

Appendix F.4

Gamma Radiation Investigation Reports

- F.4.1 Gamma Radiation Scanning Survey Report, Final. March 26, 2014
- F.4.2 Radionuclide Identification and Characterization Survey, June 11, 2014
- F.4.3 AVESI Radiological Survey Report, December 12, 2016

This page was intentionally left blank.

Appendix F.4.1

Gamma Radiation Scanning Survey Report, Final. March 26, 2014

This page was intentionally left blank.

Peck Iron & Metal

Contract No: EP-S3-07-05
Subcontract No: EPA010AJ

Gamma Radiation Scanning Survey Report Final

March 26, 2014

Prepared for:

**Hydrogeologic (HGL)
And the
United States Environmental Protection Agency
(USEPA)**



Prepared by:

**American Veteran Environmental Services, Inc.
(AVESI)**



EXECUTIVE SUMMARY

The Peck Iron and Metal Site is a former scrap metal storage facility that received scrap metal waste from multiple sources including the U.S. Navy. Because the Site received scrap metal from the Navy, a preliminary gamma radiation scanning survey of the Site was conducted to verify the presence or absence of radioactive material or contamination in the ground surface. The total accessible area available for the initial scan survey was 1,049,232 ft². This area was divided into five survey units and surveyed at 25% coverage. A total of 123 locations with elevated radioactivity measurements were identified, with locations identified on all five survey units. Since the survey only covered 25% of the Site and numerous areas with elevated radioactivity measurements were identified, some key recommendations were made. They include:

- developing a site Radiation Protection Plan and implementing a Radiation Protection Program to monitor individuals on the site and protect the public.
- It is recommended that a dose assessment be conducted based on current survey data for the reasonable maximally exposed scenario group (critical group). For example, what is the dose to a transient who accesses uncontrolled areas of the property? This dose assessment can be refined using data identified during further surveys.
- a more detailed investigation of the Site should be performed including radionuclide identification, a concentrated gamma radiation scan survey and areas with elevated radioactivity measurements should be controlled to preclude public access.
- a temporary Radioactive Materials Storage Area (RMSA) should be established to consolidate and isolate radioactive materials.

These recommendations are discussed in more detail in section 5.2 of this document.

TABLE OF CONTENTS

1. SURVEY OVERVIEW	1-5
1.1 SURVEY OBJECTIVES	1-5
1.2 SCREENING CRITERIA.....	1-6
1.3 SUMMARY OF SURVEY RESULTS.....	1-6
1.3.1 Gamma Radiation Scan Survey Summary	1-6
2. SURVEY METHODS.....	2-1
2.1 SURVEY METHOD OVERVIEW	2-1
2.1.1 Site Reconnaissance.....	2-1
2.1.2 Survey Units.....	2-1
2.1.3 Reference Area Gamma Radiation Scan Survey	2-2
2.1.4 Data Processing and Graduated Color Assignment	2-2
2.1.5 Gamma Radiation	2-3
2.1.6 Dose Rate Measurements.....	2-4
2.2 QUALITY ASSURANCE/QUALITY CONTROL	2-4
2.2.1 Instrument Quality Control.....	2-4
3. GAMMA RADIATION SCAN SUMMARIES	3-5
3.1 RADIATION SCAN SURVEY SUMMARY	3-5
3.1.1 Initial Scan Survey.....	3-5
3.1.2 Detailed Scan Survey	3-7
4. SOIL SAMPLING	4-11
4.1 SOIL SAMPLING SUMMARY.....	4-11
4.1.1 Survey Unit 1	4-11
4.1.2 Survey Unit 2	4-11
4.1.3 Survey Unit 3	4-12
4.1.4 Survey Unit 4	4-12
4.1.5 Survey Unit 5	4-13
5. CONCLUSION	5-16
5.1 Results.....	5-16
5.2 Recommendations.....	5-17
6. GLOSSARY.....	6-18
7. REFERENCES.....	7-19

LIST OF FIGURES

Figure A: Peck Iron and Metal Investigation Boundary
Figure B: Peck Iron and Metal Survey Units
Figure C: Peck Iron and Metal Reference Area
Figure 1-1: Peck Iron and Metal Survey Unit 1 Initial Survey
Figure 1-2 Peck Iron and Metal Survey Unit 1 Detailed Survey
Figure 2-1 Peck Iron and Metal Survey Unit 2 Initial Survey
Figure 2-2 Peck Iron and Metal Survey Unit 2 Detailed Survey
Figure 3-1 Peck Iron and Metal Survey Unit 3 Initial Survey
Figure 3-2 Peck Iron and Metal Survey Unit 3 Detailed Survey
Figure 4-1 Peck Iron and Metal Survey Unit 4 Initial Survey
Figure 4-2 Peck Iron and Metal Survey Unit 4 Detailed Survey
Figure 5-1 Peck Iron and Metal Survey Unit 5 Initial Survey
Figure 5-2 Peck Iron and Metal Survey Unit 5 Detailed Survey

LIST OF TABLES

Table 1-1: Reference Area Background Results
Table 2-1: Established background for Soil/Asphalt
Table 2-1: Established background for Concrete
Table 4-1: SU-1 soil sample and source material supplementary data
Table 4-2: SU-2 soil sample and source material supplementary data
Table 4-3: SU-3 soil sample and source material supplementary data
Table 4-4: SU-4 soil sample and source material supplementary data
Table 4-5: SU-5 soil sample and source material supplementary data
Table 4-6: All soil sample and source material supplementary data
Table 5-5: Detailed Survey Information Log

PHOTOS

Pic-Rad-01
Pic-Rad-02
Pic-Rad-04
Pic-Rad-05
Pic-Rad-08
Pic-Rad-09
Pic-Rad-09-1
Pic-Rad-10
Pic-Rad-11
Pic-Rad-12
Pic-Rad-13
Pic-Rad-14
Pic-Rad-15

ACRONYMS

μ	micro
AHA	Activity Hazard Analysis
AVESI	American Veteran Environmental Services, Inc.
ANSI	American National Standards Institute
BKG	Background
C-14	Carbon
cpm	counts per minute
cm ²	square centimeter
Co 60	Cobalt
COPCs	Contaminants of Potential Concern
Cs 137	Cesium
dpm	disintegrations per minute
USEPA	United States Environmental Protection Agency
ft ²	square feet
GCPM	gross counts per minute
GIS	Geographical Information System
GPS	Global Positioning System
HGL	Hydrogeologic
HP	Health Physicist
Hr	hour
HSP	Health and Safety Plan
m	milli
M	Million
NCPM	net counts per minute (gross count-rate – background count-rate)
Ni 59	Nickel
Ni 63	Nickel
NNSY	Norfolk Navy Shipyard
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
QA/QC	Quality Control/ Quality Assurance
rem	roentgen equivalent man
RA	Radiation Program
RPP	Radiation Protection Plan
RMSA	Radioactive Materials Storage Area
SU	Survey Unit
Sr 90	Strontium
NAVY	United States Navy
VA	Virginia
yr	year

1. SURVEY OVERVIEW

The Peck Iron and Metal site is a former scrap metal storage facility that may have received scrap metal waste from multiple sources including power companies, manufacturing companies, and production facilities. A preliminary gamma radiation scan survey of the site needed to be conducted to verify the presence or absence of radiological contaminated material in the ground surface for assessing potential health and safety concerns to field sampling crews and the public.

