to a computer which was used to run the RSS-131 utility program in order to configure the desired settings for the field screening. At least three of the known radioactive source options provided with the equipment, including cesium-137 (Cs-137), cobalt-60 (Co-60), europium-152 (Eu-152), Th-232, and americium-241 (Am-241), with known gamma values, were utilized to calibrate the instrument daily. When the known radioactive source was placed next to the HPIC, the gamma reading displayed on the computer monitor was noted and compared with the known gamma value of that radioactive source. The instrument was turned off after calibration. When a location was selected for screening, the HPIC was turned on with the computer still connected. Instantaneous gamma readings were recorded every 60 seconds for the duration of each screening. The HPIC is normally uncollimated (*i.e.*, it measures cosmic, terrestrial, and foreign source contributions without discrimination); however, it is highly sensitive, precise, and accurate to vast changes in exposure rate, but it lacks the ability to distinguish either energy spectral characteristics or source type. For these reasons, the first two readings recorded by the HPIC at the beginning of each screening were not utilized in calculating the average gamma reading at that location. At least five data points were collected for each screening duration. When the data was downloaded unto a computer, the gamma reading in μR/hr was determined by calculating the average of the five data points collected at each specific location. The HPIC was utilized by RST 3 to collect and document gamma readings at all the soil sample locations selected by EPA for screening. The average gamma reading collected at each soil sample location was compared with the background gamma value measured by the instrument.

A Ludlum-2241 (Serial No.: 149408) Scaler Ratemeter and NaI 2x2 scintillator [Model: 44-10 (Serial No.: PR199131)] equipped with a 15 feet data cable was utilized by EPA with support from RST 3 to conduct gamma screening vertically down each sample location borehole. After soil sample locations were selected, a Geoprobe® was utilized to advance boreholes to desired depths.

A polyvinyl chloride (PVC) pipe was inserted into the borehole to prevent it from collapsing and to prevent residual potentially radioactive material from contaminating the scintillator. The NaI 2x2 scintillator was lowered into each borehole via a PVC pipe, and static gamma measurements in cpm were documented by RST 3 every 6-inch interval up to the total depth of the boring. The PVC pipe was extracted from the borehole after screening.

A Ludlum-2241 (Serial No.: 207757) Scaler Ratemeter and NaI 2x2 scintillator [Model: 44-10 (Serial No.: PR277919)] equipped with a standard (3 feet) data cable was utilized by RST 3 to conduct gamma screening of soil samples. After soil samples were collected and placed in laboratory glassware, static gamma measurements in cpm were collected by placing the scintillator next to each jarred soil sample. Gamma measurements were documented by RST 3 for all the soil samples collected during this event.

6.0 Soil Sampling Methodology

Soil sampling was conducted in accordance with EPA ERT/Scientific, Engineering, Response & Analytical Services (SERAS) contractor's Standard Operating Procedure (SOP) 2012: *Soil Sampling*. Soil sampling locations were selected by the EPA OSC based on information from prior site investigation and Removal Assessment, and from radiological data collected during this Phase II Removal Assessment of the Site, including Ludlum-2241 and HPIC gamma measurements.

Prior to mobilizing to the Site, at the request of RST 3, Dig Safely New York conducted a subsurface utilities mark-out to clear the locations within the ROW areas. RST 3 subcontractor, Environmental Field Services (EFS), located in Marlton, New Jersey utilized a ground-penetrating radar (GPR) to conduct subsurface utilities mark-out around all the proposed soil sampling locations within the Site, including the offsite background location. EFS utilized a Geoprobe® in accordance with SERAS SOP 2050: *Geoprobe Operation*, to facilitate soil sample collection by extracting soil cores from borings advanced to depths 4 feet below ground surface (bgs) at 15 locations and up to 8 feet bgs at five locations. MacroCore® sampling tubes lined with new, clean acetate sleeves were utilized for each soil boring. Upon completion of each sample location borehole, gamma screening data was obtained with a Ludlum-2241 and NaI 2x2 scintillator at 6 inch intervals vertically down to the bottom of the hole. After borehole screening and soil sample collection was completed, the borehole was backfilled in reverse order with the leftover soil, topped off with bagged garden soil, tamped down, and sealed with bentonite.

