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June 11, 2014

Mr. Andrew Fessler
U.S. Environmental Protection Agency
290 Broadway - 18th Floor
New York, NY 10007-1866

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Subject: **Final Site Reassessment Summary Letter Report**
Work Assignment No.: 2222, Canadian Radium & Uranium Corp. site
Contract No.: EP-S5-06-04, TDD No. S05-0013-1307-009

Dear Mr. Fessler:

Weston Solutions, Inc. (WESTON®) is pleased to submit the final Site Reassessment Summary Letter Report for the Canadian Radium & Uranium Corp. site in Mount Kisco, New York. If you have any questions, please contact me at (732) 417-5814.

Very truly yours,

WESTON SOLUTIONS, INC.

Denise Breen

Denise Breen
SAT 2 Assistant Project Scientist

Enclosure

cc: C. Romano, EPA (w/o enclosure)
G. Gilliland, WESTON (w/o enclosure)
site file

SITE REASSESSMENT SUMMARY LETTER REPORT
CANADIAN RADIUM & URANIUM CORP.
KISCO AVENUE
VILLAGE OF MOUNT KISCO, WESTCHESTER COUNTY, NEW YORK

EPA Contract No.: EP-S5-06-04
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June 2014

Prepared for:

UNITED STATES ENVIRONMIENTAL PROTECTION AGENCY

Prepared by:

Region 2 Site Assessment Team 2
Weston Solutions, Inc.
Edison, New Jersey 08837

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SUBMITTED BY:

Denise Breen
SAT 2 Assistant Project Scientist

6/11/2014
Date

Gerald V. Gilliland, P.G.
Senior Technical Manager

6/11/2014
Date

Introduction

The United States Environmental Protection Agency (EPA) has tasked Weston Solutions, Inc. (WESTON®) Region 2 Site Assessment Team (SAT) with a Site Reassessment to gather and evaluate new information on the Canadian Radium & Uranium Corp. (CRU) site in the Village of Mount Kisco, Westchester County, New York, to determine whether further Superfund action is needed. The Site Reassessment activities included radiation screening, soil sampling, and air monitoring at the site in September and November 2013. This Site Reassessment Summary Letter Report provides a description of the CRU site, a discussion of investigative and remedial actions at the site, results of the November 2013 soil sampling and air monitoring, results of the May 2014 sediment sampling, and a hazard assessment including a Hazard Ranking System (HRS) site score.

Site Location

The CRU facility recovered uranium and other radioactive elements from uranium bearing sludge and old instrumentation; the subject property is located to the east of Kisco Avenue and to the west of railroad tracks in the Village of Mount Kisco, Westchester County, New York, in an area that is primarily suburban residential and commercial (Ref. 2, Figures 1 and 2; 12, pp. 9, 12). The historic CRU property (103 and 105 Kisco Ave.) is 2.72 acres and is currently occupied by a landscaping business (103 Kisco Ave.) and a stone, masonry, and landscaping business (105 Kisco Ave.) (Ref. 3, pp. 3–10; 6, p. 1). The property is bounded by: Kisco Avenue to the west, southwest, and northwest; railroad tracks to the south, east, and northeast; and a large, privately- owned warehouse to the north and northeast (Ref. 2, Figures 1, 2; 12, pp. 9–11).

Site History

From 1943 until approximately 1966, the CRU facility operations included the recovery of uranium and other radioactive elements from uranium-bearing sludge, old instrumentation, and watch dials (Ref. 12, p. 12; 14, p. 5; 17, p. 3). This work began as part of the federal government's Manhattan Engineering District (Manhattan Project) (Ref. 12, p. 12; 14, p. 5). From 1943 to the 1950s, the primary product was uranium; subsequently, radium became the principal product until the facility's closure (Ref. 12, p. 12). According to a Village of Mount Kisco memorandum, in 1957 CRU pleaded guilty to charges of allowing three employees to be overexposed to radiation (Ref. 14, p. 6; 22, p. 2).

From March 5, 1958 until sometime after May 19, 1961, decontamination procedures and expectations were established for the CRU facility (Ref. 23, pp. 1–4). 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 (Ref. 14, p. 5; 17, pp. 3–9; 18, p. 1). Removal of radioactive dirt to a depth of 12 inches was required on the CRU premises (Ref. 23, p. 4). 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 (Ref. 14, p. 5; 15, p. 1; 17, pp. 9–10; 18, p. 1). After demolition and decontamination, a post-operation survey was conducted by Isotopes, Inc. (Ref. 17, pp. 11–13). Two locations on the Haggerty Millwork wall, which originally shared a wall with the CRU facility which was demolished during the 1966 demolition and decontamination process, were found above specifications (Ref. 14, p. 5; 17, p. 5,

11). One contaminated location was removed by chiseling out the masonry of a wall (Ref. 17, p. 11). The second was a result of tailings from a leaking waste drum, which CRU had apparently stored on the second floor fire escape (Ref. 17, p. 11). Since contamination was low here, the area was sealed with 1 to 2 inches of mortar (Ref. 14, p. 5; 17, p. 11). Railroad Avenue was constructed where the main CRU building once stood and was put in place by the urban renewal efforts in the area (Ref. 12, p. 12; 17, p. 3). 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 (Ref. 9, pp. 6–7).

On April 5, 1979, a local newspaper reported the 1957 death of the CRU plant manager due to leukemia and cited high radioactivity levels in his body (Ref. 14, p. 6; 22, p. 2). On April 20, 1979, a survey was performed by the Assistant Commissioner of Health for Environmental Quality, Westchester Department of Health (Ref. 14, p. 6; 15, pp. 1–2; 18, p. 2). 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) (Ref. 2, Figure 2; 9, p. 6; 15, pp. 1–2). All other 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 in an area not used by the public; after the review of data, the report indicated that the dose rates found did not pose a public health hazard to the public passing the fenced area, to persons working in buildings adjacent to the area, or to persons living across the railroad tracks to the east (Ref. 14, pp. 6, 10; 15, p. 2).