The form of materials most likely associated with the radiological waste streams include metal cruds, deposits of nuclear reactor corrosion products removed during the servicing of nuclear powered vessels; nuclear activated metal components; and possibly nuclear gauges; sources; and/or related radioactive materials. Depending on the source material, radiological contaminants could include cobalt-60 (Co-60), nickel-59 (Ni-59), Nickel-63 (Ni-63), cesium-137 (Cs-137), strontium-90 (Sr-90), traces of plutonium isotopes, carbon-14 (C-14), and other radionuclides. At the Site, radionuclide contaminants of potential concern (COPCs) are expected to be bound to metallic materials, particulate materials or entrained in the metal matrix in the case of activation products such as C-14. Non-gamma emitting radionuclides for the purpose of this preliminary survey are assumed to be co-located with Co-60 and Cs-137.

The primary objective of this effort was to provide data sufficient to plan future actions such as demolition, remediation, characterization, decontamination, final status surveys, etc... Given the limited scope of these activities, the survey design was not necessarily intended to conclusively demonstrate compliance with regulatory standards, although data may ultimately be used to support that purpose. Data collected during this effort was to determine the presence of radiological activity within the property boundary.

Survey activities were conducted in accordance with the standard operating procedures of American Veteran Environmental Services, Inc. (AVESI). Field activities consisted of:

- Gamma radiation scan surveys of soils, asphalt, concrete, etc...
- Source dose rate surveys for whole body exposure of gamma radiation
- Beta radiation scans for field personnel, equipment, and supplies
- Alpha/Beta surface removable survey for personnel, equipment and supplies

1.1 SURVEY OBJECTIVES

The purpose of the Peck Iron and Metal Radiation Scan Survey is to identify elevated concentrations of gamma-emitting radionuclides (e.g., Co-60, Ni-59, Ni-63, Cs-137, Sr-90 and traces of plutonium isotopes) from materials contained within surface soils and bias sampling of soils with elevated gamma activity located within the Peck Iron property survey boundary. (**Attachment A Figure A: Peck Iron and Metal Investigation Boundary Map**) This radiation scan survey will include:

- an *initial scan* survey consisting of 25% coverage of accessible areas within the 32 acre property boundary; and
- a *detailed scan* survey consisting of 100% coverage of all areas identified during the initial scan survey as areas of elevated activity.

1.2 SCREENING CRITERIA

For personnel and equipment and supplies, dose-based limits have not yet been established. In the absence of site-specific limits, *Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86* average values for beta-gamma emitters were used for surface screening levels including 1000 dpm/100 cm² for removable alpha and beta activity and 5000 dpm/100 cm² for total alpha and beta activity.

For soil, gravel, concrete and asphalt media scan surveys, all material and materials that exceed 2 times the comparable reference area background (BKG) (2 X BKG) were flagged as isolated areas of elevated activity. Isolated areas of elevated activity were scanned at 100% to demonstrate size and magnitude.

Areas containing multiple isolated areas of elevated activity were combined during the detailed 100% scan survey to ensure size of elevated areas of activity were recorded.

1.3 SUMMARY OF SURVEY RESULTS

Although survey results are described in detail later in this report, the following summaries provide a brief overview.

1.3.1 Gamma Radiation Scan Survey Summary

For scanning survey purposes the 32 acre property was divided into five (5) manageable survey units based primarily on physical boundaries. (**Attachment A Figure B: Peck Iron and Metal Survey Units**)

Survey Unit 1 – Eight (8) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 1 (SU-1). Upon further investigation, it was concluded that one location of elevated activity in the southern portion of SU-1 was due to the presence of a large piece of granite. The remaining seven (7) locations were surveyed at 100% and determined to be random isolated anomalies. During the detailed scan survey an additional one (1) location of isolated activity was identified in the northern central portion of SU-1 making a total of **8** confirmed radiologically impacted locations.

Survey Unit 2 – Eight (8) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 2 (SU-2). Of these, 6 locations were located in close proximity of each other. The two remaining locations are random isolated anomalies. During the detailed scan survey an additional eight (8) locations of elevated activity were identified within the central portion of SU-2 making a total of **16** confirmed radiologically impacted locations.

Survey Unit 3 – Six (6) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 3 (SU-3). Of these, all locations were scan surveyed at 100%. All six locations are random isolated anomalies. During the detailed scan survey an additional two (2) locations of elevated activity were identified within the central portion of SU-3 making a total of **8** confirmed radiologically impacted locations.

Survey Unit 4 – Six (6) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 4 (SU-4). Of these, all locations were scan surveyed at 100%. All six locations are random isolated anomalies. During the detailed scan survey no additional locations of elevated activity were identified within SU-4 making a total of **6** confirmed radiologically impacted locations.

Survey Unit 5 – Forty six (45) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 5 (SU-5). Thirty one (31) locations were located in close proximity of each other. One area

contained three (3) locations in close proximity of each other and two other areas each had two (2) locations in close proximity of each other. The remaining eight (8) locations are random isolated anomalies. During the detailed scan survey an additional forty (40) locations of elevated activity were identified within SU-5 making a total of **85** confirmed radiologically impacted locations.

A total of **123** areas were confirmed to be radiologically impacted throughout the Peck Iron and Metal Property.

2. SURVEY METHODS

The following discussion presents an overview of field measurement methods used during investigation and an overview of the quality assurance/quality control (QA/QC) measures employed to assure that the data are adequate to meet project objectives.

2.1 SURVEY METHOD OVERVIEW

The survey method discusses the characteristics that make up the Gamma Radiation Scan Survey including the Site Reconnaissance, Survey Units, Reference Area Gamma Radiation Scan Survey, Initial Survey, Detailed Survey and Dose Rate Measurements.

2.1.1 Site Reconnaissance

Upon site arrival, a Site Reconnaissance was performed to orientate the Gamma Scan Surveyors with the site with regard to terrain, potential safety hazards, inaccessible areas, physical boundaries, scan survey material types and overall extent of the Peck Iron and Metal property boundaries. Potential safety hazards were addressed in the AVESI Health and Safety Plan (HSP) and Activity Hazard Analysis (AHA).

Inaccessible areas include wet and/or steep inclines, large rubble piles, debris-piles, areas of debris with overgrown vegetation, machinery, dumpsters, roll-off boxes, trailers, and areas where water was present and preventing access to other areas. Every effort was made to access as much of the site as physically possible, safely without debris or vegetation removal.