Decontamination of non-dedicated sampling equipment (*i.e.* Geoprobe® cutting shoe) was conducted in accordance with SERAS SOP 2006: *Sampling Equipment Decontamination* and was performed before and after the sampling event and between soil sample locations, and it consisted of an industrial soap (Alconox®) solution scrub, tap water rinse, steam-clean with deionized water, air dry, and screening with Ludlum-2241 for residual radiological contamination. In order to confine potential surface runoff to areas of contamination, the decontamination fluid was discarded on-site at the location indicating the highest levels of contamination based on radiological screening data.

At each sample location, EFS utilized new acetate sleeves to extract the soil cores. The physical characteristics and description of the soils in each core were documented in boring logs prior to sample collection. Soil samples were collected every 12 inch interval of each sample sleeve. All

the soil samples were collected by RST 3 using dedicated disposable plastic scoops, placed directly into re-sealable plastic bags, homogenized in the plastic bags, and then placed into glass sample jars. RST 3 utilized the Ludlum-2241 with a NaI 2x2 scintillator to collect and document the highest instantaneous gamma exposure rate measurement in cpm for each jarred soil sample. Fresh nitrile gloves were donned between sampling intervals and locations. Rinsate blanks were collected daily to demonstrate adequate decontamination of non-dedicated sampling equipment. The soil and aqueous samples were collected for definitive data and quality assurance/quality control (QA/QC) objectives. Field duplicates and matrix spike/matrix spike duplicate (MS/MSD) samples were collected at the rate of 1 per 20 field samples. All sample information was transcribed into EPA's SCRIBE database, an environmental data management system, from which the sample labels and chain of custody (COC) records were generated. All samples were stored on ice in a cooler.

Refer to Attachment B: Table 2: Soil Sample Location (HPIC) Screening Results and Soil Boring Logs Summary Table

At the discretion of the OSC, the soil and aqueous samples were spilt between two laboratories for analysis. Some of the soil samples and all of the aqueous samples were submitted to an RST 3-procured laboratory, Pace Analytical Services (PACE) located in Greensburg Pennsylvania for analyses. The remaining soil samples were submitted to EPA's National Analytical Radiation Environmental Laboratory (NAREL) located in Montgomery Alabama for analysis.

7.0 Laboratory Receiving Samples

The following laboratories were utilized during the April 2016 sampling event:

Sample Matrix	Analysis	Laboratory
Soil	Isotopic thorium, isotopic uranium, and other alpha emitting actinides via alpha spectroscopy HASL-300 Method U-02. Radium-226, radium-226 (in-growth), radium-228, and other gamma emitting radioisotopes via gamma spectroscopy EPA Method 901.1 modified	Pace Analytical Services 1638 Roseytown Road, Suite 2,3,4 Greensburg PA 15601
Aqueous	Isotopic thorium and isotopic uranium via HASL-300 Method U-02. Radium-226 via EPA Method 903.1 and radium-228 via EPA Method 904.0	
Soil	Isotopic thorium and isotopic uranium via sodium hydroxide fusion. Radium-226 (21-day ingrowth), radium-228, and other gamma emitting radioisotopes via gamma spectroscopy	National Analytical Radiation Environmental Laboratory (NAREL) 540 South Morris Avenue, Montgomery, AL 36115

8.0 Sample Collection and Dispatch

On April 5 through 6, 2016, RST 3 collected a total of 71 soil samples, including three field duplicates and three MS/MSD samples from 16 soil boring location at Property C003. On April 6, 2016, RST 3 collected 25 soil samples, including one field duplicate and one MS/MSD sample from three soil boring location at Property C002. On April 6, 2016, RST 3 collected seven soil samples, including one field duplicate and one MS/MSD sample from a background soil boring location at Property C005. One aqueous rinsate blank sample was collected each day of the sampling event.

Refer to Attachment A, Figure 4: Soil Boring Location Map and Attachment B, Table 1: Sample Collection Summary Table.

On April 7, 2016, RST 3 shipped a total of 52 soil samples and two aqueous rinsate blank samples under COC record number (No.): 2-040716-155816-0006 via Fedex Airbill No.: 8037-9662-5485 to PACE for laboratory analyses. All the soil samples were analyzed for isotopic thorium, isotopic uranium, and other alpha emitting actinides via alpha spectroscopy HASL-300 Method U-02; radium-226 (21-day ingrowth), radium-228, and other gamma emitting radioisotopes via gamma spectroscopy EPA Method 901.1 modified. The aqueous rinsate samples were analyzed for isotopic thorium and isotopic uranium via HASL-300 Method U-02; radium-226 via EPA Method 903.1 and radium-228 via EPA Method 904.0.