In a memorandum dated Feb 7, 1980, the Westchester County Health Department described investigation findings in more detail (Ref. 18, p. 1). 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 (Ref. 18, p. 1). The most significant contaminated area was a strip 15 feet by 5 feet, containing two separate "hot spots" (Ref. 18, p. 1). A surface reading using an alpha probe survey meter measured 50 disintegrations per minute (dpm) (Ref. 18, p. 1). Elevated readings several times above background were reported for an area extending about 50 feet south from the chain-link fence (Ref. 18, p. 2). The memorandum stated that the origin of this contamination was unknown and that it was not discovered in previous surveys (Ref. 18, p. 2).

In September 1993, the Bureau of Environmental Radiation Protection of the New York State Department of Health (NYSDOH) completed a survey of the CRU site; indoor radon measurements were collected (i.e., office, show room, storage/sale floor) which documented a maximum value of 9.8 pCi/L, and the average of the different detectors was about 8.1 pCi/L (Ref. 16, pp. 15, 19). NYSDOH also identified two outdoor areas where presence of radioactive materials were indicated: 1) the back of Richard's Lumber, and 2) 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 (Ref. 16, pp. 6–7).

In 1994, EPA conducted an on-site inspection to measure radon levels, collect air and soil samples, and measure exposure rates (Ref. 12, p. 13; 37, p. 4–5). 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 (Ref. 12, p. 13). 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 (Ref. 12, p. 13). 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) (Ref. 12, p.13; 37, p. 13). All of the radon measurements were below EPA's guideline (i.e., 4 picocuries per liter [pCi/L]) and the air samples collected at the site did not detect any suspension of radioactive contamination (Ref. 12, p. 13; 37, p. 13). EPA concluded that the site was not a potential candidate for inclusion in the National Priorities List and, therefore, was not eligible for long-term remediation (Ref. 12, p. 13; 35, p. 1).

In July 1998, a complete radiological survey for Village of Mt. Kisco and Richard's Lumber (former CRU) was conducted by NYSDEC (Ref. 12, pp. 7–8). 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 ft^2) and a few smaller areas (Ref. 12, p. 7, 17–20, 22, 186–188). The 1998 report states 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 (Ref. 12, p. 7, 19–20; 59, 61, 63). The report stated that the distribution suggests that uranium-containing material was placed on the surface and then the area was leveled (Ref. 12, p. 7). A new road (Railroad Avenue) had been built where the CRU facility once stood; soil sampling completed near the road showed elevated radium a few feet below the surface (Ref. 9, p. 7; 12, p. 7). 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 (Ref. 12, p. 7, 55). Sampling beneath the road surface was not performed (Ref. 12, p. 7). There is no documentation of shielding or other control measures implemented on 103 Kisco Avenue property, though current conditions suggest the property was recently paved with asphalt (of an unknown depth) or other cover materials (Ref 3, p. 4; 9, p. 13).

The 1998 report further states 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 (Ref. 12, p. 7, 17–20, 23–25, 27, 55). The highest concentration of radium at the site was found just north of Railroad Avenue (about 6,000 pCi/g) (Ref. 12, p. 7, 28–30, 95–118). 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 (Ref. 12, p. 7, 37, 42, 48). Survey data suggests that the contamination stopped abruptly at the edges of the paved areas (Ref. 12, p. 7). 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) (Ref. 9, p. 7; 12, p. 7).

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 (Ref. 12, p. 54). 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 is small; therefore, the accumulated dose was also estimated to be small (Ref. 12, p. 54). The July 1998 report suggested that significant radium contamination was present on both Mt. Kisco and Richard's Lumber properties (Ref. 12, p. 54). NYSDEC did not consider the site to be fully characterized at the completion of the survey (Ref. 12, p. 54).

In September 2013, WESTON performed an on-site reconnaissance and gamma radiation screening of the historic CRU property and other possible areas of contamination (Ref. 3, p. 3–4, 6–8). Background readings taken north and northeast of the site in the right-of-way (ROW) area alongside Kisco Avenue show background gamma radiation levels of approximately 7,500 counts per minute (CPM) (Ref. 2, Figure 3). The highest reading was located on the 105 Kisco Avenue property with a reading of 73,637 CPM (Ref. 2, Figure 3). Most readings were below 2 times (2x) background (Ref. 2, Figure 3). There were three areas with readings that exceeded 2x background, ranging from 30,000 CPM to the maximum screening reading of 73,637 CPM (Ref. 2, Figure 3). All three areas above 2x background were located in the back portion of the 105 Kisco Avenue property, east of the historic CRU facility (Ref. 2, Figure 3). No signs of ground discoloration were seen (Ref. 3, pp. 3–4, 6–8). The results of the September 2013 gamma screening survey are shown on Figure 3 (Ref. 2, Figure 3).

Current site conditions for the 105 Kisco Avenue property, New York Stone and Masonry Supply, are normal for stone, masonry, and landscaping business and have not changed significantly since the 1998 report (Ref. 3, pp. 4–5, 9–10; 22, p.1). The back portion of the property is where surplus materials are stored in corrals, separating different materials such as gravel, sand, wood chips, etc. (Ref. 3, pp. 4–5, 9–10). The most southeastern portion of the property consists of a newly paved asphalt parking area for customers (Ref. 3, pp. 4–5, 9–10). Although the supporting documentation does not describe all redevelopment activities at the site, it is not believed that any of the current buildings were part of the original CRU facility (Ref. 3, pp. 4–5, 9–10; 9, pp. 6–7). Materials and heavy machinery were present throughout the property, including the concrete corrals for materials (Ref. 3, pp. 4–5, 9–10). Many areas were unable to be screened due to obstructions (e.g., wood piles, heavy machinery, roll-offs) (Ref. 3, pp. 4–5, 9–10). The current property owner did not allow WESTON to perform gamma level screenings inside the main building; however, the owner did allow WESTON to take outdoor gamma screening levels in outdoor sheds and other storage warehouse-type buildings (Ref. 3, pp. 4–5, 9–10).