2.1.2 Survey Units

Physical boundaries were utilized to the extent possible to divide the site into manageable survey units. **(Attachment A Figure C: Peck Iron Survey Unit)**

- SU-1 is bound by chain link metal fencing on the northern, western, and eastern sides. The southern boundary for SU-1 is a gravel access road that travels east and west.
- SU-2 is not within the fenced property boundary of Peck Iron and Metal. SU-2 consists of a fence outlining the western and southern borders. An active railroad borders the northern extent of the property and the eastern border extends to the curbed right of way of Elm Ave.
- SU-3 is bound by a chain link fence on the western border extending south until it meets the bank of the Paradise Creek and wetland area on the southern border. During the scan survey a substantial amount of snow and rain contributed to a larger inaccessible area. The northern border runs along the east west gravel road and is consistent with a fence that runs along the north eastern border. The eastern border runs along an abandoned road that runs north and south.
- SU-4 the western border extends along an abandoned road that runs north and south and extends to the fenced northern border. The western border terminates in the south at a specific point rather than a physical boundary. The southern border follows the Site's property boundary. The western border has no physical border and runs north and south just east of a small building.
- SU-5 consists of a chain link fence on all sides with the exception of the western border that is shared with SU-4.

2.1.3 Reference Area Gamma Radiation Scan Survey

Reference area radiation scan surveys were conducted at the Craddock Recreational Center located at 4300 George Washington Hwy, Portsmouth, VA 23702. (**Attachment A: Figure 5-1 Peck Iron & Metal Reference Area**) Reference area radiation scan surveys were conducted to establish BKG radioactivity levels in soil, concrete, gravel and other materials. Background radioactivity levels in these materials are used for comparison to radioactivity level data collected during the radiation scan surveys within the Peck Iron and Metal site investigation area.

The corner coordinates for each reference area were flagged prior to the gamma walkover survey. The gamma walkover survey covered approximately 2 acres of land at 25% coverage. In addition, data was collected from similar material types found within the investigation area during the site reconnaissance. Data for soil, concrete, and asphalt material types were transferred or downloaded into Microsoft Access and a mean activity level was established. Below are the results of the reference area Gamma Scan Survey:

Media Type	Mean (cpm)	Median (cpm)	Established Background
Asphalt	11080	11145	11000
Soil	6169	5742	5700
Concrete	7481	7428	7500

Table 1-1: Reference Area Background Results

Reference Area Soil/Asphalt: After further inspection of the reference area asphalt it was determined that the asphalt at the reference area contained small fragments of granite. This was consistent with materials contained in the soils at the investigation site. Therefore, to establish consistency at both locations the soil and asphalt background was combined and the higher background was used (11,000 counts per minute [cpm]). The Asphalt mean at the reference area was 11,080 cpm. The background was established at 11,000 cpm subsequently designating the investigation level for Soil/Asphalt material to be 22,000 cpm.

Reference Area Concrete: the concrete mean at the reference area was 7,481 cpm. The background was established at 7,500 cpm subsequently designating the investigation level for concrete material to be 15,000 cpm (2 x BKG).

2.1.4 Data Processing and Graduated Color Assignment

Radiation scan survey data processing was completed using ArcView Geographic Information System (GIS) software and creating a graduated color range table that was applied to the radiation scan survey data. Once the data was imported into the GIS software the color ranges were set by observing the backgrounds established at the reference area and the investigation level (2 x BKG) as outlined in the tables below:

Reference Area Soil/Asphalt

Range color	Range	Range Representation
Blue	0 - 10499	Negative Background
Green	11000 - 15999	Positive Background
Yellow	16000 - 21999	Suspected Radioactivity
Red	22000 - 1000000	Probable Radioactivity

Table 2-1: Established background for soil/asphalt

Reference Area Concrete

Range color	Range	Range Representation
Blue	0 - 7499	Negative Background
Green	75000 - 11249	Positive Background
Yellow	11250 - 14999	Suspected Radioactivity
Red	15000 - 1000000	Probable Radioactivity

Table 2-2: Established background for concrete

2.1.5 Gamma Radiation

Gamma radiation is an electromagnetic wave or photon emitted from the nuclei of excited atoms following radioactive transformations (such as alpha or beta), and has no electrical charge. Because it has no mass and no charge, gamma radiation is very penetrating. Gamma rays and x-rays can be thought of as physically identical. The only difference is in their origins. Gamma rays are generally emitted from the nucleus during radioactive decay, while x-rays are emitted from orbital electrons. Gamma radiation ionizes atoms as a result of direct interactions with orbital electrons.

Range - Because gamma radiation has no charge and no mass, its penetrating ability is very high (put another way, the radiation has a low probability of interacting with matter).

Terrestrial sources exist because a number of materials have remained radioactive since the formation of the earth. These natural radioactive materials are found in the ground, rocks and building materials. Some of the contributors to terrestrial sources are the natural radioactive elements radium, uranium and thorium. In fact, there are some areas in Brazil and India where the natural background radiation levels reach 3,000 mrem/year. The average dose from terrestrial sources in the United States is approximately 28 millirem per year (mrem/year).

Internal sources; our bodies contain various, naturally occurring radioactive elements, including potassium (K 40) which is one of the major contributors to non-occupational internal dose. The average dose from internal sources in the United States is approximately 40 mrem/year.

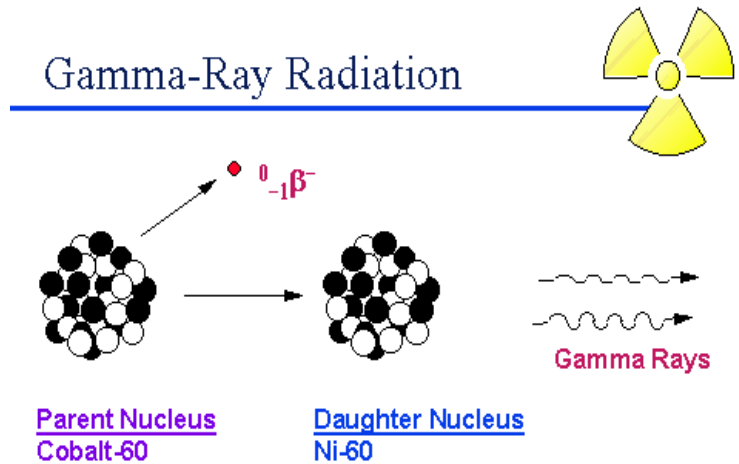
Major man-made sources that contribute radiation dose to the general public include:

Medical/dental sources; this includes diagnostic (such as a chest or dental x-ray) and therapeutic uses of radiation (such as radiation therapy for tumors). Because medical and dental doses are so individualized, the dose may vary from a few mrem to several thousand mrem.

The average dose from medical and dental sources in the United States is approximately 54 mrem/year.

Consumer products; some consumer products contain small amounts of radioactive material. Examples include certain ceramic dishes (usually with an orange glaze), some luminous dial watches, and some smoke detectors. These consumer products account for a very minor contribution to the background dose.

The average dose from consumer products in the United States is approximately 10 mrem/year.



Other; this category includes dose from fallout caused by bomb testing, and accidents such as Chernobyl. The average dose from other sources in the United States is approximately 3 mrem/year.

Overall, the average radiation dose to a member of the general population in the United States, from background and man-made sources is approximately **360 mrem/year** or approximately **1 mrem/day**.

