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MJW TECHNICAL SERVICES, INC.

Field Sampling and Dose Assessment Plan

For the

Western New York Nuclear Service Center

In Follow Up to

Aerial Gamma Radiation Survey

Conducted in 2014

Prepared For

New York State Energy and Research Development Authority

West Valley Site Management Program

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1. Background and Introduction

The New York State Energy Research and Development Authority (NYSERDA) owns the 3,300-acre Western New York Nuclear Service Center (Center) in the Town of Ashford. Since 1982, NYSERDA and the U.S. Department of Energy (DOE) have been working at the Center to conduct the West Valley Demonstration Project (WVDP), a high-level radioactive waste solidification and cleanup project. In September 2014, DOE and NYSERDA jointly initiated an aerial radiological survey to examine the radiological conditions of the Western New York Nuclear Service Center (Center) and adjacent areas, as well as Cattaraugus Creek from the Center to Lake Erie in Western New York. This survey was conducted by the National Nuclear Security Administration's Remote Sensing Laboratory (RSL).

The 2014 aerial radiation survey shows five limited areas outside the Center property with radiation levels that are slightly above the "background" radiation levels seen throughout Western New York[1]. Two of these areas were identified during the previous aerial surveys, and the three other locations were only identified during the 2014 aerial survey. The identification of the three new areas is likely due to either: the fact that the areas were not examined during earlier surveys; and improvements in instrument sensitivity since the time of the earlier surveys, or the deposition of additional contamination

The purpose of this project is to collect information on radionuclide concentrations in the soil to verify whether the areas identified as having elevated levels of radiation in the 2014 aerial survey are confirmed to have elevated levels of radionuclides in the soil. If the radionuclide levels in the soil are elevated, a dose assessment will be conducted to confirm that there is no health and safety concern. It should be noted that a 1990s investigation of the largest of these areas (called the Cesium Prong) demonstrated that the area met all public health and safety standards. It is also important to note that the 2014 aerial survey results for the Cesium Prong, and for the other previously observed areas, are lower than observed in the previous surveys. The areas that have not been previously observed in aerial radiation surveys show radiation levels that are very low, just slightly above background.

These activities will be completed by MJW Technical Services (MJWTS), a radiation safety consulting company, under contract to NYSERDA.

2. Project Objectives

The objective of this survey, sampling and dose assessment project is to provide additional data for the five areas that were identified for further evaluation. These areas were identified by RSL using the criteria described in Section 7.

[1] Background radiation is caused by naturally occurring radioactive materials like radon and from certain man-made radioactive materials that are found throughout the environment today.

A summary of the data collection and evaluation approach is as follows:

a) For Area 1 (the Cesium Prong, see Figure 1), soil samples will be collected in several areas as described in Table 3. The analytical results will be compared to the data collected during the 1995 Western New York Nuclear Service Center Off-Site Radiation Investigation (Dames and Moore, 1995) to determine whether the conditions in this area today are consistent with decay-corrected concentrations measured in the 1990s. Since this area has been extensively characterized and evaluated, a dose assessment will not be conducted unless the newly collected data identify conditions that are not consistent with previous results.

b) For Area 2 (see Figure 2), the areas identified using the RSL criteria will be surveyed, and soil samples will be collected as described in Table 3. If elevated concentrations of radionuclides are identified in the soil samples, a dose assessment will be prepared, as described in Section 11.

c) For Area 3, located at the confluence of Buttermilk and Cattaraugus Creeks (see Figure 3), the areas identified using the RSL criteria will be surveyed, and soils will be collected as described in Table 3. If elevated concentrations of radionuclides are identified in the soil samples, a dose assessment will be prepared, as described in Section 11. This area was previously identified in the 1979 and 1984 Aerial Radiological Survey of the West Valley Demonstration Project and Surrounding Area (EGG-10617-1080, May 1991, see Figure 11, Area 2), but to date, this area has not been field surveyed or sampled.

d) For Areas 4 and 5 (see Figures 4 and 5), which were not identified in previous aerial surveys, the areas identified using the RSL criteria will be surveyed, and soils will be collected as described in Table 3. If elevated concentrations of radionuclides are identified in the soil samples, a dose assessment will be prepared as described in Section 11.

The sampling activity described in this plan is focused on areas identified through the aerial survey as having radiation levels above background. For areas identified outside of stream valleys and floodplains, the primary samples collected will consist of soil. For areas within the stream valleys and floodplains of Buttermilk and Cattaraugus Creeks, the samples collected will likely consist of stream sediments.

It should be noted that, as of the date of this Plan, coordination with property owners on the sampling activity is continuing. Changes in sampling strategy could be required if permission to sample is not obtained for each of the properties identified.

3. Comparison of Dose Assessments to Dose Standards

The radiological surveys results and soil and stream sediment sample data will be used in a dose assessment (described in Section 11), and compared to the dose limits included in 10 CFR 20.1402 - Radiological Criteria for Unrestricted Use.

In addition, the soil and sediment concentrations will be compared to the WVDP Phase 1 Decommissioning Plan, Revision 2, resident farmer scenario, Derived Concentration Guidelines

(DCGLs) surface soil values for the current year, which represent radionuclide-specific concentrations that would achieve the regulatory dose standard for release of a licensed property and termination of the license without restrictions (i.e., < 25 mRem/year as per 10CFR 20.1402).

4. Safety and ALARA Objectives

All project activities will be conducted in a safe manner, consistent with the ALARA principle of maintaining radiation exposures to a level that is as low as reasonably achievable, and MJW Technical Services' (MJWTS) commitment to safety as manifested in our corporate and project specific safety plans. MJWTS will conduct the survey and sampling activities under the MJW Technical Services' New York State Department of Health Radioactive Materials License and application for reciprocity filed with and approved by the U.S. Nuclear Regulatory Commission (NRC).

To ensure the health and safety of all staff working on this project, a project-specific Health and Safety Plan (HASP) has been prepared, and is available through MJW or NYSERDA. This HASP details the radiological and industrial safety requirements for this project.

5. Quality Assurance Project Plan (QAPP)

The QAPP provides the project specific details on how the surveys and samples will be collected to ensure representativeness, traceability and reproducibility. The data quality objectives are also defined for this project in the QAPP, along with information detailing the data quality and validation processes for these activities. A copy of the QAPP is available through MJW or NYSERDA.

6. Participants, Roles, and Responsibilities

The project will be performed by MJWTS, with support by NYSERDA staff. Key positions for executing the project are:

NYSERDA Project Manager

The NYSERDA Project Manager will be the primary point of contact and coordination with the MJWTS Project Manager, and ensure that the MJWTS Project Manager is cognizant of relevant information, issues, objectives, requirements, and potential concerns or deficiencies.

Project Manager

The Project Manager (PM) bears overall responsibility for execution of the sampling and exposure assessment activities, and is responsible for the health physics aspects of the execution of the sampling plan. The PM will ensure that the sampling plans are adapted to meet the project objectives, and that the work is executed in a timely manner, in accordance with the project plan and in conformance with all applicable regulatory requirements.

Project Safety Director (PSD)

The Project Safety Director (PSD) will perform hazard and risk assessments as required, develop appropriate safety plans and mitigation methods, and will work with the Project Manager to ensure that the HASP is followed and adapted, if required, based upon unforeseen field conditions or situations.

Project Certified Health Physicist

The Project Certified Health Physicist (PCHP) will ensure that the collection and analysis of survey data and the derived dose assessments are conducted properly, and in accordance with appropriate professional and regulatory standards and practices to ensure that results are accurate and defensible.

Project Radiation Safety Officer

The Project RSO (PRSO) will ensure that all activities conducted will be in compliance with the MJWTS' radioactive materials license, under reciprocity with the requirements of the NRC. The PRSO is authorized to halt any action considered to be unacceptable from the standpoint of radiological safety or regulatory compliance.

Project Health Physicist

The Project HP (PHP) is responsible for the analysis of survey and laboratory data, and for the performance of the exposure assessments.

Project Quality Assurance and Control Manager

The Project Quality Assurance and Control Manager (PQA/QCM) will be responsible for all aspects of project Quality Assurance and Quality Control actions, and will ensure that appropriate measures are implemented during survey operations, analysis operations as well as by the radiochemistry laboratory that is utilized.

Project Data Validation Specialist

The Project Data Validation Specialist (PDVS) will be responsible for the validation of data as required by accepted professional practices and standards.

Project Field Supervisor

The Project Field Supervisor (PFS) will be responsible for the in-field conduct of survey and sampling operations, and will ensure that applicable safety, compliance, and QA/QC requirements are followed during the execution of field activities. The PFS will supervise the activities of radiological control technicians and any other staff working in the field. In addition, the PFS will ensure that all field operations are appropriately documented.