Current site conditions for the 103 Kisco Avenue property, Hickory Homes and Properties, Inc., are normal for a landscaping supply and material storage facility (Ref. 3, pp. 3–5, 6–8). The property is semi-paved (during the 1998 report, the property was not paved), and completely fenced with an access gate (Ref. 3, pp. 3–5, 6–8). The access gate is closed and locked when employees are not on site (Ref. 3, pp. 3–5, 6–8). There is one small work trailer located at the northernmost portion of the property which includes an employee break room, office, and reception area (Ref. 3, pp. 3–5, 6–8). Trucks, forklifts, and other heavy machinery were parked on the property (Ref. 3, pp. 3–5, 6–8). Various on-site roll-offs were filled with debris and materials (Ref. 3, pp. 3–5, 6–8). Cement corrals for materials are also located on-site (Ref. 3, pp. 3–5, 6–8). A manhole is located at the northeast corner of the site, although no elevated gamma screenings were detected. Many areas were unable to be screened due to obstructions (e.g., wood piles, heavy machinery, roll-offs) (Ref. 3, pp. 3–5, 6–8). There were no elevated screening readings on the 103 Kisco Avenue property (Ref. 2, Figure 3).

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 (Ref. 2, Figure 3).

Current Hazard Assessment

Based on extensive background information regarding site conditions and history, as well as results of the November 2013 investigation, residual contamination is known to exist in subsurface soils at the site.

Sources – The site was historically a uranium and radium extraction facility functioning from 1943 to approximately 1966 (Ref. 12, p. 12; 16, p. 8). Prior to the 1950s, CRU's primary product, uranium, was processed from uranium sludge (Ref. 14, p. 5). However, from the 1950s until closure, the majority of the uranium was processed and recovered from instruments and watch dials (Ref. 14, p. 5). Under the contracts let by the federal government, any materials recovered other than uranium was the property of the processor (Ref. 14, p. 4). In addition, radium, radium-D, radon, polonium, and actinium were recovered at this facility (Ref. 14, p. 5). This work began as part of the federal government's Manhattan Project (Ref. 14, p. 5). From 1943 to the 1950s, the primary product was uranium; subsequently, radium became the principal product until the facility's closure (Ref. 12, p. 12; 16, p. 8).

As described previously, the CRU facility buildings were decontaminated and demolished in the 1960s, and the radioactive demolition materials were removed from the site for disposal. Physical changes to the property have occurred since that time, including the construction of Railroad Avenue where the main CRU building once stood. Several investigations since 1979 have indicated the presence of residual contamination at the site. As described below in "Soil Exposure Pathway", the radiation surveys and soil sampling completed by WESTON in September and November 2013 confirm the presence of residual contamination.

Groundwater Migration Pathway – A potential to release to groundwater exists at the site due to the proximity of the contaminated soil to the water table. Groundwater samples have not been collected at the site and an observed release is not documented (Ref. 2, Figure 6; 3, pp. 3-10). There are 42 active drinking water wells within 4 miles of the Site (Ref 2, Figure 6).

Targets Associated with the Groundwater Migration Pathway

The CRU Site overlies unconsolidated fluvial sands and gravels of glacial outwash origin (Ref. 14, p. 12; 37, p. 15). These materials comprise a water table aquifer with a saturated zone of unknown thickness (Ref. 14, p. 12). The depth to the water table is estimated to be approximately 24 feet beneath ground surface at the site (Ref. 14, p. 12; 37, p. 15). The sand and gravel aquifer is assumed to have moderate to high permeability based on estimated well yields of 10 to 100 gallons per minute (gpm) (Ref. 14, p. 12; 37, p. 15; 41, p. 13). Groundwater flow direction in the sand and gravel aquifer is presumed to be roughly south or southwest based upon the general topographic trend (Ref. 14, p. 12; 37, p. 15).

The glacial deposits lie within a northeast-southwest trending valley defined by a syncline in the underlying bedrock, with the centerline of the valley roughly coinciding with the axis of the syncline (Ref. 14, p. 12; 37, p. 5). The bedrock consists of Manhattan Schist, which unconformably overlies Inwood Marble, which in turn unconformably overlies Fordham Gneiss (Ref. 14, p. 12; 37, p. 15). The CRU Site lies near the center of the valley (Ref. 2, Figure 1; 14, p. 12).

The Manhattan Schist is present as a narrow band oriented beneath the valley (Ref. 14, p. 12; 37, p. 15). This rock is comprised of muscovite-biotite-garnet schist, gneiss, intertwining schist, and marble (Ref. 14, p. 12). This bedrock unit is younger than the Inwood Marble, which subcrops in an even thinner band immediately northwest of the Manhattan Schist (Ref. 14, p. 12; 37, p. 15). The Inwood Marble consists of pure calcite marble, dolomite units containing calcite marble layers, and coarse dolomite containing actinolite-tremolite and other siliceous minerals (Ref. 14, p. 12; 37, p. 15). Together, the Manhattan Schist and Inwood Marble comprise much of the valley floor in the vicinity of the site (Ref. 14, p. 12; 37, p. 15). The valley walls and surrounding uplands are underlain almost entirely by Fordham Gneiss (Ref. 14, p. 12).