2.1.6 Dose Rate Measurements

Dose rates were measured with a Ludlum Model 9 meter and recorded in units of $\mu\text{rem/hr}$ and mrem/hr . All dose rates were typically obtained either on contact or at a distance of three feet. The site background dose rate is approximately $14 \mu\text{rem/hr}$.

$$1 \text{ rem/hr} = 10^3 \text{ mrem/hr or } 10^6 \mu\text{rem/hr}$$

2.2 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of field operations, QA/QC measures were taken to assure the usability and reproducibility of the data. The following subsections summarize these measures.

2.2.1 Instrument Quality Control

Radiological instrumentation and associated detectors were calibrated (annually) using National Institute of Standards and Technology (NIST) traceable sources and calibration equipment. Check Source Certificates, Instrument Calibration Certificates, Instrument Initial Check In paperwork, and Daily Response Check Log are in Attachment C. Instrumentation was calibrated in accordance with guidance contained in American National Standards Institute (ANSI) N323 (ANSI, 1978) and manufacturers' instructions.

An instrument identifier (A or B) was assigned to each combination of Global Positioning System (GPS) Trimble Geo XH and Ludlum 2221/44-10.

The following information was produced for each instrument:

- a background acceptance criteria was calculated; and
- a source check acceptance range was calculated.

3. GAMMA RADIATION SCAN SUMMARIES

For ease of presentation, the following subsections focus on gamma activity results as opposed to the dose rate results. Dose rates were obtained during sampling activities and will be discussed in the sampling section of this report.

3.1 RADIATION SCAN SURVEY SUMMARY

This section discusses the results of the site radiation scan survey in detail including the initial scan survey results and the detailed scan survey results for each survey unit.

3.1.1 Initial Scan Survey

The initial Scan Survey was completed at 25% coverage. The site area was 32 acres of which at least 6 acres is tidal wetlands and/or overgrown with wetland shrubs including phragmites, saw grass, and (primarily) cattails. Large areas of debris piles and buried rubble were present and in some cases impeded the scan survey. Every effort was made to complete the initial scan survey in a safe yet productive manner.

Audible response of the instrument was monitored, and locations of elevated audible response were investigated. The initial field investigation level for the gamma scans were set at 2 x BKG for each specific material present at the site. Areas exceeding 2 x BKG were flagged and investigated further during the detailed scan. The investigation level may be adjusted by the scan survey supervisor based on the deviation of the count rates encountered as the survey progresses.

Survey Unit 1 – Seven (7) confirmed locations of elevated activity were flagged during the initial scan survey of SU-1. (**Attachment A Figure 1-1: Peck Iron and Metal Survey Unit 1 Initial Survey**)

SU-1 physical description: The northern portion of SU-1 contains visible concrete pads, visible roads, subsurface concrete pads, subsurface roads and subsurface railroad bed. There were many obstacles that impeded the survey as well as buildings that may have disrupted communication with satellite signals. The southern portion of SU-1 contained more obstacles such as, machinery, trailers, abandoned vehicles, rubble, debris piles, dumpsters, roll-off boxes and mobile homes. In the southern portion of the survey unit the ground materials are more uniform and consistent. On the southwestern portion of the property access was difficult due to an existing water filled ditch and wet land. The southeastern portion of the property was not passable in areas where the rubble piles and debris piles were too dense. It was not possible to get to the property line in this area.

Elevated activity: In the northern portion of SU-1, seven (7) locations of elevated activity were identified during the initial scan survey ranging in activity from 150k cpm to 550k cpm. In the southern portion of SU-1, one (1) location of elevated activity was identified however, after further investigation it was determined that the activity was originating from a large piece of granite rock. Seven locations were detail scan surveyed.

Survey Unit 2 – Eight (8) locations of elevated activity were flagged during the initial scan survey of SU-2. (**Attachment A Figure 2-1: Peck Iron and Metal Survey Unit 2 Initial Survey**)

SU-2 physical description: The northern border of SU-2 is an active railroad with a ditch that runs from east to west. One location of slightly elevated activity was located in the northern portion of SU-2 however, the activity of this location never exceeded the investigation level. Crushed debris, gravel, granite, asphalt, brick etc... are present on the north end SU-2 near the Elm street right of way and becomes more apparent when moving toward the southern end of SU-2.

Elevated activity: In the central portion of SU-2, six (6) locations of elevated activity were flagged during the initial scan survey ranging from 28k cpm to 310k cpm. Two other isolated areas of elevated activity were also detected, one on the bank of the ditch that runs north and south in the central portion of SU-2 and the second located at the southern border of SU-2. The activity at these locations were 150k cpm and 700k cpm respectively.

Survey Unit 3 – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-3. (**Attachment A Figure 3-1: Peck Iron and Metal Survey Unit 3 Initial Survey**)

Survey unit description: The northern portion of SU-3 contains visible concrete pads, visible roads, subsurface concrete pads, and subsurface road. There were many obstacles that impeded the survey including large debris piles, large rubble piles and large piles of tires. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-3. The southern portion of SU-3 is bordered by Paradise Creek and contains a large area of wetlands.

Elevated activity: In the north eastern corner of SU-3, one (1) location of elevated activity was flagged during the initial scan survey at 125k cpm. In the central western portion of SU-3, two (2) locations of elevated activity were flagged during the initial scan survey at 290k cpm and 185k cpm. In the central portion of SU-3, one (1) location of elevated activity was flagged during the initial scan survey just west of the access road at 200k cpm. In the south central portion of SU-3, one (1) location of elevated activity was flagged during the initial scan survey near the bank of the Paradise Creek at 60k cpm. In the south eastern portion of SU-3, near the SU-4 border, one (1) location of elevated activity was flagged during the initial scan survey at 100k cpm.

Survey Unit 4 – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-4. (**Attachment A Figure 4-1: Peck Iron and Metal Survey Unit 4 Initial Survey**)

Survey unit description: The northern portion of SU-4 contains visible gravel roads, subsurface concrete pads, and subsurface road. There are many obstacles that impeded the survey including large debris piles, large rubble piles and large piles of tires. One small abandoned building is located in the central western portion of the property near the access road. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-4. The southern portion of SU-4 contains large debris piles, large rubble piles and large piles of tires as well as a ditch and water retention area near the tree line. In the tree line, the slope to the adjacent property is steep and not accessible.

Elevated activity: One (1) location of isolated elevated activity was recorded in the north western corner of SU-4 at 40k cpm. Four (4) locations of isolated elevated activity were recorded in the south central portion of SU-4 just south of the gravel access road at 225k, 90k, 190k and 450k cpm. One (1) location of isolated elevated activity was recorded near the south western border of SU-4 at 125k cpm.

Survey Unit 5 – Forty five (45) locations of elevated activity were flagged during the initial scan survey of Survey Unit 5 (SU-5). (**Attachment A Figure 5-1: Peck Iron and Metal Survey Unit 5 Initial Survey**)

Survey unit description: SU-5 contains visible gravel roads, subsurface concrete pads, and subsurface road. There were very few obstacles that impeded the survey. One large abandoned building (the former Maintenance Garage) is located in the central portion of the property near the access gravel road and one smaller building (the Shear Building) near the western border. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-5. The southern portion of SU-5 contains a tree line that slopes sharply to the adjacent property.