On April 18, 2016, RST 3 shipped a total of 51 soil samples under COC record No: 2-041816-105138-0008 via Fedex Airbill No.: 8022-3572-1333 to NAREL for laboratory analyses. The soil samples were analyzed for isotopic thorium and isotopic uranium via sodium hydroxide fusion, an in-house Method, and radium-226 (21-day ingrowth), radium-228, and other gamma emitting radioisotopes via gamma spectroscopy.

Refer to Attachment B, Table 1: Sample Collection Summary Table and Attachment C: Chain of Custody Record and FedEx Airbill.

9.0 Radiological Survey and Screening Results

For reference purposes, Chart 1 (Background Gamma Reading) below provides the background gamma readings collected with each field instrument at the selected offsite background location. Results of the mobile radiological survey and static screening were compared with the background readings obtained with the survey or screening instrument.

Chart 1: Background Gamma Reading

Field Instrument	Radiological Parameter	Background Values
Ludlum-2241 with 3x3 scintillator	Gamma (Survey)	9 μR/hr
High Pressure Ion Chamber (HPIC)	Gamma (Screening)	9.12 μR/hr
Ludlum-2241 with 2x2 scintillator	Gamma (Screening)	7,500 - 9,500 cpm

9.1 Radiological Survey Results

A mobile radiological survey was conducted in order to identify additional source areas on-site and to provide additional information to assist EPA in determining the horizontally extent of the contamination. Radiological survey within Property C002 was minimally hindered by parked vehicles and supplies in outside storage areas, however, at Property C003, the presence of large quantities of merchandize in outside storage areas throughout the property grounds was a great hindrance for the survey equipment setup. Specifically, the northeast area of Property C003, near the "former old depot", which was not surveyed during prior site investigations due to presence of obstacles, could not be surveyed during this event due to obstruction from piles of stored merchandize.

Based upon the radiological survey results, most areas throughout the Site were generally within the background value of 9 μR/hr. However, several on-site locations were identified with gamma

readings exceeding 2x background, 3x background, and more than 3x background. At Property C002, one location along the northeast fence line near the staging location of five bags of contaminated soils which were identified during the Phase I Removal Assessment conducted in August 2015 indicated gamma readings that were greater than 3x background (>24 μR/hr). Other areas around Property C002 with elevated gamma readings include a location along the northwest ROW area, the ROW area north of Property C002, and the entire south portion of Railroad Avenue. These areas indicated elevated gamma reading that were 2 to 3 times background (>16 - 24 μR/hr). At Property C003, one area around the northwest corner of Warehouse-2 and an asphalt-paved area immediately south of Warehouse-2, indicated gamma readings exceeding 3x background (>24 μR/hr). Some northwest locations of Property C003, between merchandize stored outside, indicated gamma readings that were more than 2x background. Other "hotspots" (locations with gamma readings exceeding 24 μR/hr) identified at Property C003 include, a location by the south access gate to Property C003 next to the customer parking lot, the southeast corner of the perimeter fence by the "former dumpster location" near a utility pole, a location in the center of the customer parking lot, and a location near the west entrance to the main building.

Refer to Attachment A, Figure 3: Gamma Survey Results Map.

9.2 Soil Sample Location Screening Results

Soil sample location screening results provided surface gamma readings which were part of the decision-making information utilized in the field by EPA to select boring locations for soil sample collection. Screening data was collected each day of the sampling event at the background sample location. Based on soil sample location screening results, all three soil sample locations selected at Property C002 and 12 of the 16 soil sample locations selected at Property C003 were within background gamma values. Elevated gamma readings were observed at the remaining four soil sample locations [C003-SB010 (11.48 μR/hr), C003-SB011 (10.94 μR/hr), C003-SB015 (11.88 μR/hr), and C003-SB016 (9.88 μR/hr)] selected at Property C003.

Refer to Attachment B, Table 2: Soil Sample Location (HPIC) Screening Results and Soil Boring Logs Summary Table.

9.3 Borehole and Soil Sample Screening Results

Subsurface borehole screening was conducted to determine the depth intervals with the highest gamma reading in order to vertically delineate the extent of the radiological contamination. Soil sample screening was conducted in order to determine if a correlation exists between borehole screening measurements and individual soil sample measurements collected at corresponding borehole screening and soil sample depth intervals.