The relative thicknesses and hydrogeological characteristics of each of the bedrock types are unknown (Ref. 14, p. 12). The bedrock of the area contains water-bearing fractures, though it is unknown to what degree these fractures are hydraulically connected to each other and to the sand and gravel aquifer (Ref. 14, p. 12). Historically, groundwater supplies in Westchester County have come from shallow wells (i.e., < 60 ft) in the sand and gravel aquifer or deeper wells in several of the bedrock formations (Ref. 41, pp. 5–7, 13).

There are 42 active drinking water wells (from 24 water suppliers) within 4 miles of the Site (Ref. 2, Figure 6; 13, pp. 1–2, 7–13). Out of the 24 water suppliers, 7 are used as Community Water Systems (Ref. 13, p. 2). The other 17 water suppliers are transient or non-community targets such as golf courses, churches, schools, and other non-Community Water Systems (Ref. 13, p. 2). Approximately 19,983 people are supplied water from Community Water System groundwater wells that are located within 4 miles of the Site (Ref. 13, pp. 3–5). In addition, approximately 4,246 people are supplied water from non-transient, non-community systems using groundwater wells that are located within 4 miles of the Site (Ref. 13, pp.1–6). The nearest drinking water supply well system is the Ramleh Water Works (NY5922912), which consists of two wells located approximately 0.38 mile from the site and serving a total population of 80 (Ref. 2, Figure 6; 13, pp. 2, 9; 37, pp. 16, 552–553). Mount Kisco receives greater than 30 inches net precipitation a year (Ref. 39, p. 1).

There is groundwater contamination reported for the Ramleh Water Works system, but it is not believed to be site-attributable (Ref. 13, p. 9; 32, p. 1). The two wells within the Ramleh Water Works groundwater system are located approximately 2,000 feet northeast and up gradient of the Site (Ref. 2, Figure 6; 13, pp. 2, 9). The wells are 200 and 305 feet deep, which suggests that they are bedrock wells (Ref. 37, pp. 16, 552-553; 41, pp. 5–8, 13). Drinking water quality reports from 2004 documented Ra-226, radium-228 (Ra-228), combined uranium and alpha particle activity (Ref. 32, p.1). The highest report of combined

Ra-226 and Ra-228 was documented on June 1, 2004 at 5.4 pCi/L (Ref. 32, p. 1). The highest report of alpha particle activity on September 1, 2004 was 8.7 pCi/L (Ref. 32, p. 1). The 2004 results are the most recent data discovered, and the water system operator could not be reached (Ref. 13, p. 28; 32, pp. 1–2). The contamination is believed to be derived from a naturally occurring source in the geologic units of the Hudson Highlands (Ref. 36, pp. 12–15).

Surface Water Migration Pathway An observed release to surface water of site-attributable contaminants is documented by chemical analysis, as described below. Site runoff drains toward the northern and eastern portions of the site (Ref. 2, Figure 7; 14, p. 15). Runoff of the site enters on-site storm drains and flows to the storm water pipe located along Kisco Avenue, which abuts the site to the west. The storm water pipe runs northeast from the site along Kisco Avenue, turns east and crosses beneath a parking lot and railroad tracks, and discharges to a perennial drainage ditch through an outfall located approximately 1,000 linear feet from the site (Ref. 2, Figure 7; 14, p. 15). The Conrail ROW abuts the site on its easterly border (Ref. 2, Figures 2 and 7; 14, p. 15). A possible secondary runoff route would flow to the east onto the railroad property and ultimately enter the perennial drainage ditch through overland flow (Ref. 2, Figure 7; 14, p. 15). The outfall location is considered as the probable point of entry (PPE) to surface water, and the perennial drainage ditch flows for approximately 0.2 mile and discharges into Tributary 8 of the Kisco River (Ref. 2, Figure 7; 14, p. 15). The in-water segment then continues for 0.9 mile along Tributary 8 until it meets the Kisco River (Ref. 2, Figure 7; 14, p. 15). After 3.1 miles, the Kisco River discharges into New Croton Reservoir (part of Croton River) (Ref. 2, Figure 7; 14, p. 15). The New Croton Dam lies 6.3 miles downstream of the mouth of the Kisco River, at which point the in-water segment continues within the Croton River for 3.4 miles until it reaches Croton Bay (Ref. 2, Figure 7; 14, p. 15). Croton Bay extends for 1 mile, where it meets the Hudson River (Ref. 2, Figure 7; 14, p. 15). The in-water segment ends in the Hudson River 0.3 mile downstream from Croton Bay (Ref. 2, Figure 7; 14, p. 15). The CRU site lies within the Croton Watershed (Ref. 27, pp. 1–3, 6).

Sediment Sampling Results

WESTON personnel collected six sediment samples (including one environmental duplicate sample) from five locations along the surface water pathway of the CRU site in May 2014 (Ref. 45, pp. 2–3). Potential release samples were collected near the outfall (i.e., at the PPE), downstream of the outfall within the perennial drainage ditch, and from Kisco River Tributary 8 at the confluence with the perennial drainage ditch (Ref. 2, Figure 5; 45, p. 3). One background location was collected upstream from the PPE and another background location was collected from the tributary upstream of the confluence with the perennial drainage ditch (Ref. 2, Figure 5; 45, p. 3).

Analytical data collected in the WESTON May 2014 sampling efforts suggest that there is a release of measureable residual contamination from the CRU site (Ref. 2, Figure 5; 44, pp. 2–6; 46, pp. 1-2). Complete sample analysis concentrations of radionuclides and TAL metals are presented in Table 1 (Ref. 44, pp. 5; 46, p. 3). In order to evaluate the maximum possible background concentrations and minimum possible release concentrations, WESTON adjusted the results to account for uncertainty of the reported values (Ref. 44, p. 2). Adjusted concentrations of TAL lead and radionuclides considered to be significant based on the

evaluation are shown in Table 2 and Figure 5 (Ref. 2, Figure 5).