Elevated activity: Forty five (45) locations of elevated activity were flagged during the initial scan survey of Survey Unit 5. Thirty one (31) locations of isolated elevated activity were concentrated in the central portion

of SU-5 east of the existing large building ranging from 30k cpm to 1M cpm. Two (2) locations of isolated elevated activity were recorded in the central portion of SU-5 south of an existing building up to 150k cpm. Two (2) locations of isolated elevated activity were recorded in the south eastern portion of SU-5 up to 1M cpm. Two (2) location of isolated elevated activity were recorded in the western central area of SU-5 up to 150k cpm. Three (3) locations of isolated elevated activity were recorded in the south western corner of SU-5 up to 160k cpm. Three (3) locations of isolated elevated activity were recorded in the western portion of SU-5 up to 250k cpm. Finally, two (2) locations of isolated elevated activity were recorded in the eastern portion of SU-5 up to 250k cpm.

3.1.2 Detailed Scan Survey

Survey Unit 1 – seven (7) locations of elevated activity were flagged during the initial scan survey of SU-1. Of these, seven locations were detailed scan surveyed in a total area of 6,272 ft². (**Attachment A Figure 1-2: Peck Iron and Metal Survey Unit 1 Detailed Survey**)

- Four (4) locations of elevated activity were combined and detailed scan surveyed in the northern western portion of SU-1. A total of 4,092 ft² were detailed scan surveyed. Zero (0) additional locations of elevated activity were recorded.
- Two (2) locations of elevated activity were detailed scan surveyed in the north central portion of SU-1 near the northwest corner of the building. A total of 1,570 ft² were detailed scan surveyed. One (1) additional location of elevated activity was recorded.
- One (1) location of isolated elevated activity in the north central portion of SU-1 was detailed scan surveyed. A total of 614 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity in the south central portion of SU-1 was investigated and upon further investigation, it was concluded that the activity was originating from a large piece of visible granite and this location was not detail scan surveyed.

A total of seven (7) locations of elevated activity were recorded during the initial scan survey. Another one (1) location of elevated activity was recorded during the detailed scan survey. A total of eight (8) locations of elevated activity were recorded on SU-1.

There were no locations of elevated activity identified on Concrete.

Survey Unit 2 – Eight (8) locations of elevated activity were flagged during the initial scan survey of SU-2. All eight locations were detailed scan surveyed in a total area of 4,425 ft². (**Attachment A Figure 2-2: Peck Iron and Metal Survey Unit 2 Detailed Survey**)

- Six (6) locations of elevated activity were combined and detailed scan surveyed in the central portion of SU-2. A total of 3,640 ft² were detailed scan surveyed. Eight (8) additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the southern central portion of SU-2. A total of 435 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

- One (1) location of isolated elevated activity was detailed scan surveyed near the southern boundary of SU-2. A total of 350 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of eight (8) locations of elevated activity were recorded during the initial scan survey. Another eight (8) locations of elevated activity were recorded during the detailed scan survey. A total of sixteen (16) locations of elevated activity were recorded on SU-2.

There were no locations of elevated activity identified on Concrete.

Survey Unit 3 – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-3. All six locations were detailed scan surveyed in a total area of 2,828 ft². (**Attachment A Figure 3-2: Peck Iron and Metal Survey Unit 3 Detailed Survey**)

- Three (3) locations of isolated elevated activity were combined and detailed scan surveyed in the north western portion of SU-3. A total of 1,469 ft² were detailed scan surveyed. Two (2) additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north eastern corner of SU-3. A total of 603 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the south eastern border of SU-3 near the Paradise Creek bank. A total of 378 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the eastern border of SU-3 just north of the access road. A total of 378 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of six (6) locations of elevated activity were recorded during the initial scan survey. Another two (2) locations of elevated activity were recorded during the detailed scan survey. A total of eight (8) locations of elevated activity were recorded on SU-3.

There were no locations of elevated activity identified on concrete.

Survey Unit 4 – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-4. All six locations were detailed scan surveyed in a total area of 2,510 ft². (**Attachment A Figure 4-2: Peck Iron and Metal Survey Unit 4 Detailed Survey**)

- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 381 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 318 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 500 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 373 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 557 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the south western border of SU-4. A total of 381 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of six (6) locations of elevated activity were recorded during the initial scan survey. Zero (0) locations of elevated activity were recorded during the detailed scan survey. A total of six (6) locations of elevated activity were recorded on SU-4.

There were no locations of elevated activity identified on Concrete.

Survey Unit 5 – Forty five (45) locations of elevated activity were flagged during the initial scan survey of SU-5. All 45 locations were detailed scan surveyed in a total area of 25,287 ft². (**Attachment A Figure 5-2: Peck Iron and Metal Survey Unit 5 Detailed Survey**)

- Thirty one (31) locations of isolated elevated activity were combined and detailed scan surveyed in the northern central portion of SU-5 east of an existing large building. A total of 19,471 ft² were detailed scan surveyed. Thirty Seven (37) additional locations of elevated activity were recorded.
- Two (2) locations of isolated elevated activity were combined and detailed scan surveyed in the central portion of SU-5 south of an existing building. A total of 641 ft² were detailed scan surveyed. Two (2) additional locations of elevated activity were recorded.
- Two (2) locations of isolated elevated activity were combined and detailed scan surveyed in the south eastern portion of SU-5. A total of 1,328 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- Three (3) location of isolated elevated activity were combined and detailed scan surveyed in the western central area of SU-5. A total of 1500 ft² were detailed scan surveyed. One (1) additional location of elevated activity was recorded.
- Three (3) locations of isolated elevated activity were combined and detailed scan surveyed in the south western corner of SU-5. A total of 1,221 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western portion of SU-5. A total of 380 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the central western portion of SU-5. A total of 373 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

- One (1) location of isolated elevated activity was detailed scan surveyed in the south western portion of SU-5. A total of 196 ft² were detailed scan surveyed. The most elevated point of this location is just north of the existing concrete pad. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the far western portion of SU-5 near the western border. A total of 177 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of forty five (45) locations of elevated activity were recorded during the initial scan survey. Another forty (40) locations of elevated activity were recorded during the detailed scan survey. A total of eighty five (85) locations of elevated activity were recorded on SU-5.

There were no locations of elevated activity identified on concrete.

4. SOIL SAMPLING

A total of 15 soil samples were collected for radiological analysis. Samples were collected at the highest and lowest activity recorded on each survey unit totaling ten (10) samples. The remaining five (5) samples were discretionary samples obtained at elevated locations near possible migration routes such as ditches, low lying areas creek banks, existing traffic areas, etc... The analysis of these samples were not complete prior to the conclusion of this report.

4.1 SOIL SAMPLING SUMMARY

This section discusses the description of the collected samples including the location, depth, activity and if possible the identity of the source and origin of the gamma radiation activity. Although in most cases the source and origin of the radioactivity were obtained, the source of the activity was not included in any of the samples. The samples focused on the collection of soil only.