Chart 2 (Borehole/Soil Sample Screening Exceedance Graph) below, shows that generally, at all the selected soil boring locations, subsurface borehole screening results were significantly elevated; however, soil sample screening results were generally within background values. The highest borehole and soil sample screening results were observed at C003-SB010 approximately 36 to 48 inches bgs. The highest borehole screening results at C003-SB010 exceeded the maximum detection limit (999,000 μR/hr) of the Ludlum-2241 unit at depths 42 to 48 inches bgs. At the corresponding depths (42 to 48 inches bgs), the soil sample screening result was 24,300 μR/hr.

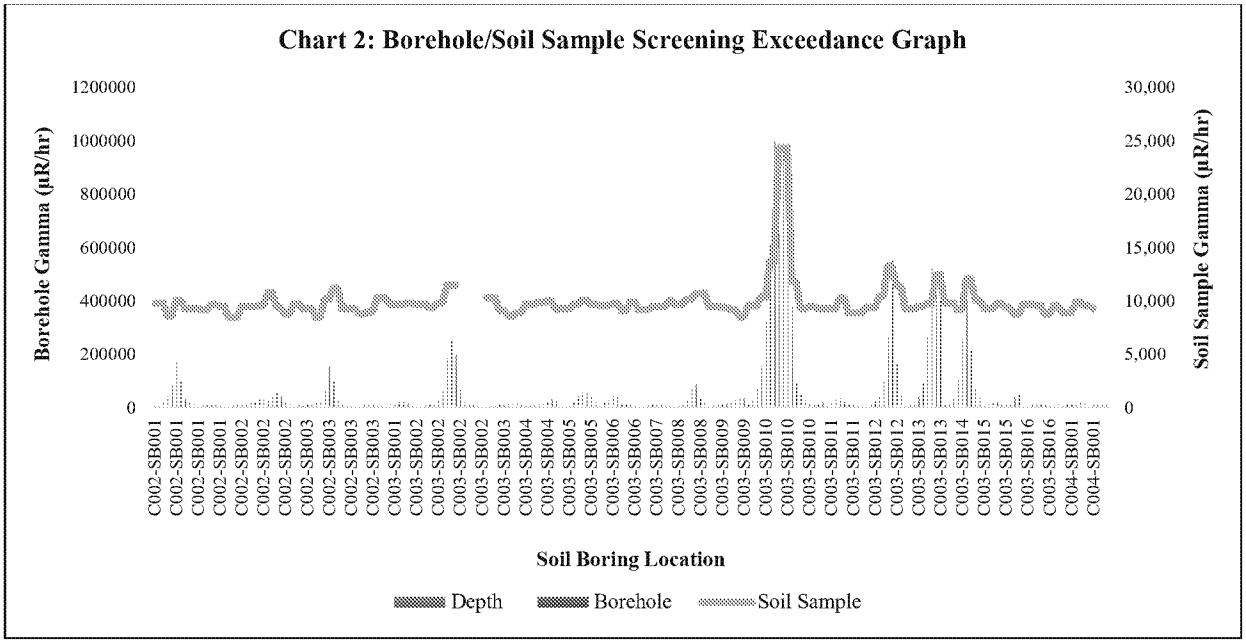
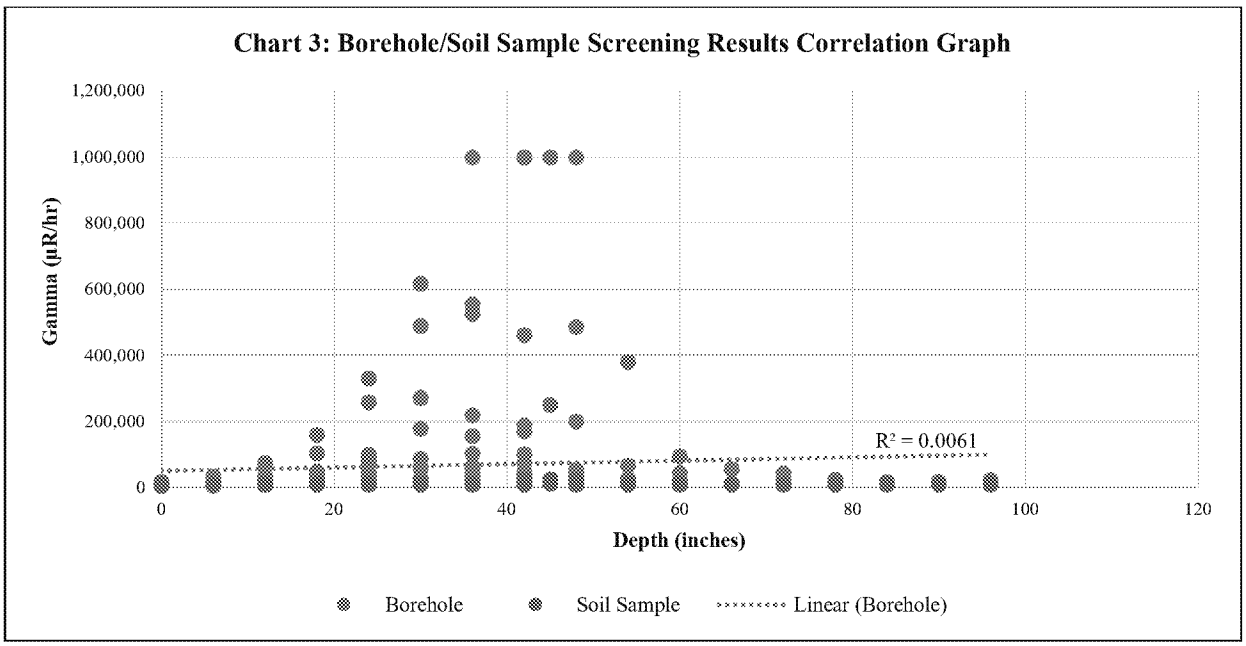