All analytical results reported for the thorium-232 (Th-232) decay series (Th-232, Th-228, Ra-228, and Pb-212) ranged from 0.282 +/- 0.113 pCi/g to 1.07 +/- 0.251 pCi/g; these concentrations are below the upper-limit value of regional background concentration values (i.e., 1.5 pCi/g for each radionuclide) and are therefore considered to be at background levels (Ref. 44, pp. 1–2, 5). In addition, all of the individual radioisotopes in this decay series were observed to be in equilibrium in each sample (Ref. 44, pp. 1–2, 5).

One sample location (2222-SD04) exhibited a concentration of the Ra-226 radionuclide within the U-238 decay series that meets the criteria for establishing observed release (Ref. 44, pp. 3, 4, 5, 6). Adjusted Ra-226 concentration in sample 2222-SD04 exhibited a significantly elevated concentration of 2.74 pCi/g (Ref. 44, pp. 3, 5). The reported Ra-226 concentrations for duplicate samples 2222-SD03 and -SD06 were also elevated above background, but the adjusted concentrations did not meet the criteria for observed release due to high uncertainty (Ref. 44, pp. 3, 6). The adjusted concentrations of Pb-210 were elevated in samples 2222-SD03, -SD04 and -SD06 (2.00 pCi/g, 1.38 pCi/g, and 2.01 pCi/g, respectively), but were slightly below criteria for establishing observed release (Ref. 44, pp. 3, 5). This elevation in Pb-210, a daughter product of Ra-226, further supports the presence of Ra-226 in the surface water pathway (Ref. 36, p. 2; 44, pp. 3, 5).

There were two sample locations that exhibited greater than three times (3x) the highest background level of lead concentrations: 2222-SD04 with 361 milligrams per kilogram (mg/kg) and -SD03/-SD06 (duplicate) with 290 mg/kg and 390 mg/kg, respectively (Ref. 2, Figure 5; 46, pp. 1–3). It is unknown if this exceedance is linked to the residual radioactive contamination on the CRU site (Ref. 2, Figure 5; 46, pp. 2). These results are shown on Figure 5 (Ref. 2, Figure 5).

Percentages of isotopic lead (Pb-204, Pb-206, Pb-207, and Pb-208) found at the sediment sample locations were compared to average natural abundances (Ref. 46, p. 2). All of the samples including background are slightly elevated (approximately 1.25–1.75%) for Pb-206 and slightly depressed for Pb-204, Pb-207, and Pb-208 (Ref. 46, pp. 2, 4). The highest percentage of Pb-206 is at 2222-SD05, which is closest to the site (Ref. 46, pp. 2, 4). This might indicate greater relative impact to the background location, but the numbers show greater absolute impact at the PPE (2222-SD04) and at 2222-SD03 (i.e., more discharge through the storm sewers and ditch than overland runoff across/under the train tracks) (Ref. 2, Figure 5; 46, pp. 2, 4). The slightly elevated abundance of Pb-206 seems to support the conclusion that there is an observed release that is at least partially attributable to the CRU site (Ref. 46, pp. 2).

The observed release affects sample locations 2222-SD04 and -SD03/-SD06, both of which are located in the perennial drainage ditch (Ref. 2, Figure 5).

<u>Targets Associated with the Surface Water Migration Pathway</u>

One surface water intake is located along the 15-mile surface water pathway for the CRU site within the New Croton Reservoir (Ref. 2, Figure 6; 14, p. 16). The New Croton Reservoir intake is approximately 10.2 miles downstream of the PPE, with a flow of 15,000 cubic feet per second (cfs); the intake serves approximately 831,000 people (Ref. 14, p. 15). There are available areas where fishing is allowed, including: the Kisco River (moderate stream), New Croton Reservoir (large river), Croton River (large stream), and Croton Bay (river) (Ref. 14, p. 16). There are approximately 5.96 miles of HRS-eligible wetlands along the surface water pathway (Ref. 2, Figure 6; 14, p. 16). The Federal Emergency Management Agency (FEMA) has designated the site property to be in an area of minimal flooding (Ref. 8, pp. 1–2).

Soil Exposure Pathway – Soil contamination at the site is reported in historic surveys and is confirmed by the most recent survey and soil sampling performed by WESTON in September and November 2013 (Ref. 12, p. 13; 14, p. 11; 15, p. 3; 16, p. 17; 18, p. 1; 19, p. 5; 21, p. 2; 23, p. 4; 38, p. 1). The site is mostly paved and enclosed with a maintained fence (i.e., stopping public access), as well as the presence of layers of asphalt and concrete over the contaminated soil (Ref. 2, Figure 2; 3, pp.26–30). There are areas of observed contamination are located within the fenced 105 Kisco Avenue property which is paved (Source 1) and unpaved (Source 2), as well as outside of the fenced property (Source 2) which is unpaved, that exhibit gamma radiation that exceeds 2x the background concentrations (Ref. 2, Figure 2 and 4; 31, pp. 1–2). Source 1 and Source 3 are low-traffic areas that are used or traversed intermittently by on-site workers and are not known to be used by the public (Ref. 2, Figure 4). Source 2 is unpaved and located outside of the fenced portion of the property and is accessible to the public (Ref 2, Figure 4).

Soil Sampling Results

WESTON advanced 8 boreholes to depth of 10 feet at the site for gamma screening and soil sample collection in November 2013 (Ref. 3, pp. 13–19; 38, p.3). Using a gamma scintillation meter (Ludlum 2221 Scaler Ratemeter), field gamma screening data collected during the November 2013 sampling event document the gamma exposure rates at 6-inch depth intervals vertically down each sample location borehole (Ref. 3, p. 25; 38 p. 3). The soil samples collected represent the highest levels of gamma radiation recorded for each borehole. Complete field data can be found on Table 1 (Ref. 34, p. 19–21; 38, p. 3).