Project IT/GIS Specialist

The Project IT/GIS Specialist (PITGIS) will be responsible for oversight of data file storage and the processing of acquired data, in particular, GPS-driven radiation survey data.

7. Areas Selected for Ground Truth Measurements

As stated previously, five areas have been identified for further evaluation by RSL, with the following considerations:

a) The "anthropogenic extraction algorithm" used by RSL in evaluating the aerial survey results has a large variance and can produce false positives if used to look for a specific isotope (e.g., Cs-137).

b) The "cesium-137 extraction algorithm" has a relatively smaller variance but can contain false negatives (e.g., where Cs-137 may be indicated in spectral data though not strongly within the photopeak).

As such, the following criteria were used by RSL to screen the aerial survey results and identify areas that warranted the follow up sampling:

The areas identified for further evaluation are those areas where **both** the anthropogenic extraction and the Cs-137 extraction indicate results that are 2 standard deviations (2σ) above background or greater (≥ 1000 cps in the anthropogenic extraction and ≥ 30 cps in the Cs-137 extraction). RSL indicated that these are very small deviations above background and could simply be due to expected statistical variance; but they recommended this as a conservative approach for identifying areas for further evaluation.

RSL also noted that applying these criteria strictly to the point-by-point GIS data is not suitable because of the averaging effects inherent in aerial data, so they applied the criteria on a scale approximately between 300-3,000 feet.

This allowed RSL to identify areas where the Cs-137 extraction exceeds 2σ above background at the same location or in close proximity to areas where the anthropogenic extraction also exceeds 2σ above background.

Finally, because the 2σ above-background levels represent very small deviations above background, RSL applied a third criterion, and focused on those areas exceeding the 2σ thresholds were clustered together or extended into an area. Maps of these areas were generated as shown in Figures 1 through 5.

These areas and the current land use (as determined through aerial photos) are defined further in Table 1 and Figures 1 through 5 detail each specific area.

Table 1 – Locations Selected for Ground Truth Measurements

Area No.	Location	Current Land Use	GPS Coordinates (centroid location)	
1	Cesium Prong	Residential properties, with cleared and tree covered areas.	42°27'46.97" N	78°40'13.53" W
2	Near Scoby Hill Dam (new location likely an extension of the Cesium Prong)	Varying in terrain and tree cover. These areas are not residential.	42°28'25.66" N	78°41'18.84" W
3	Near confluence of Buttermilk and Cattaraugus Creeks	Active agriculture area.	42°28'56.20" N	78°40'42.19" W
4	Cattaraugus Territory of the Seneca Nation of Indians	Wooded area that does not include residences.	42°32'23.84" N	79°02'13.07"W
5	Cattaraugus Territory of the Seneca Nation of Indians	Wooded area near residential property.	42°31'12.94" N	78°58'25.11" W

Figure 1 shows Area 1, which is adjacent to the WNYNSC site. This area is the off-site portion of the Cesium Prong, which was extensively characterized in the 1990s. The four confirmatory soil sample locations are identified in Figure 1 (Locations 1.1, 1.2, 1.3 and 1.4). The details regarding these sample locations are provided in Tables 2, 3 and 4.

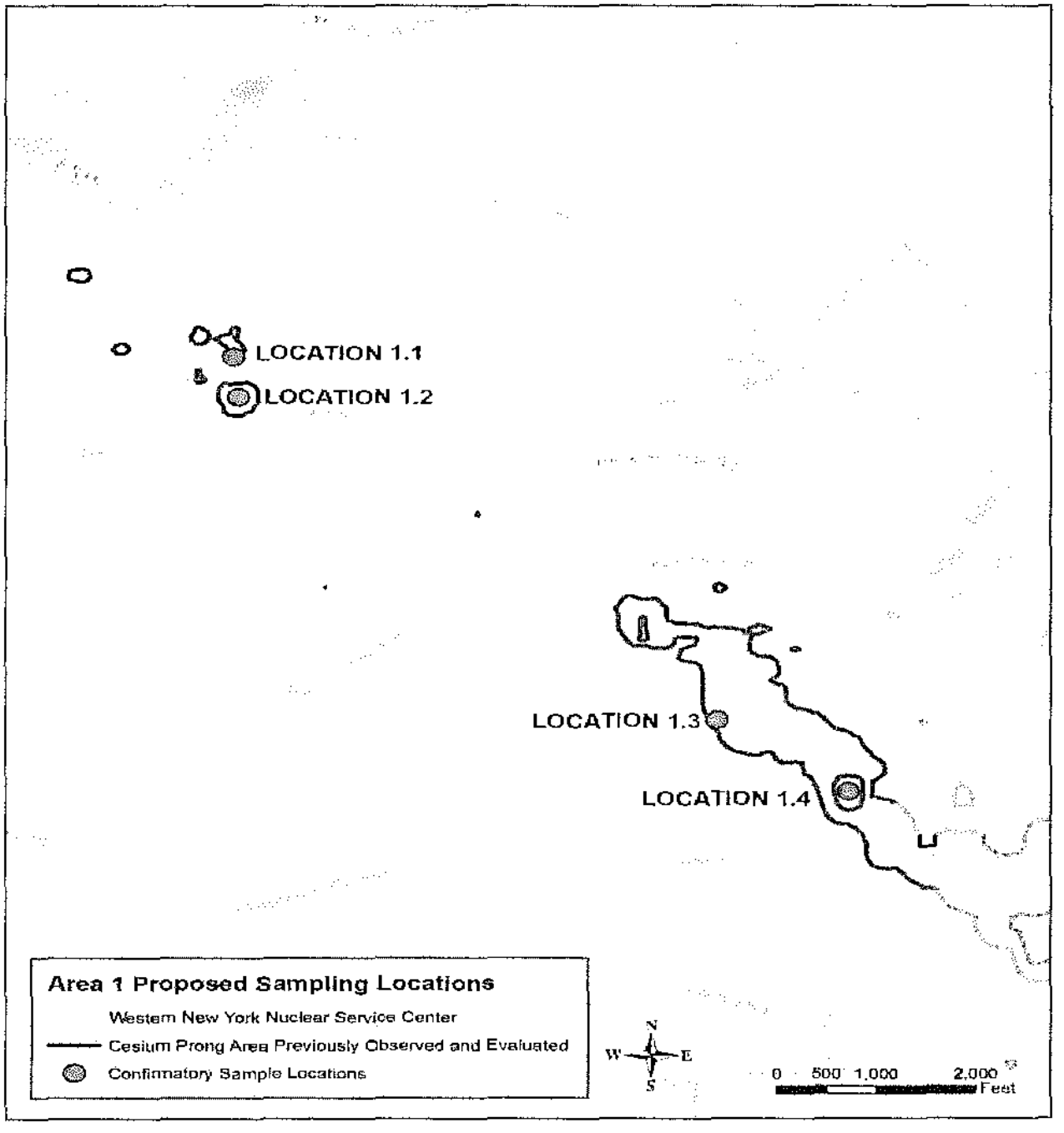


Figure 1 – Area 1, the Cesium Prong

Figure 2 shows Area 2, one of the newly identified areas. This area is located at the outer edge of the Cesium Prong, and may be a linear extension of the Cesium Prong (Area 1). The identification of this area in the 2014 survey may be due to improvements in the sensitivity of the radiation survey equipment since the previous surveys were conducted in 1979 and 1984. The area identified by the blue contour in the middle of the map is not being evaluated because the property owner declined the sampling request. It may be possible to obtain qualitative information on conditions in this area through the evaluation of the sample results from Sub Areas 2.1 and 2.2. The details regarding these sample locations are provided in Tables 2, 3 and 4.