4.1.1 Survey Unit 1

Soil sample RAD-04 was obtained at the 2nd lowest activity location identified as SU1-07. Due to a substantial amount of rain and snow, the lowest activity location (SU1-01 @ 150,000 cpm) was under water and therefore not sampled. The source of the radioactivity was due to a piece of what looks to be copper wire insulation. (**Attachment B Photo: Pic-Rad-04**)

Soil sample RAD-05 was obtained at the highest activity location identified SU1-04. The source of the radioactivity was due a piece of what looks to be copper wire insulation. (**Attachment B Photo: Pic-Rad-05**) After the soil samples were collected, the pieces of what looks to be copper wire insulation were returned to the sample location.

Table 4-1: SU-1 soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-04	2/5/2014	1101	SU1-07	6"	3"	250	14	11984	L
RAD-05	2/5/2014	1202	SU1-04	1"	2.5"	900	14	11179	H

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

4.1.2 Survey Unit 2

Soil sample RAD-01 is a discretionary sample obtained due to its proximity to an existing drainage ditch that runs north and south. The source of the radioactivity was the result of a 2" non-magnetic circular disk. (**Attachment B Photo: Pic-Rad-01**)

Soil sample RAD-02 was obtained at the lowest activity location identified on SU-2. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. (**Attachment B Photo: Pic-Rad-02**)

Soil sample RAD-03 was obtained at the highest activity location identified on SU-2. The source of the radioactivity was never identified. Approximately 8" below the ground surface the sampler encountered a concrete or asphalt obstruction. The gamma readings at this location exceeded the scale of the gamma

detector and the dose rate meter. The soil sample was collected and the sample location was filled in. No photo was taken.

After the soil samples were collected, the circular disk and deteriorated metal pieces were returned to the respective sample locations.

Table 4-2: SU-2 soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-01	2/5/2014	0918	SU2-08	0-6"	1.5"	900	20	14716	D
RAD-02	2/5/2014	0950	SU2-02	3-6"	>1"	110	14	20721	L
RAD-03	2/5/2014	1010	SU2-07	NA	NA	NA	NA	10647	H

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

4.1.3 Survey Unit 3

Soil sample RAD-06 a discretionary sample was obtained due to its proximity to Paradise Creek. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. No picture was taken.

Soil sample RAD-07 was obtained at the highest activity location identified on SU-3. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. No picture was taken.

Soil sample RAD-08 was obtained at the lowest activity location identified on SU-3. The source of the radioactivity was due to a rock material.

After the soil samples were collected the rock like item and rusted material were returned to the respective sample locations. (**Attachment B Photo: Pic-Rad-08**)

Table 4-3: SU-3 soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-06	2/5/2014	1235	SU3-05	NA	NA	NA	NA	21921	D
RAD-07	2/5/2014	1445	SU3-02	NA	NA	NA	NA	27814	H
RAD-08	2/5/2014	1514	SU3-06	0-3'	1"	135	14	12744	L

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

4.1.4 Survey Unit 4

Soil sample RAD-09 was obtained at the highest activity location identified on SU-4. The source of the radioactivity was due to a button shaped object with a crystal or glass center. After the soil sample was collected the button shaped object was returned to the sample location. (**Attachment B Photo: Pic-Rad-09 and Pic-Rad-09-1**)

Soil sample RAD-10 was obtained at the lowest activity location identified on SU-4. The source of the radioactivity was due to a liquid filler aviation gauge. The gauge was solid brass painter black. The face of gauge is black with white markings. After the soil sample was collected the liquid filler aviation gauge was returned to the sample location. (**Attachment B Photo: Pic-Rad-10**)

Table 4-4: SU-4 soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-09	2/5/2014	1540	SU4-05	0-3"	>1"	2100	14	14279	H
RAD-10	2/5/2014	1630	SU4-01	12"	8" X 3"	2500	25	14445	L

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

4.1.5 Survey Unit 5

Soil sample RAD-11 was obtained at one of the highest activity locations identified on SU-5. The source of the radioactivity was a piece of broken curved plastic. (**Attachment B Photo: Pic-Rad-11**)

Soil sample RAD-12 was obtained at the 3rd lowest activity location (80,000 cpm) identified on SU-5. The lowest activity sample location in SU5 (SU5-02 @ 50,000 cpm) was sampled as a discretionary sample due to its proximity to flowing water. Due to excessive amounts of precipitation, the second lowest activity sample location (SU5-06 @ 60,000 cpm) was under water and therefore not sampled. The source of the radioactivity was a button shaped object. (**Attachment B Photo: Pic-Rad-12**)

Soil sample RAD-13 was obtained due to its proximity to Elm St. The source of the radioactivity was a plastic circular disk. After the soil sample was collected a duplicate sample was also collected. The plastic circular disk was falling apart. (**Attachment B Photo: Pic-Rad-13**)

Soil sample RAD-14 was obtained due to its proximity to a water migration pathway. The source of the radioactivity was a button shaped object with a crystal or glass center. (**Attachment B Photo: Pic-Rad-14-1**)

Soil sample RAD-15 was obtained at the lowest activity location identified on SU-5. The source of the radioactivity was a metal circular disk. (**Attachment B Photo: Pic-Rad-15-1**)

Two additional locations were chosen for Quality Control spilt samples RAD-12 and RAD-13. After the soil samples were collected the broken piece of plastic, button shaped objects, the plastic circular disk and the metal circular disk was returned to the respective sample locations.

Table 4-5: SU-5 soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-11	2/6/2014	0830	SU5-08	6-9"	1.5"	<5000	150	34192	H
RAD-12	2/6/2014	0905	SU5-09	0-3"	1"	1000	14	11367	L/QC1
RAD-13	2/6/2014	0935	SU5-10	6"	1.5"	1800	15	12234	D/QC2
RAD-14	2/6/2014	1011	SU5-12	3"	1"	800	14	11534	D
RAD-15	2/6/2014	1030	SU5-02	>1"	2.5"	180	14	11532	D

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

The supplemental data for all soil samples collected on all survey units are listed in **Table 4-6: All soil sample and source material supplementary data.**

Table 4-6: All soil sample and source material supplementary data

Sample ID	Date	Time	Hot Spot ID	Depth of Point Source (inches)	Size of Point Source (inches)	Dose on Contact Source (µrem/hr)	Dose @3 Feet Source (µrem/hr)	Soil Sample CPM (BKG 10708 cpm)	Sample Type
RAD-01	2/5/2014	0918	SU2-08	0-6"	1.5"	900	20	14716	D
RAD-02	2/5/2014	0950	SU2-02	3-6"	>1"	110	14	20721	L
RAD-03	2/5/2014	1010	SU2-07	NA	NA	NA	NA	10647	H
RAD-04	2/5/2014	1101	SU1-07	6"	3"	250	14	11984	L
RAD-05	2/5/2014	1202	SU1-04	1"	2.5"	900	14	11179	H
RAD-06	2/5/2014	1235	SU3-05	NA	NA	NA	NA	21921	D
RAD-07	2/5/2014	1445	SU3-02	NA	NA	NA	NA	27814	H
RAD-08	2/5/2014	1514	SU3-06	0-3'	1"	135	14	12744	L
RAD-09	2/5/2014	1540	SU4-05	0-3"	>1"	2100	14	14279	H
RAD-10	2/5/2014	1630	SU4-01	12"	8" X 3"	2500	25	14445	L
RAD-11	2/6/2014	830	SU5-08	6-9"	1.5"	<5000	150	34192	H
RAD-12	2/6/2014	905	SU5-09	0-3"	1"	1000	14	11367	L/QC1
RAD-13	2/6/2014	935	SU5-10	6"	1.5"	1800	15	12234	D/QC2
RAD-14	2/6/2014	1011	SU5-12	3"	1"	800	14	11534	D
RAD-15	2/6/2014	1030	SU5-02	>1"	2.5"	180	14	11532	D