Analytical data collected in the WESTON November 2013 sampling efforts suggest that there is measureable residual contamination remaining at the CRU site (Ref. 34, pp. 1–21; 30, pp. 1–2; 38, p. 3). Complete sample analysis concentrations of TAL metals and radionuclides is shown in Table 1 (Ref. 34, pp. 19–21). Significant concentrations of radionuclides are shown in Figure 4 (Ref. 2, Figure 4).

All analytical results reported 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 are therefore considered to be at background levels (Ref. 30, pp. 1–2). In addition, all of the individual radioisotopes in this decay series were observed to be in equilibrium in each sample (Ref. 30, pp. 1–2).

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 (Ref. 30, pp. 1–2). 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 (Ref. 30, pp. 1–2; 34, pp. 19–21). Th-230 concentrations in three of the samples (2222-S01, -S07, and -S08) were at background concentrations (Ref. 30, pp. 1–2; 34, pp. 19, 21). Th-230 concentrations in samples 2222-S02, -S03, -S04, -S06, and -S09 exhibited significantly elevated levels ranging from 4.6 to 83.3 pCi/g (Ref. 30, pp. 1–2; 34, pp. 19–21). Th-230 analytical results for sample 2222-S05 may or may not be elevated, as the measured result was 1.8 +/- 0.3 pCi/g (Ref. 30, pp. 1–2; 34, p. 20). Based upon the above, it can be concluded that the contaminants represent residual contamination from processed material and not uranium ore (Ref. 30, pp. 1–2).

Ra-226 analytical results in samples 2222-S01, -S02, -S03, -S04, -S05, -S06, and -S09 were all significantly elevated, ranging from 15.4 pCi/g to 135 pCi/g (Ref. 30, pp. 1–2; 34, 19–21). Sample location 2222-S07 was, as expected, at a background level of 0.9 pCi/g (Ref. 30, pp. 1–2; 34, p. 21). Sample 2222-S08, which was collected at an assumed background location near the northeast corner of the subject property, showed a Ra-226 concentration of 3.4 pCi/g, which is slightly elevated above the background level (Ref. 30, pp. 1–2; 34, p. 21). In all instances, when an elevated concentration of Th-230 was detected in a sample, the Ra-226 was also elevated (Ref. 30, pp. 1–2; 34, 19–21). These results are shown in Figure 4 (Ref. 2, Figure 4).

Lead and thallium isotopes are a result of the decay chain of U-238 and Th-232 (Ref. 36, pp. 1–2, 4). There was one sample location that exhibited greater than three times (3x) the highest background level of lead: 2222-S04/-S09 (duplicate) with 1,000 mg/kg and 440 mg/kg, respectively (Ref, 2, Figure 4; 34, pp. 12, 17, 20). It is unknown if this exceedance is linked to the residual radioactive contamination on the CRU site (Ref. 2, Figure 4). There were no detections of thallium at the CRU site (Ref. 34, pp. 9–21). Mercury concentrations greater than 3x the highest background level were also documented at 2222-S01, -S03, and -S04, yet are not known to be linked to the former site operations (Ref. 34, pp. 9, 11, 12, 19–20). These results are shown on Figure 4 (Ref. 2, Figure 4).

Targets Associated with the Soil Exposure Pathway

The site is situated in a mixed commercial and residential area (Ref. 2, Figure 2). There are eight residences within 200 feet of the site property, housing an estimated 22 people (Ref. 2, Figure 2; 28, p. 1); there are no people residing on and within 200 feet of the area of observed contamination. There are no schools or daycare centers on or within 200 feet of the site property (Ref. 2, Figure 2). There are approximately 10 employees currently working on New York Stone and Masonry Supply (105 Kisco Avenue) property (Ref. 24, pp. 1–2). There are approximately 4-15 employees, depending on work load and season, currently working on Hickory Homes and Properties, Inc. (103 Kisco Avenue) property (Ref. 24, pp. 1, 3) Approximately 9,047 people reside within 1 mile of the CRU site (Ref. 7, pp. 1–2). There are no known terrestrial sensitive environments located on or within 200 feet of the site property (Ref. 2, Figure 6; 14, p. 16; 25, p.1).

Air Migration Pathway – A release of contamination from the facility to the ambient air is not observed (Ref. 2, Figure 9; 4, pp. 22–24, 30; 5, pp. 1–14). Although the presence of thoron at a slightly elevated level was documented during the November 2013 air monitoring event at the CRU site, it is not considered to be attributable to site activities because Th-232 decay series isotopes exhibited background levels and equilibrium in soil samples from the site (Ref.2, Figure 9; 4, pp. 22–24, 30; 38, p. 4).

During the 1993 and 2013 site reconnaissance, people moving vehicles and building materials stored on site were observed (Ref. 3, pp. 2–10; 14, p. 17). Small amounts of dust generated by the moving vehicles was observed rising from the site (Ref. 3, pp. 2-10; 14, p. 17). The 1994 EPA Final Site Inspection report stated that six air samples were collected and the analysis of the samples did not indicate a release of contaminants from the site to the air (Ref. 37, p. 5). Radon measurements were taken from within the hardware store and outdoor storage shed. The results ranged from 1.0 pCi/L to 2.2 pCi/L which are below the EPA guideline of 4.0 pCi/L (Ref. 37, p. 13). A total of six air samples were collected from the property north and south of Railroad Avenue (Ref 37, p. 13). Analysis of the samples for total alpha particle concentration indicated that all of the samples had less than the minimal detectable activity of $1x10^{-12}$ $\mu R/cm^3$ (Ref 37, p. 13).