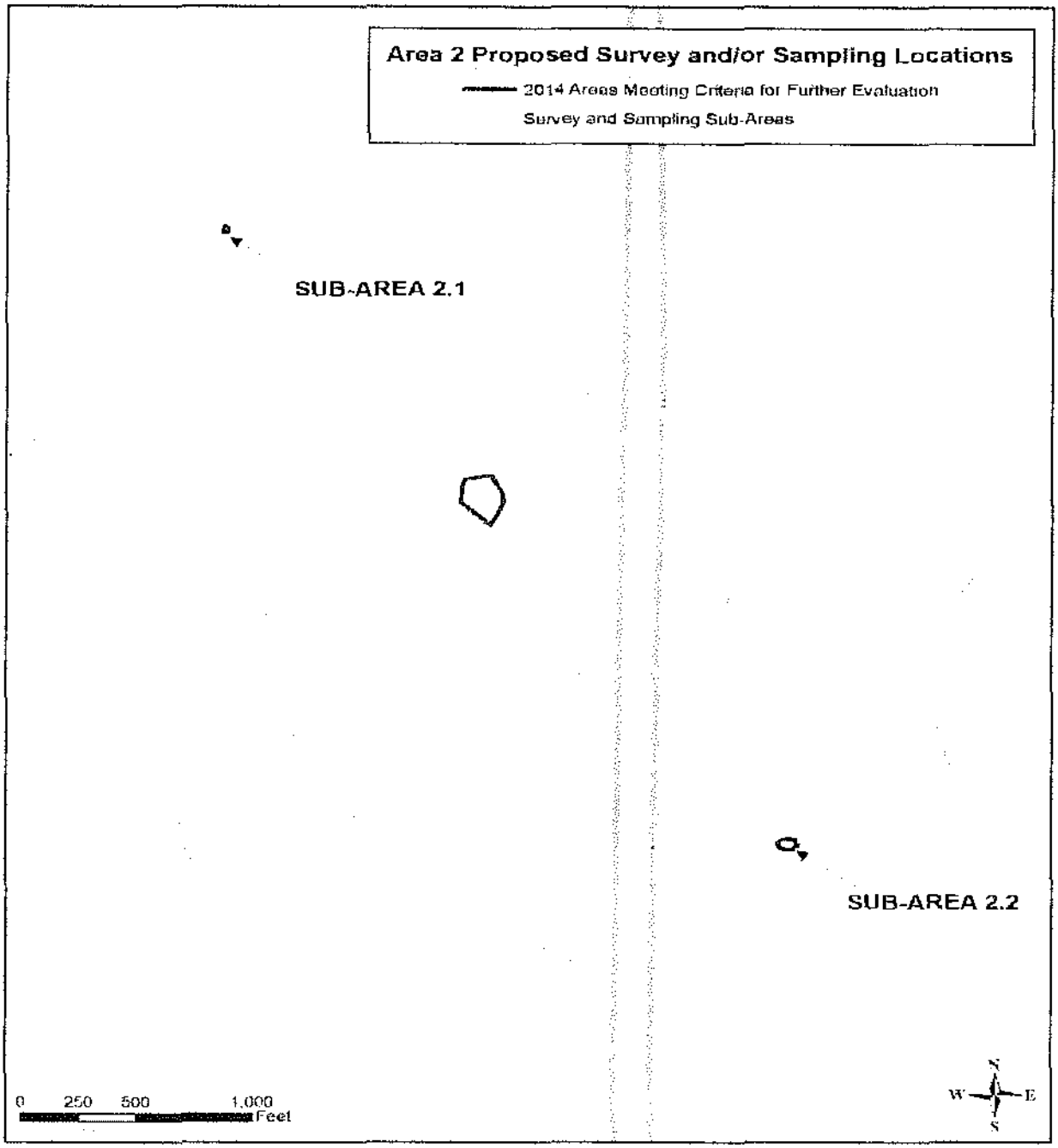


Figure 2 – Area 2, Northwest of the Cesium Prong

Figure 3 shows the general location of Area 3 at the confluence of Buttermilk and Cattaraugus Creeks. This area has been identified in previous aerial surveys, but has not been surveyed or sampled. These survey and sampling sub-areas are identified on Figure 3. This area is an active agricultural area. The details regarding these sample locations are provided in Tables 2, 3 and 4.

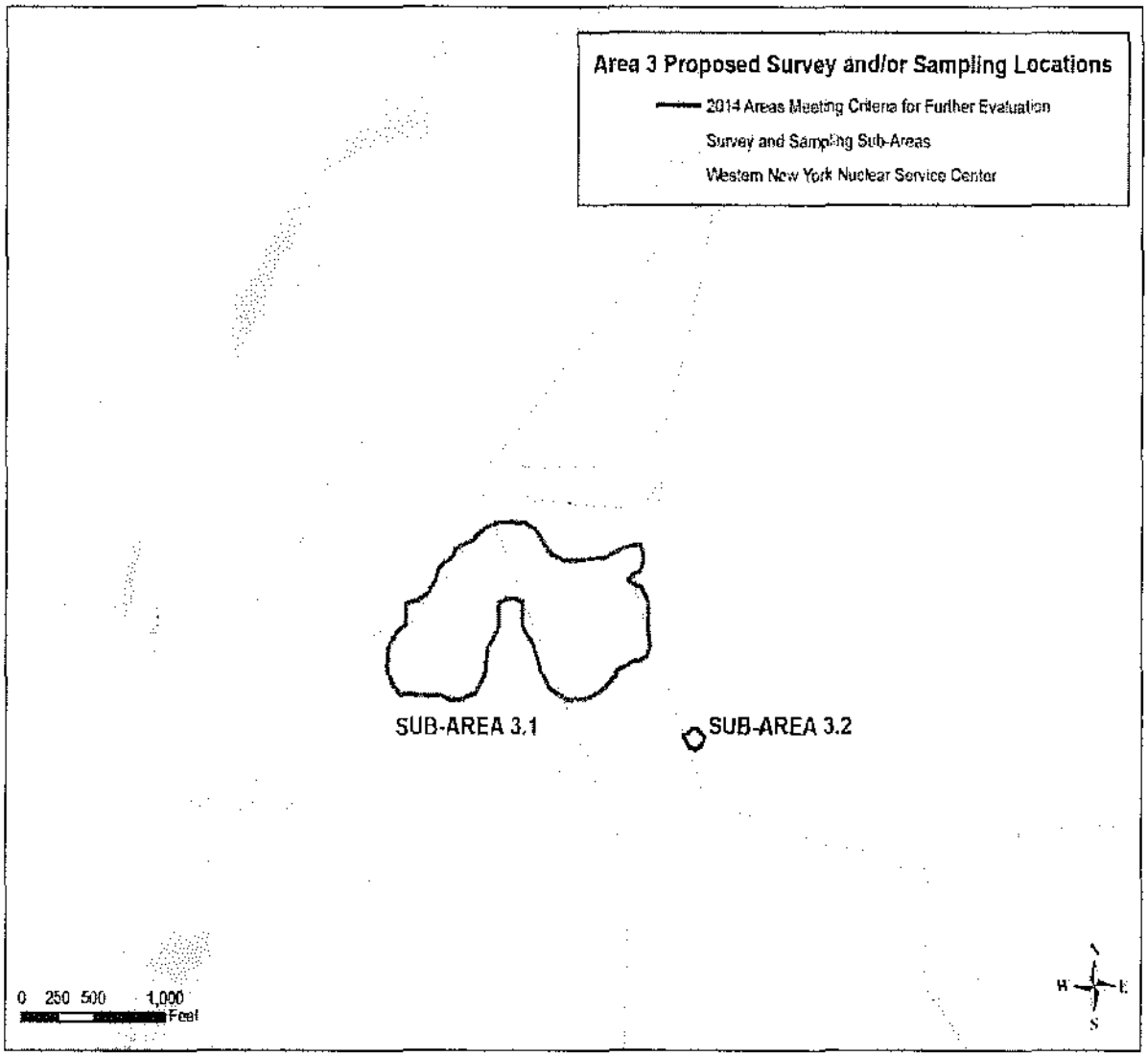


Figure 3 – Area 3, Near the Confluence of Buttermilk and Cattaraugus Creeks

Figure 4 shows the location of Area 4 on the Cattaraugus Territory of the Seneca Nation of Indians. These areas have not been previously identified. The survey and sampling sub-areas are identified on Figure 4. The details regarding these sample locations are provided in Tables 2, 3 and 4.