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit

H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location

D = Discretionary sample location

Table 4-7: Detailed Survey and Sample Log

Flagged ID	Northing	Easting	44-10 CPM (Contact)	Dose Rate on Contact (Micro Rem/hr)	Dose Rate @ 3 Feet (Micro Rem/hr)	Size (sqft)
SU1-01	3461915	12124307	150K	140	15	>1
SU1-02	3461951	12124304	210K	190	14	>1
SU1-03	3461969	12124295	280K	28	16	>1
SU1-04	3462000	12124298	550K	310	18	>2
SU1-05	3461993	12124436	380K	420	18	>2
SU1-06	3461881	12124360	290K	380	24	>2
SU1-07	3461849	12124348	160K	180	24	>1
SU2-01	3461396	12125595	210K	110	19	>1
SU2-02	3461368	12125600	28K	39	10	>1
SU2-03	3461363	12125581	310K	210	26	>1
SU2-04	3461350	12125572	85K	90	13	>1
SU2-05	3461375	12125561	100K	110	23	>1
SU2-06	3461219	12125616	42K	45	14	>1
SU2-07	3461078	12125614	700K	900	60	>2
SU2-08	3461328	12125614	150K	60	19	>1
SU3-01	3461043	12124432	125K	120	14	>1
SU3-02	3460829	12124100	290K	190	23	>2
SU3-03	3460814	12124115	185k	120	18	>1
SU3-04	3460719	12124180	200K	200	24	>1
SU3-05	3460507	12124198	60K	60	14	>1
SU3-06	3460590	12124449	100K	50	14	>1
SU4-01	3461065	12124612	40K	40	14	>1
SU4-02	3460693	12124793	225K	110	14	>1
SU4-03	3460654	12124704	90K	50	14	>1
SU4-04	3460589	12124660	190K	100	15	>1
SU4-05	3460582	12124617	450K	210	20	>2
SU4-06	3460490	12124470	125K	130	14	>1
SU5-01	3461056	12125417	<1000K	2900	170	6
SU5-02	3460936	12124947	50K	40	14	>1
SU5-03	3461023	12124966	225K	120	14	>1
SU5-04	3460896	12125082	250K	200	30	>1
SU5-05	3460958	12125117	250K	200	20	>1
SU5-06	3460968	12125212	60K	50	14	>1
SU5-07	3460937	12125239	150K	300	18	>1
SU5-08	3460904	12125501	<1000K	1000	150	6
SU5-09	3460943	12125634	80K	40	14	>1
SU5-10	3460912	12125729	240K	280	15	>2
SU5-11	3460803	12124961	160K	60	16	>1
SU5-12	3461076	12126368	150K	220	14	>1

Note 1: Bold Italicized IDs denotes sampled locations

Note 2: Dose BKG is 14 µrem

Table 4-7: Detailed Survey and Sample Log

5. CONCLUSION

5.1 Results

The total site area is 33.49 acres or 1,458,824 ft². Of which, 24.9 acres or 1,049,232 ft² was accessible and subjected to initial scan survey. Results of the initial scan survey identified 123 locations requiring a more detailed 100% scan survey totaling 0.95 acres or 41,326 ft².

A total of 85 elevated activity locations were recorded during the initial scan survey and 38 elevated locations were identified during a more concentrated detailed scan survey for a total of 123 elevated activity locations.

A total of 15 samples were obtained and in most cases, the source of the radioactivity was obtained and photographed.

All locations of radioactivity were relatively small in size (<2 ft²) suggesting activity emanating from single point sources. At three locations the objects that were the origin of radioactivity had corroded and deteriorated leaving behind small rust particles of radioactivity which may have spread into the soil.

During personnel and equipment surveying, there were no incidents of removable or easily transferrable radioactivity. All personnel and equipment were free released from the site.

There were no locations of elevated activity recorded on concrete.

Survey Unit 1

The total area of the SU-1 is approximately 8 acres or 348,464 ft² of which approximately 75% or 261,348 ft² (6 acres) were accessible for initial scan survey. Of the 261,348 ft² of area that was subjected to initial scan survey only 6,276 ft² (0.144 acres) required detailed scan survey. A total of 8 locations of elevated radioactivity were recorded.

Survey Unit 2

The total area of the SU-2 is approximately 2.73 acres or 118,843 ft² of which approximately 85% or 101,017 ft² (2.32 acres) were accessible for initial scan survey. Of the 101,017 ft² of area that was subjected to initial scan survey only 4,425 ft² (0.10 acres) required detailed scan survey. A total of 16 locations of elevated radioactivity were recorded.

Survey Unit 3

The total area of the SU-3 is approximately 9.84 acres or 428,634 ft² of which approximately 60% or 257,180 ft² (5.90 acres) were accessible for initial scan survey. Of the 257,180 ft² of area that was subjected to initial scan survey only 2,828 ft² (0.065 acres) required detailed scan survey. A total of 8 locations of elevated radioactivity were recorded.

Survey Unit 4

The total area of the SU-4 is approximately 7.46 acres or 324,916 ft² of which approximately 70% or 227,441 ft² (5.22 acres) were accessible for initial scan survey. Of the 227,441 ft² of area that was subjected to initial scan survey only 2510 ft² (0.058 acres) required detailed scan survey. A total of 6 locations of elevated radioactivity were recorded.

Survey Unit 5

The total area of the SU-5 is approximately 5.46 acres or 237,937 ft² of which approximately 85% or 202,246 ft² (4.64 acres) were accessible for initial scan survey. Of the 202,246 ft² of area that was

subjected to initial scan survey 25,287 ft² (0.58 acres) required detailed scan survey. A total of 85 locations of elevated radioactivity were recorded.

Future soil intrusion activities at the Peck Iron and Metal site may pose a few challenges when considering the safety of the public and workers. AVESI has confirmed the presence of radioactive materials within the soils of the Peck Iron and Metal site however, the extent of the hazard is still unknown.

The total accessible area available for initial scan survey was 1,049,232 ft². This area was surveyed at 25% coverage where 85 locations of elevated activity were identified on all five survey units. A statistical argument could be made that as many as 340 elevated areas could be recorded if a detailed survey were performed on the entire property.

The radiation scan survey characterizes elevated radioactivity within the top 6 inches of soil. Radioactive materials in subsurface soils remains unknown due to the fact that site soils have been disturbed, removed or replaced with non-native fill materials.