Chart 3 (Borehole/Soil Sample Screening Correlation Graph) below, shows that the gamma values for borehole and soil sample screening results have no correlation as indicated by the correlation coefficient $R^2 = 0.0061$. It is therefore suspected that potential subsurface interference exists from other gamma emitting sources which may have biased the borehole screening results.



Refer to Attachment B, Table 3: Borehole and Soil Sample (Ludlum-2241) Screening Results Summary Table.

10.0 Analytical Results Summary

The validated analytical results of all the soil samples collected during this sampling event were compared with the EPA SSALs for the target radioisotopes. Based upon the validated analytical results, Ra-226 was detected above the EPA SSAL of 2.52 pCi/g in eight of the 25 soil samples collected from three soil sample locations at Property C002. Ra-226 exceedance ranged from 2.57 pCi/g (C002-SB002-2436-01 collected 24 to 36 inches bgs) to 89.391 pCi/g (C002-SB001-2436-01 collected 24 to 36 inches bgs). In all three soil sample locations, the concentration of Ra-226 was below the EPA SSAL in soil samples collected at 0 to 12 inches bgs.

Based upon the validated analytical results, Ra-226 was detected above the EPA SSAL of 2.52 pCi/g in 32 of the 71 soil samples collected from 16 locations at Property C003. Ra-226 exceedance ranged from 2.79 pCi/g (C003-SB013-1224-01 collected 12 to 24 inches bgs) to 926.1 pCi/g (C003-SB010-3648-01 collected 36 to 48 inches bgs). C003-SB010 was the only location at Property C003 sampled to depths 84 to 96 inches bgs. Analytical results indicated exceedance of Ra-226 in C003-SB010-7284-01 (5.16 pCi/g) collected 72 to 84 inches bgs at C003-SB010. Except at C003-SB003 and C003-SB016, concentrations of Ra-226 exceeded the EPA SSAL in at least one 6 inch interval sampled at depths 0 and 48 inches bgs in the remaining 14 soil sample locations. Except at C003-SB007, Ra-226 was not detected above the EPA SSAL in soil samples collected 0 to 12 inches bgs in the remaining 15 soil sample locations. Lead-210 (Pb-210) was detected above the EPA SSAL of 418 pCi/g in one sample C003-SB010-3648-01 (810.09 pCi/g), collected 36 to 48 inches bgs.

Based upon the analytical results, Ra-226 was detected above the EPA SSAL of 2.52 pCi/g in three of the seven soil samples collected from a presumed offsite background location at Property C005. The highest concentration of Ra-226 was detected in C004-SB001-8496-01 (11.04 pCi/g) collected 84 to 96 inches bgs. It is noteworthy that due to poor soil recovery, samples were not collected at intervals 48 to 60 inches bgs. Ra-226 was not detected above the EPA SSAL in C004-SB001-0012-01 collected at depths 0 to 12 inches bgs.

Refer to Attachment A, Figure 5: Soil Analytical Results Map (Radium Only), Attachment B, Table 4: Validated Soil Analytical Results Summary Table - Radioisotopes, and Attachment E: Data Validation Memo - Soil Analytical Results (Radioisotopes).

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