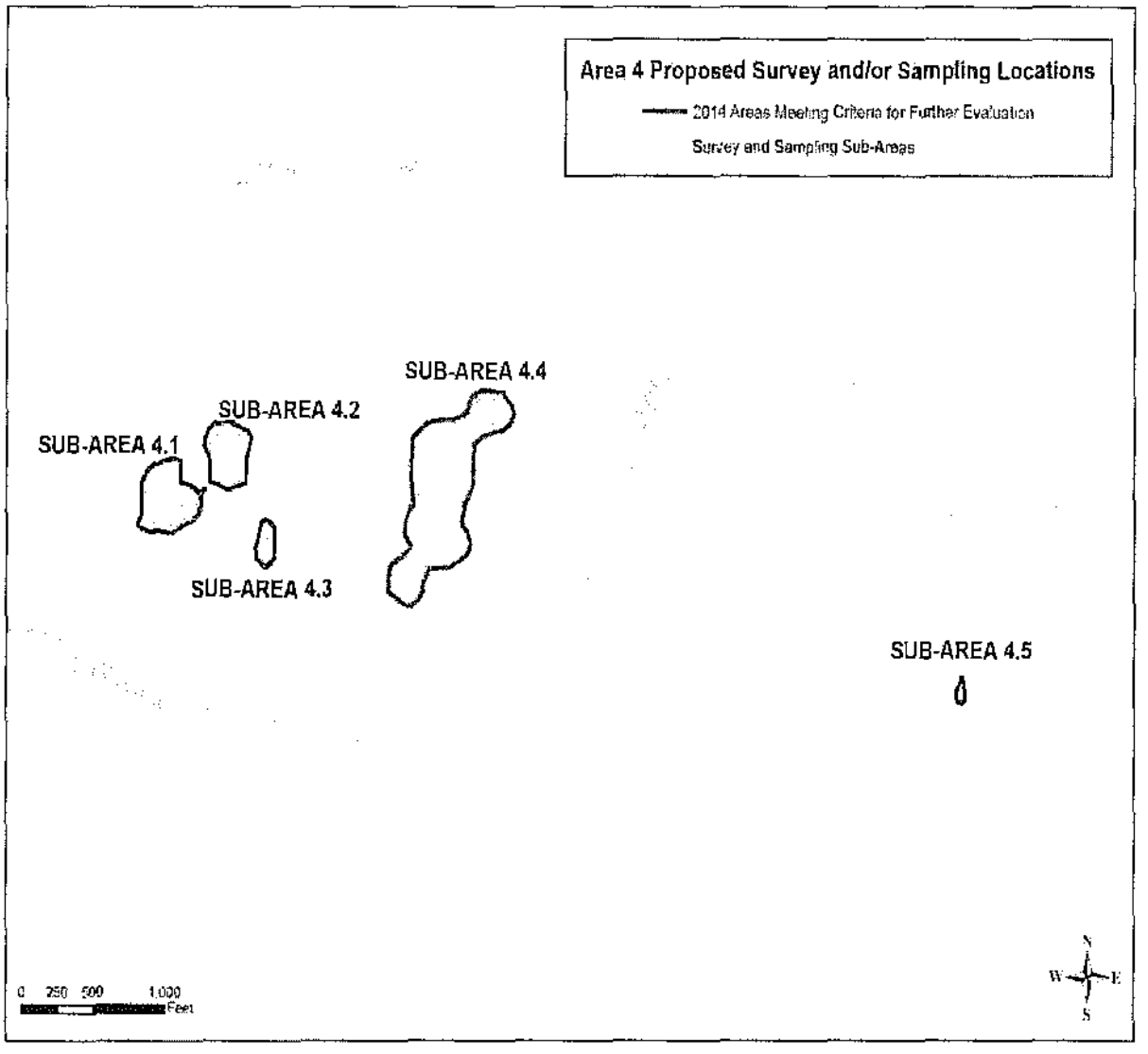
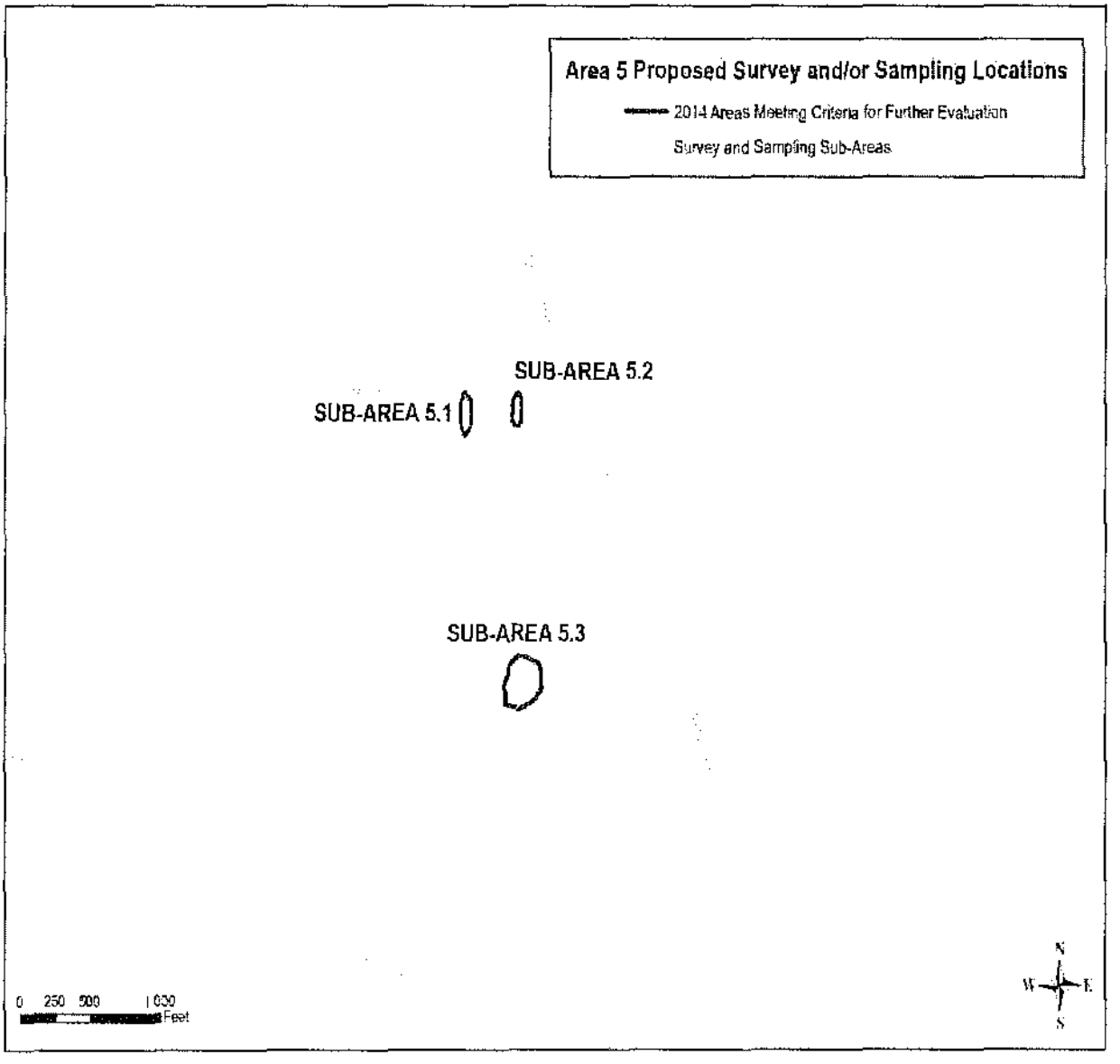


Figure 4 – Area 4, located on the Cattaraugus Territory of the Seneca Nation of Indians

Figure 5 shows the location of Area 5 on the Cattaraugus Territory of the Seneca Nation of Indians. These areas have not been previously identified. We note that this area is not within the historic floodplain of Cattaraugus Creek, and RSL noted that there was not a strong cesium-137 signal in the aerial survey results. Because the RSL criteria were met, the area will be evaluated further. The survey and sampling sub-areas are identified in Figure 5. The details regarding these sample locations are



provided in Tables 2, 3 and 4.

Figure 5 – Area 5, located on the Cattaraugus Territory of the Seneca Nation of Indians

8. Areas of Known Contamination on the WNYNSC

In order to evaluate the aerial radiation survey results for areas with elevated concentrations of Cs-137, four known areas of contamination have been selected for analysis. These are "on Center" locations. In order to evaluate direct radiation dose rates in the areas of known contamination, microRem readings will be collected at ground surface and at one meter for each of these sample locations. Three soil samples will be collected from each of the four "on Center" locations (0-5 cm, 5-15 cm and 15-30 cm), with one subsurface sample collected for Location C-02 (30 cm -1 m). The details regarding these sample locations are provided in Figure 6 and Table 4.

9. Areas Selected for Background Measurements

In order to determine if the five areas are above background for Cs-137, background survey and soil sampling data will be collected. Due to the variability of background, two background areas have been identified; one background area will be located on the WNYNSC for the elevated locations near the WNYNSC site, and one background area for the locations on the Cattaraugus Territory of the Seneca Nation of Indians.

a) WNYNSC Background Area – This activity will use the background data collected and analyzed by the U.S. Department of Energy (DOE) to support the 2014 West Valley Demonstration Project Terrestrial Background Study (Safety and Ecology Corporation, 2014). The total area for the background reference location is 2,000 m^2, with 10 samples collected at equally spaced locations representing 200 m^2. At each sampling location, one near surface sample was collected (0-15 cm) and one deep surface sample was collected (15-100 cm).

   Figure 7 shows the DOE background sampling location on the WNYNSC property.