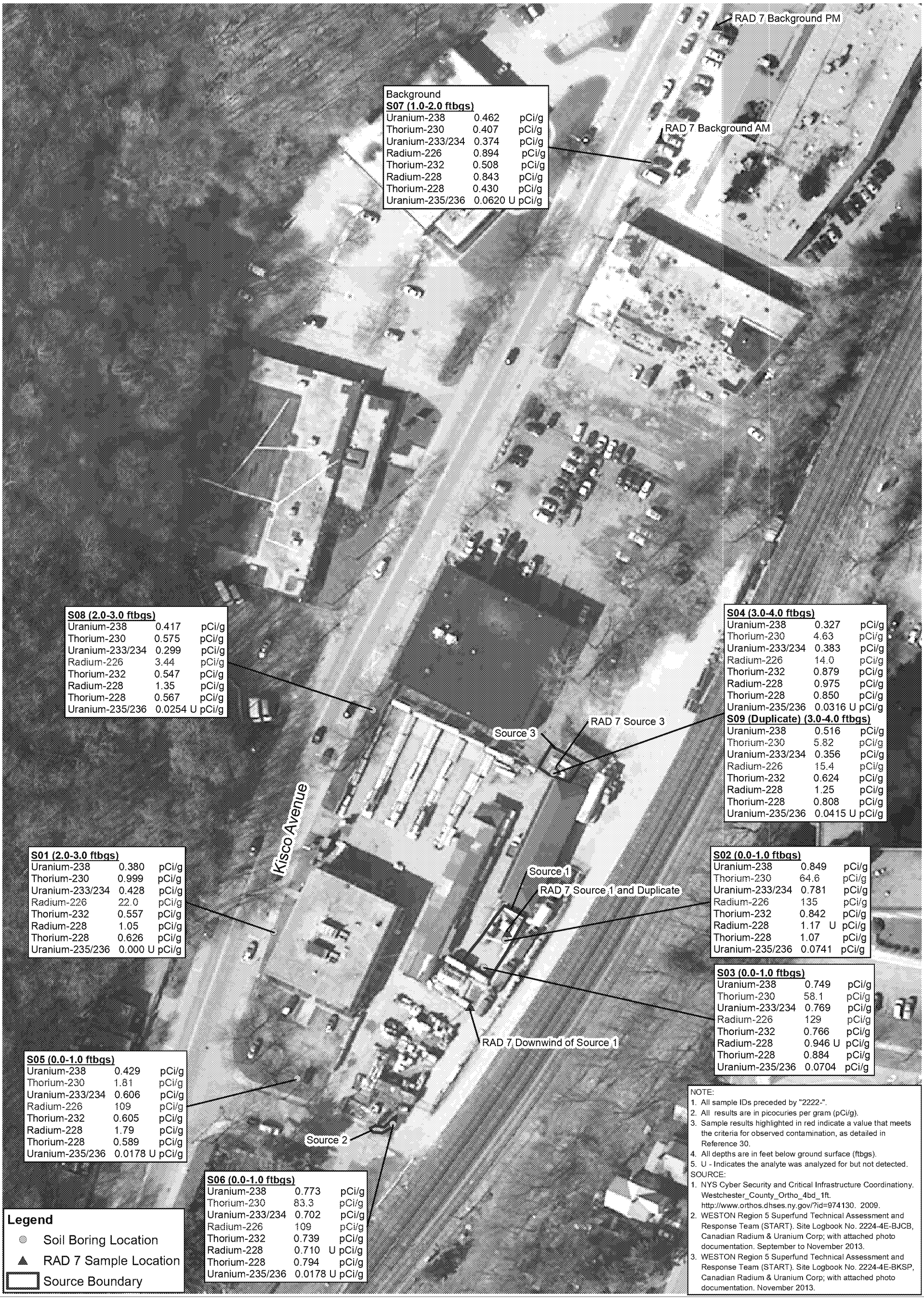
Air Monitoring Results

During the November 2013 on-site air monitoring event, background radon concentrations were calculated to be 0.03999 +/- 0.056 pCi/L (adjusted concentration is 0.0959 pCi/L) in the a.m. and 0.0532 +/- 0.08 pCi/L (adjusted concentration is 0.1332 pCi/L) for the p.m. (Ref. 2, Figure 9; 3, p. 23; 38, p. 4). Background thoron concentrations were calculated to be 0 +/- 0.04 pCi/L (adjusted concentrations is 0.04 pCi/L) in the a.m. and 0.0525 +/- 0.1 pCi/L (adjusted concentration is 0.1524 pCi/L) for p.m. (Ref. 2, Figure 9; 3, p. 23). Only one air monitoring location, Downwind Source 1, had documented thoron concentrations which exceeded two standard deviations above the site-specific background concentration (Ref. 2, Figure 9; 3, p. 23; 29, p. 1). This elevated thoron concentration is not considered to be site-attributable because there is no documented on-site contamination of the Th-232 decay series (i.e., Th-232, Th-228, Ra-228), of which thoron is a daughter product (Ref. 2, Figure 8; 3, pp. 22–24). There were no other significant levels of radon or thoron documented (Ref. 2, Figure 9). The complete results are shown in Figure 7.

Targets Associated with the Air Migration Pathway

Approximately 1,448 people reside within 0.25 mile of the site and a total of approximately 36,997 people reside within 4 miles of the site (Ref. 7, p. 1). There are approximately 1,129 acres of HRS-eligible wetlands within 4 miles of the site (Ref. 2, Figure 6; 26, p. 1). According to NYSDEC, there is one state-listed threatened species habitat within 4 miles of the site (Ref. 25, pp. 1–2).