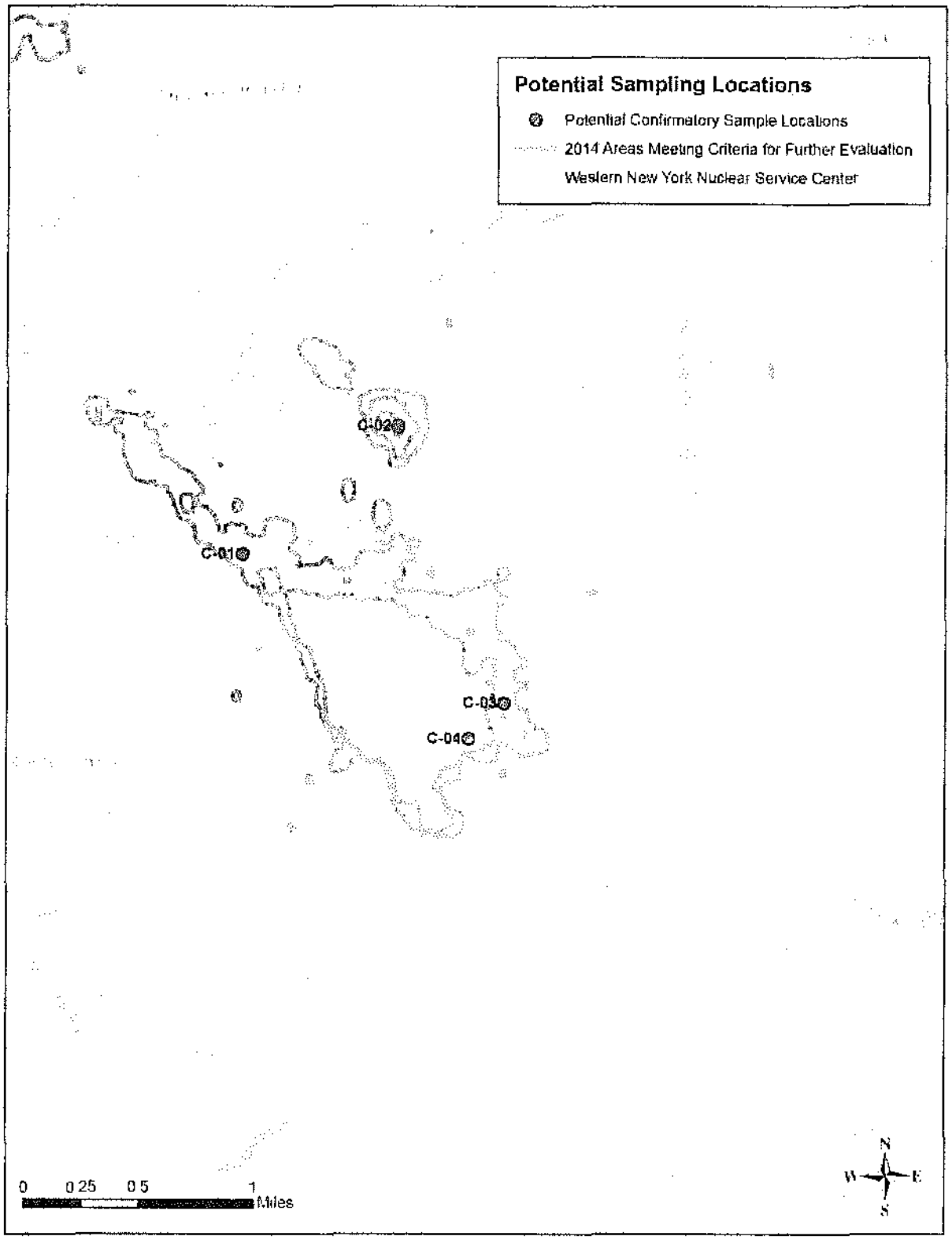


Figure 6 – Known Contamination Sample Locations located on the WNYNSC

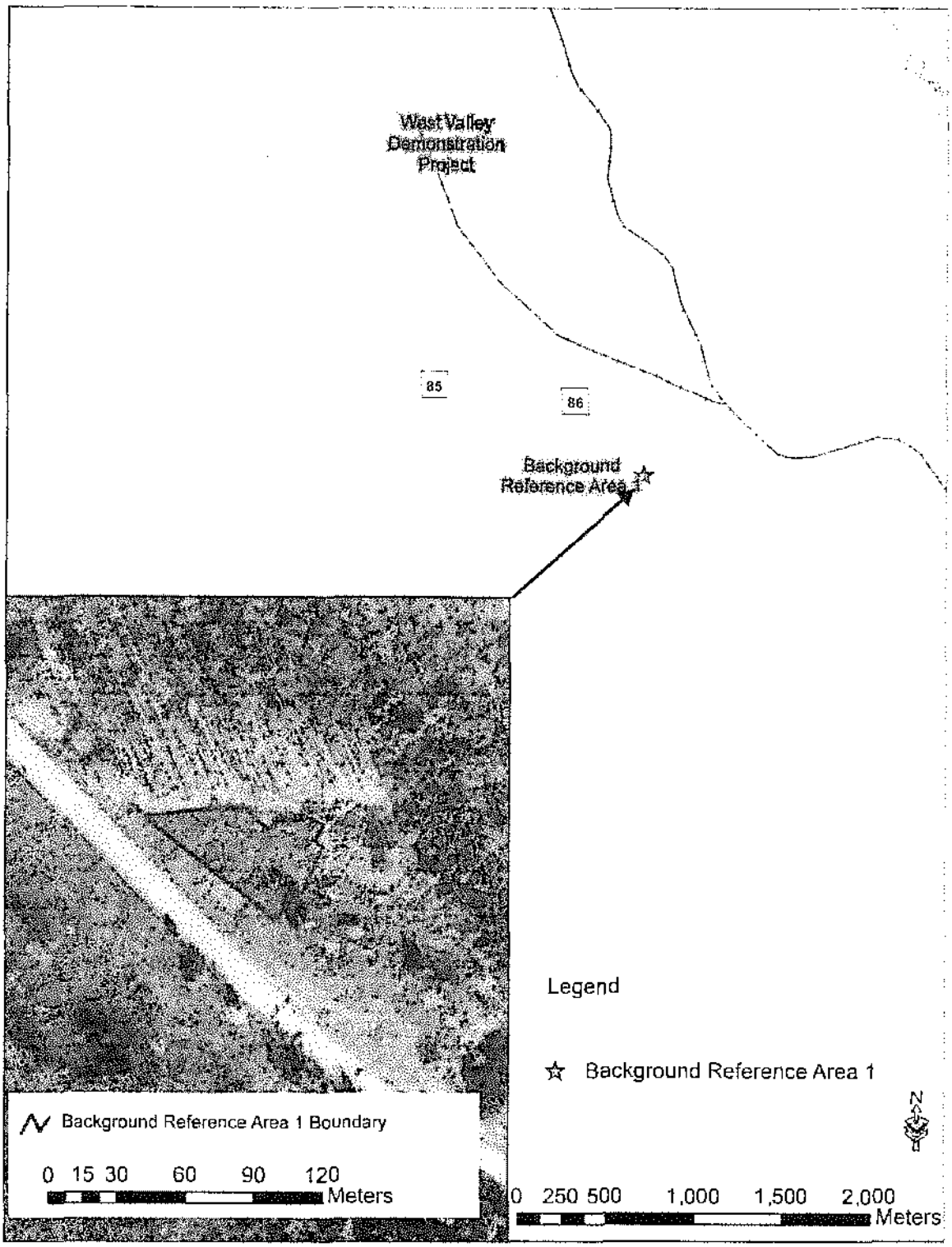


Figure 7 – DOE Background Locations on the WNYNSC

b) Cattaraugus Territory of the Seneca Nation of Indians Background Area - There are 10 potential background locations on the Cattaraugus Territory of the Seneca Nation of Indians. These locations are not in close proximity to the sampling locations. Five of these locations are located within the Cattaraugus Creek valley, and represent similar soil and stream sediment characteristics. Five background locations are outside of the stream valley. A minimum of two background samples will be collected at each location (0-15 cm and 15 – 30 cm), with three background locations collected for subsurface samples (30 cm – 1 m).

Figure 8 and Table 4 detail the 10 potential background sampling locations on the Cattaraugus Territory of the Seneca Nation of Indians.

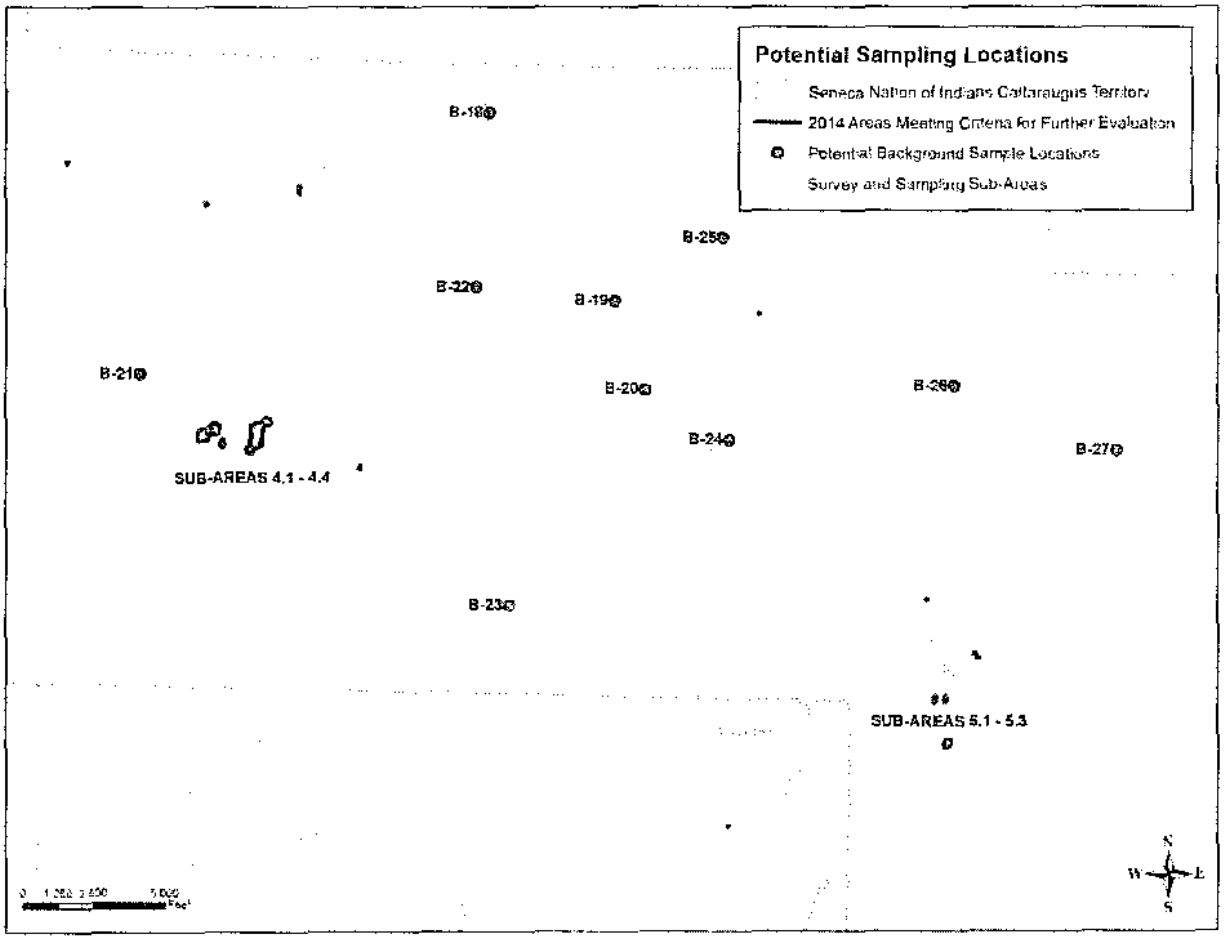


Figure 8 – Potential Background Locations on the Cattaraugus Territory of the Seneca Nation of Indians

10. Overview of Survey and Sampling Approach to be used to Ground Truth Aerial Survey Results

The approach and sequential process that will be used for each location (i.e., elevated, random, confirmatory or "on Center" locations) is detailed below:

a) GPS Survey of Areas - For sub-areas that have not been previously sampled (i.e., Sub Areas 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 4.4, 4.5, 5.1, 5.2 and 5.3), a walkover survey of each sub-area will be conducted, with a GPS system recording the coordinates as the survey is being completed.

The general methodology to conduct the radiological surveys will be as follows:

I. A course grid walkover survey (typically 20 to 30 meter spacing) will be conducted utilizing a 2"x2" NaI gamma detector, coupled with a Ludlum Model 2241-2 scaler/ratemeter. The count rate signal from the Ludlum 2241-2 will be transferred to a GPS instrument, which will simultaneously log the GPS position and count rate. The logged data will subsequently be transferred to a computer to be displayed on a map and/or satellite image. Each count rate data point will be assigned to a count rate range. For example: 0-4,000 CPM, 4,001 to 8,000 CPM, 8,001 to 12,000, and greater than 12,000 CPM. These count rate ranges will be color coded (e.g., green/yellow/orange/red), and displayed as the proper colored dot on the map or satellite image.

II. After the GPS survey results are completed, MJW Corporation will review the survey results to determine if elevated locations above background levels have been identified within the surveyed area. If elevated locations are identified, these locations will be sampled and static direct radiation levels collected at the sample locations. If elevated locations are not identified, random locations will be selected for survey and sampling on a grid pattern commensurate the shape of the area, as well as terrain and related physical conditions. The minimum number of survey and sampling locations are subsequently described in Table 3.

b) Detailed Survey and Sampling Locations Determination - Each location where elevated, random or known sampling has been identified will be surveyed and sampled using:

i. Tissue equivalent micro Rem readings at ground surface and 100 cm elevation.
ii. Static 2" x 2" NaI detector readings at contact and 100 cm elevation.
iii. Collection of soil and stream sediment samples (0 to 15 cm and 15-30 cm depths).
iv. Subsurface soil samples (30 cm - 100 cm depth).

c) For Cesium Prong confirmatory locations, based on previous sampling efforts (see Offsite Investigation Report in Section2), the highest levels of radioactivity are

expected to be located in the 0-5 cm soil layer. Samples for the confirmatory locations will be collected in three soil depth intervals, 0 to 5 cm, 5-15 cm and 15-30 cm.

d) Sample Number Determination - The total number of samples that will be collected for each sub-area was determined based on the size/area (in m^2). The sub-unit size/area determinations are as follows:

   I. 0 – 2,000 m^2 in area – A minimum of four locations will be sampled for each sub-area.
   II. 2,001 – 10,000 m^2 in area – A minimum of 15 locations will be sampled for each sub-area.
   III. > than 10,000 m^2 in area – A minimum of 24 locations will be sampled for each sub-area

   The total number of samples from each sub-area are detailed in Table 3.

e) Sample Analysis Strategy
   I. All of the 0-15 cm interval samples will be analyzed for gross alpha, gross beta and gamma spectroscopy. Based on these results, additional expanded analysis (detailed in Table 5) may be warranted.
   II. If any of the Cs-137 results are above background plus 2 standard deviations, then the next greater depth sample will be sent for analysis.
   III. If the gross alpha or beta results are greater than background plus 2 standard deviations, then radiation doses will be calculated assuming that the gross beta background exceedance is attributed to Sr-90, and the gross alpha exceedance is attributed to the most limiting (i.e., most conservative) alpha-emitting radionuclide (Am-241 or Pu-239).
   IV. For the subsurface soil samples (30 cm – 1m), each sample will be surveyed using the 2"x2" NaI detector, and the region of depth with the highest elevated counts will be sent for analysis. If no elevated areas are identified, the 30 cm to 45 cm sample will be sent for analysis.
      i. Standard Analysis - All soil samples will be analyzed for gross alpha and beta and gamma spectroscopy.
      ii. Expanded Analysis - Selected samples will be analyzed more extensively, based upon initial sample results, information gathered in the field, and project Quality Assurance/Quality Control requirements. At a minimum, two quality control samples from each sub-area will be sent for expanded analysis. Additional information related to the quality control samples is detailed in the QAPP. The expanded analysis will require a 20-day ingrowth period for a precise analysis of some radionuclides, such as Radium-226, and as such will not be included in the dose assessment. If this analysis yields information that would have a significant impact on the dose assessment, the dose assessment will be revised.

V. Based on the information detailed in Tables 2, 3 and 4, there will be 179 elevated or random soil samples, 23 SNI background, 5 "on Center" and 37 quality control soil samples that will be collected and initially sent for analysis.

VI. In addition, all four Cesium Prong-confirmatory samples at 0-15 cm depth and one confirmatory sample at 30 cm -1 m depth will be sent for gross alpha, gross beta and gamma spectroscopy. All five have been selected for expanded analysis.

VII. For samples that were analyzed for gross alpha, gross beta, and gamma spectroscopy only (i.e., that did not exceed background plus two standard deviations), the alpha activity will be attributed to Am-241, a second calculation will be performed assuming Pu-239 (the limiting alpha emitting radionuclide).

VIII. For samples that were analyzed for gross alpha, gross beta, and gamma spectroscopy only (i.e., that did not exceed background plus two standard deviations), the beta activity will be attributed to Sr-90, the limiting beta emitting isotope.