P:/SAT2/2013 NY RAD Sites/Canadian_Radium_Uranium/MXD/14372_CRU_SR_Rad_Soil_Results.mxd



NOTE:
1. All sample IDs preceded by "2222-".
2. All results are in picocuries per gram (pCi/g).
3. Sample results highlighted in red indicate a value that meets the criteria for observed contamination, as detailed in Reference 30.
4. All depths are in feet below ground surface (ftbgs).
5. U - Indicates the analyte was analyzed for but not detected.

SOURCE:
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3. WESTON Region 5 Superfund Technical Assessment and Response Team (START). Site Logbook No. 2224-4E-BKSP, Canadian Radium & Uranium Corp; with attached photo documentation. November 2013.

Scale:
80 40 0 80
Graphic Scale In Feet

PROJECT:
Canadian Radium & Uranium Corp.

CLIENT NAME:
EPA

TITLE:
Sample Location and Data Results Map
Canadian Radium & Uranium Corp.
105 Kisco Avenue
Mount Kisco, NY 10549

WESTON

DRAWING NUMBER: 14372

FIGURE #: 4

DRAWN BY: J. Lynes

REVIEWED BY: D. Breen

PROJECT MANAGER: D. Breen

SCALE: 1" = 80'

DATE: June 2014

N W E S

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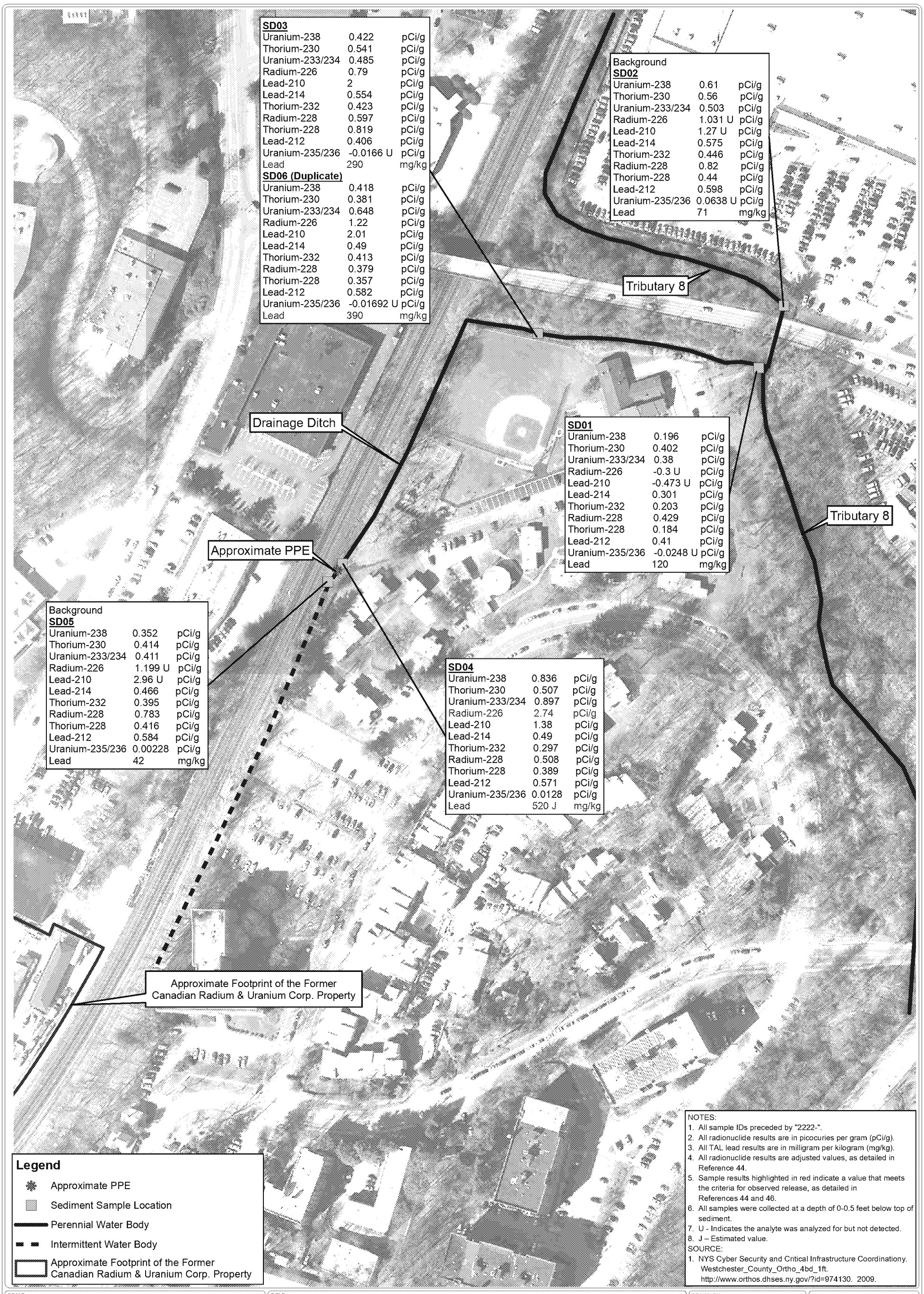

SCALE:
150 75 0 150
Graphic Scale In Feet

PROJECT: Canadian Radium & Uranium Corp.

CLIENT NAME: EPA

TITLE:
Sample Location and Data Results Map
Canadian Radium & Uranium Corp.
103/105 Kisco Avenue
Mount Kisco, NY 10549

WESTON

DRAWING NUMBER: 15154

FIGURE #: 5

DRAWN BY: J. Lynes

REVIEWED BY: D. Breen

PROJECT MANAGER: D. Breen

SCALE: 1" = 150'

DATE: June 2014

N W E S

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