Table 2 – Sub-Area Description, Survey and Results Comparison

Area	General Description of Area	Approximate Size of Area (m^2)	Walkover Survey and GPS	Results Compared To
1.1	Cesium Prong	NA	NA Confirmatory Location	1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.2	Cesium Prong	NA	NA–Confirmatory Location	1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.3	Cesium Prong	NA	NA–Confirmatory Location	1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.4	Cesium Prong	NA	NA–Confirmatory Location	1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
2.1	Northwest of Cesium Prong	42	Yes	2014 WVDP Terrestrial Background Study
2.2	Northwest of Cesium Prong	350	Yes	2014 WVDP Terrestrial Background Study
3.1	Field at Confluence of Buttermilk and Cattaraugus Creeks	46,933	Yes	2014 WVDP Terrestrial Background Study
3.2	Elevated sub-area on Farm	1,028	Yes	2014 WVDP Terrestrial Background Study
4.1	Cattaraugus Territory of the Seneca Nation of Indians	12,913	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
4.2	Cattaraugus Territory of the Seneca Nation of Indians	9,378	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
4.3	Cattaraugus Territory of the Seneca Nation of Indians	2,591	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
4.4	Cattaraugus Territory of the Seneca Nation of Indians	44,329	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
4.5	Cattaraugus Territory of the Seneca Nation of Indians	550	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
5.1	Cattaraugus Territory of the Seneca Nation of Indians	1,374	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
5.2	Cattaraugus Territory of the Seneca Nation of Indians	902	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values
5.3	Cattaraugus Territory of the Seneca Nation of Indians	5,845	Yes	2015 Cattaraugus Territory of the Seneca Nation of Indians Background Values

Table 3 – Sub-Area Description, Number of Sample Locations, Maximum Depth, and Total Number of Samples

Area	General Description of Area	Approximate Size of Area (m^2)	Total Sample Locations	Maximum Sample Depth	Number of Samples: Elevated (E), Random (R), or Confirmatory (C) and Depths (m)	Total Samples Collected
1.1	Cesium Prong	NA	1	30 cm	3 **C** Samples: 0-5 cm 5-15 cm 15-30 cm	3
1.2	Cesium Prong	NA	1	30 cm	3 **C** Samples: 0-5 cm S-15 cm 15-30 cm	3
1.3	Cesium Prong	NA	1	30 cm	3 **C** Samples: 0-5 cm 5-15 cm 15-30 cm	3
1.4	Cesium Prong	NA	1	30 cm	3 **C** Samples: 0-5 cm 5-15 cm 15-30 cm	3
2.1	Possible Cesium Prong Extension	42	4	1 m	3 **E** or **R** Samples: 0-5 cm 5-15 cm, 15 cm – 1m	12
2.2	Possible Cesium Prong Extension	350	4	1 m	3 **E** or **R** Samples: 0-5 cm 5-15 cm, 15 cm – 1m	12
3.1	Field at Confluence of Buttermilk and Cattaraugus Creeks	46,933	24	1 m	24 **E** or **R** Samples: 0-15 cm 15-30 cm 6 **E** or **R** Samples:	60

Table 3 – Sub-Area Description, Number of Sample Locations, Maximum Depth, and Total Number of Samples

Area	General Description of Area	Approximate Size of Area (m^2)	Total Sample Locations	Maximum Sample Depth	Number of Samples: Elevated (E), Random (R), or Confirmatory (C) and Depths (m)	Total Samples Collected
					30 – 60 cm 60 cm – 1 m	
3.2	Elevated sub-area on Farm	1,028	4	1 m	4 **E** or **R** Samples: 0-15 cm 15 -30 cm; 1 **E** or **R** Sample: 30 – 60 cm 60 cm – 1 m	10
4.1	Cattaraugus Territory of the Seneca Nation of Indians	12,913	24	1 m	24 **E** or **R** Samples: 0-15 cm 15 -30 cm; 6 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	60
4.2	Cattaraugus Territory of the Seneca Nation of Indians	9,378	15	1 m	15 **E** or **R** Samples: 0-15 cm 15 -30 cm; 4 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	38
4.3	Cattaraugus Territory of the Seneca Nation of Indians	2,591	15	1 m	15 **E** or **R** Samples: 0-15 cm 15 -30 cm; 4 **E** or **R** Samples: 30 – 60 cm; 60 cm – 1 m	38
4.4	Cattaraugus Territory of the Seneca Nation of Indians	44,329	24	1 m	24 **E** or **R** Samples: 0-15 cm 15 -30 cm;	60

Table 3 – Sub-Area Description, Number of Sample Locations, Maximum Depth, and Total Number of Samples

Area	General Description of Area	Approximate Size of Area (m^2)	Total Sample Locations	Maximum Sample Depth	Number of Samples: Elevated (E), Random (R), or Confirmatory (C) and Depths (m)	Total Samples Collected
					6 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	
4.5	Cattaraugus Territory of the Seneca Nation of Indians	550	4	1 m	4 **E** or **R** Samples: 0-15 cm 15 -30 cm; 1 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	10
5.1	Cattaraugus Territory of the Seneca Nation of Indians	1,374	4	1 m	4 **E** or **R** Samples: 0-15 cm 15 -30 cm; 1 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	10
5.2	Cattaraugus Territory of the Seneca Nation of Indians	902	4	1 m	4 **E** or **R** Samples: 0-15 cm 15 -30 cm; 1 **E** or **R** Samples: 30 – 60 cm 60 cm – 1 m	10
5.3	Cattaraugus Territory of the Seneca Nation of Indians	5,845	15	1 m	15 **E** or **R** Samples: 0-15 cm 15 -30 cm; 4 **E** or **R** Samples: 30 – 60 cm; 60 cm – 1 m	38

Table 4 – Sub-Area Description, Total Samples from Each Sub-Area, Standard and Expanded Analysis and Dose Assessment

Area	General Description of Area	Total Samples from Each Sub-Area Sent for Initial Analysis	Standard Analysis	Expanded Analysis	Dose Assessment Information
1.1	Cesium Prong	1	Gross alpha, Gross Beta, Gamma Spec	If standard analysis data is > 1995 values + 10% decay-corrected values, refer to Section 10.	Use 1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.2	Cesium Prong	1	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > 1995 values + 10% decay-corrected values, refer to Section 10.	Use 1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.3	Cesium Prong	1	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > 1995 values + 10% decay-corrected values, refer to Section 10.	Use 1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
1.4	Cesium Prong	1	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > 1995 values + 10% decay-corrected values, refer to Section 10.	Use 1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report
2.1	Cesium Prong Extension	4	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > WNYNSC Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
2.2	Cesium Prong Extension	4	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > WNYNSC Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
3.1	Field at Confluence of Buttermilk and Cattaraugus Creeks	30	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > WNYNSC Background + 2σ, refer to Section 10.	Resident Farmer Scenario Dose Assessment using RESRAD Calculation
3.2	Elevated sub-area on Farm	5	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > WNYNSC Background + 2σ, refer to Section 10.	Resident Farmer Scenario Dose Assessment using RESRAD Calculation
4.1	Cattaraugus Territory of the Seneca Nation of Indians	30	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation

Table 4 – Sub-Area Description, Total Samples from Each Sub-Area, Standard and Expanded Analysis and Dose Assessment

Area	General Description of Area	Total Samples from Each Sub-Area Sent for Initial Analysis	Standard Analysis	Expanded Analysis	Dose Assessment Information
4.2	Cattaraugus Territory of the Seneca Nation of Indians	19	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
4.3	Cattaraugus Territory of the Seneca Nation of Indians	19	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
4.4	Cattaraugus Territory of the Seneca Nation of Indians	30	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
4.5	Cattaraugus Territory of the Seneca Nation of Indians	5	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
5.1	Cattaraugus Territory of the Seneca Nation of Indians	5	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
5.2	Cattaraugus Territory of the Seneca Nation of Indians	5	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
5.3	Cattaraugus Territory of the Seneca Nation of Indians	19	Gross Alpha, Gross Beta, Gamma Spec	If standard analysis data is > SNI Background + 2σ, refer to Section 10.	Recreational Hiker Scenario Dose Assessment using RESRAD Calculation
	General Area Description	Total Samples	Standard Analysis	Expanded Analysis	
	WNYNSC On-Center"	5	Gross Alpha, Gross Beta, Gamma Spec	Two sent for Isotopic Analysis	N/A
	SNI Background	23	Gross Alpha, Gross Beta, Gamma Spec	10% or three sent for Isotopic Analysis	N/A
	Quality Control Samples	37	Gross Alpha, Gross Beta, Gamma Spec	100% sent for Isotopic Analysis	N/A

Table 5– Standard and Expanded Analysis Information

Analytical Parameter	Method	MDC	Units
Standard Analysis			
Gross Alpha	EPA 900.0 Mod/SW	4	pCi/g
Gross Beta (Nonvolatile Beta)	EPA 900.0 Mod/SW	10	pCi/g
Gamma Scan (Cs-137, Ac-227, Co-60, Cd-113m, Eu-154, Pa-231, Ra-226, Ra-228, Sb-125, Sn-126)	DOE HASL 300 4.5.2.3/Ga-01-R	0.1 (Cs-137 Only)	pCi/g
Expanded Analysis			
Am-241,Cm-242,Cm-243/244,Cm-245/246	DOE HASL 300 Am-05-RC Mod	1	pCi/g
C-14	EPA EERF C-01 Mod	2	pCi/g
I-129	DOE HASL 300 I-01	1	pCi/g
Np-237	DOE HASL 300	1	pCi/g
Pu-238, 239/240	DOE HASL 300 Pu-11-RC Mod	1	pCi/g
Pu-241	DOE HASL 300 Pu-11-RC Mod	15	pCi/g
Sr-90	EPA 905.0 Mod	2	pCi/g
Tc-99	DOE HASL 300 Tc-02-RC Mod	5	pCi/g
U-232	DOE HASL 300 U-02-RC Mod	1	pCi/g
U-233/234, U-235/236, U-238	DOE HASL 300 U-02-RC Mod	1	pCi/g
H-3	EPA 906.0 Mod	6	pCi/g
Th-229	DOE HASL 300 Th-01-RC Mod	1	pCi/g
Th-228, Th-230, Th-232	DOE HASL 300 Th-01-RC Mod	1	pCi/g
Radium 226 (20-day ingrowth)	DOEHASL 300 4.5.2.3/GA-01-R	1	pCi/g
Radium 228	DOEHASL 300 4.5.2.3/GA-01-R	3	pCi/g

11. Dose Assessment Methodology

a) For the Cesium Prong, which has been previously evaluated, the data evaluation approach will be :

   I. Estimation of annual exposure based upon the aerial survey data.

   II. Estimation of annual exposure based upon the microRem meter readings.

   III. For Area 1, compare the decay corrected isotopic concentrations from the 1995 study to the new isotopic concentrations. Further analysis by RESRAD or generally accepted methodologies may be appropriate if comparison yields a new isotopic concentration in excess of 10% of the decay corrected 1995 data.

   IV. For Area 2 (sub-areas 2.1 and 2.2), a site-specific Recreational Hiker land use scenario will be evaluated using RESRAD; where appropriate, site-specific parameters will be entered into RESRAD (e.g., hydrology, occupancy and consumption) in order to give a more specific estimate of the Recreational Hiker's exposure. These parameters will either be adjusted based on published references for the region or historical site specific data. This area will be calculated using the arithmetic mean for the data analyzed.

b) For Area 3 (sub-areas 3.1 and 3.2) the primary method of dose assessment will be:

   I. Estimation of annual exposure based upon the aerial survey data.

   II. Estimation of annual exposure based upon the microRem meter readings.

   III. A site-specific Resident Farmer land use scenario will be evaluated using RESRAD; where appropriate, site-specific parameters will be entered into RESRAD (e.g., hydrology, occupancy and consumption) to give a more specific estimate of the exposure. These parameters will either be adjusted based on published references for the region or historical site specific data. Trend analysis of the expected annual exposure rate over time will be made to determine if a member of the public would be expected to exceed the 25 mrem/year limit currently or in the foreseeable future.

   These areas will be calculated using the arithmetic mean for the data analyzed.

c) Areas 4 and 5 (sub- areas 4.1, 4.2, 4.3, 4.4, 4.5, 5.1, 5.2 and 5.3.) the primary method of dose assessment will be:

I. Estimation of annual exposure based upon the aerial survey data.

II. Estimation of annual exposure based upon the microRem meter readings.

III. A site-specific Recreational Hiker land use scenario will be evaluated using RESRAD; where appropriate, site-specific parameters will be entered into RESRAD (e.g., hydrology, occupancy and consumption) to give a more specific estimate of the Recreational Hiker's exposure. These parameters will either be adjusted based on published references for the region or historical site specific data and in consultation with the Seneca Nation.

These areas will be calculated using the arithmetic mean for the data.

d) Each sub-area dose assessment will be compared to the surface soil decay-corrected values in Table 7 (Table ES-1 the $DCGL_w$ Peak-of-the Mean) of the WVDP Phase 1 Decommissioning Plan for comparison purposes. The peak-of-the mean values are the most conservative $DCGL_w$ values provided in the Phase 1 WVDP Decommissioning Plan and are for a resident farmer scenario.

12. Potential Obstacles and Contingency Strategy

One potential obstacle to performing the radiological surveys is inadequate GPS signal ("dead zones"). This may occur in areas where there is excessive tree cover, or geological feature such as ridges, that may obstruct the GPS Satellite signals.

If this occurs across a very limited section of a Subzone, the survey team will obtain GPS coordinates at the edges of the dead zone and will note them in the survey logs. If low precision or cell tower based location information is available, the grid lines will be mapped and readings will be logged by hand at 20 meter intervals.

If the dead zone is substantial, GPS Survey will be conducted in the areas where it is possible, and grid lines will be established and walked down manually recording the data.

A second potential obstacle will be field conditions encountered that hamper the ability to collect readings in the prescribed geometries. For example, heavy vegetation may hinder the ability to obtain measurement at the prescribed 1 cm and 100 cm elevations. Field personnel will make their best effort to achieve the geometries; but there may be some deviation which will be noted.

Table 6 - $DCGL_w$ Peak-of-the Mean values of the WVDP Phase 1 Decommissioning Plan, Rev. 2 for 25 mRem/year (pCi/g) [1]

Nuclide	Surface Soil
Am-241	2.9E+01
C-14	1.6E+01
Cm-243	3.5E+01
Cm-244	6.5E+01
Cs-137[2]	1.5E+01
I-129	3.3E-01
Np-237	2.6E-01
Pu-238	4.0E+01
Pu-239	2.5E+01
Pu-240	2.6E+01
Pu-241	1.2E+03
Sr-90[2]	4.1E+00
Tc-99	2.1E+01
U-232	1.5E+00
U-233	8.3E+00
U-234	8.4E+00
U-235	3.5E+00
U-238	9.8E+00

NOTES: (1) The $DCGL_W$ is the DCGL applicable to the average concentration over the survey unit.
(2) WVDP Phase 1 DP DCGLs for Sr-90 and Cs-137 apply to the year 2041 and later.

13. Applicable Field Procedures or Referenced Documents

MJW Field Procedures applicable to the work will include:

- "GPS Enhanced Overland Gamma Radiation Survey – Including Preparation and Assessment of Radiological and Geographical Data"
- "Instrument Operation Procedure – Ludlum 2241-2 Ratemeter/Scaler Coupled with Ludlum 44-9 or Ludlum 44-10 2x2 NaI Detector"
- "Instrument Operating Procedure – Bicron MicroRem Meter"
- Project Specific Sample Collection Procedure
- Quality Assurance Project Plan
- Health and Safety Project Plan

Other referenced documents include:

- *1995 Western New York Nuclear Service Center Off-Site Radiation Investigation Summary Report* is available through NYSERDA (Dames and Moore).
- *1984 Aerial Radiological Survey of the West Valley Demonstration Project and Surrounding Area* (EGG-10617-1080) May 1991.
- EG&G Energy Measurements Group, *A Comparison of Aerial Radiological Survey Results of the Nuclear Fuel Services Center (NFS) and Surrounding Area, West Valley, New York,* September 1979.
- *West Valley Demonstration Project Terrestrial Background Study for Task Order No. 5, Rev. 1,* (Safety and Ecology Corporation), July 2014.
- *Phase 1 Decommissioning Plan for the West Valley Demonstration Project, Rev. 2,* December 2009.

14. Reference Standards and Practices

- NCRP Report No. 50, "Environmental Radiation Measurement," December 1976.
- NUREG 1507,"Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," December 1997.
- National Council on Radiation Protection and Measurements Report NCRP No. 129, Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies, Washington, DC, 1999.
- NUREG 1506, "Measurement Methods for Radiological Surveys in Support of New Decommissioning Criteria."
- NUREG-1576- Multi-Agency Radiological Laboratory Protocols Manual (MARLAP).
- "WVDP-065, Manual for Radiological Assessment of Environmental Releases at the WVDP," Rev. 3, August 2000.
- U.S. Nuclear Regulatory Commission, Standards for Protection against Radiation, 10 CFR Part 20, November 16, 2005.
- EPA SOP #2001, General Field Sampling Guidelines, August 11, 1994.
- EPA SOP #2012, Soil Sampling, February 18, 2000.