5.2 Recommendations

It is recommended that a Radiation Protection Program (RA) with a site Radiation Protection Plan (RPP) be developed and implemented to assist and protect the public and site personnel during future intrusive soil activities. The RPP at a minimum should include sections addressing radiological hazards, radiological controls, training, dosimetry, monitoring, and posting and labeling.

It is recommended that an effort to identify the existing areas of elevated activity be performed using a handheld radionuclide identifier such as the “identiFidner”. The identification of these areas by radionuclide will be the basis of the development of the RA and RPP.

It is recommended that a dose assessment be conducted based on current survey data for the reasonable maximally exposed scenario group (critical group). For example, what is the dose to a transient who accesses uncontrolled areas of the property? This dose assessment can be refined using data identified during further surveys.

It is recommended that all known areas of elevated activity that are not controlled (SU-2) within the fenced area of Peck Iron and Metal be removed and stored within the fenced area.

It is recommended that all future soil intrusion work is supported by the radiation protection plan and health physicists (HP).

It is recommended that a temporary Radioactive Materials Storage Area (RMSA) be established in the rear of the property.

The previous recommendations will serve the purpose to identify and control radioactive materials while providing a safe work environment for the future.

6. GLOSSARY

Accessible area – For the purposes of this plan, areas where safety considerations or other restrictions allowed access for survey activities.

CPM, counts per minute – For purposes of this survey, the count-rate measured by the Ludlum Model 2221/44-10. CPM = counts per minute (as read).

Detailed Scan Survey – For purposes of this survey, is a scan performed with the intent to cover 100% of the investigation area.

Exposure rate – The amount of ionization produced per unit time in air by X-rays or gamma rays. For purposes of this survey, the unit of exposure rate is microrem per hour ($\mu\text{rem/hr}$), i.e., 10^{-6} rem/hr or milliRem per hour (mRem/hr), i.e., 10^{-3} rem/hr.

Initial Scan Survey – For purposes of this survey, is scan a performed with the intent to cover 25% of the investigation area.

Investigation level – For purposes of this survey, is two times the natural background (2 x BKG) obtained outside of the known investigation area.

Discretionary Sample – Samples obtained at locations selected using professional judgment based on unusual appearance, location relative to known contaminated areas, high potential for residual radioactivity, general supplemental information, etc...

Reference area – For purposes of this survey, the Craddock Recreational Facility is the reference area. This is the area from which representative reference measurements are performed for comparison with measurements performed in specific Investigation Area.

Scan survey – An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

Survey unit – For purposes of this survey, a portion of the property boundary investigation area with a common point-of-origin. For purposes of summarizing data.

7. REFERENCES

- NRC (United States Nuclear Regulatory Commission) 1974, *Termination of Operating Licenses for Nuclear Reactors*, NUREG-1.86, June.
- NRC (United States Nuclear Regulatory Commission) 1997, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1.86, December.
- NRC 2006. *Decommissioning Process for Materials Licensees*, NUREG-1757, September.
- ANSI (American National Standards Institute) 1997. *American National Standards Radiation Protection Instrumentation Test and Calibration*, ANSI N323A-1997.

ATTACHMENT A: FIGURES



Figure A: Peck Iron and Metal Investigation Boundary

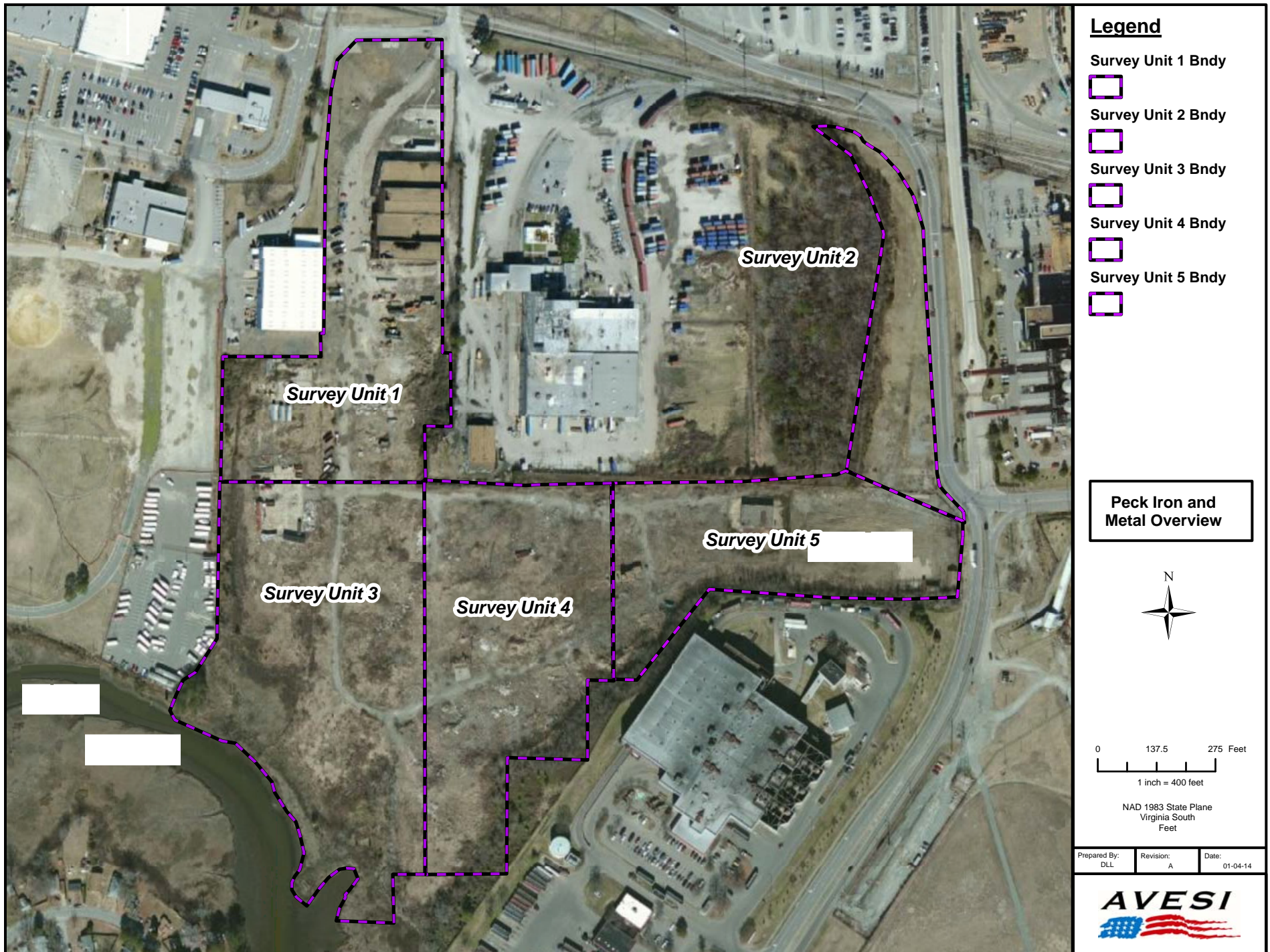


Figure B: Peck Iron and Metal Survey Units



Figure C: Peck Iron and Metal Reference Area

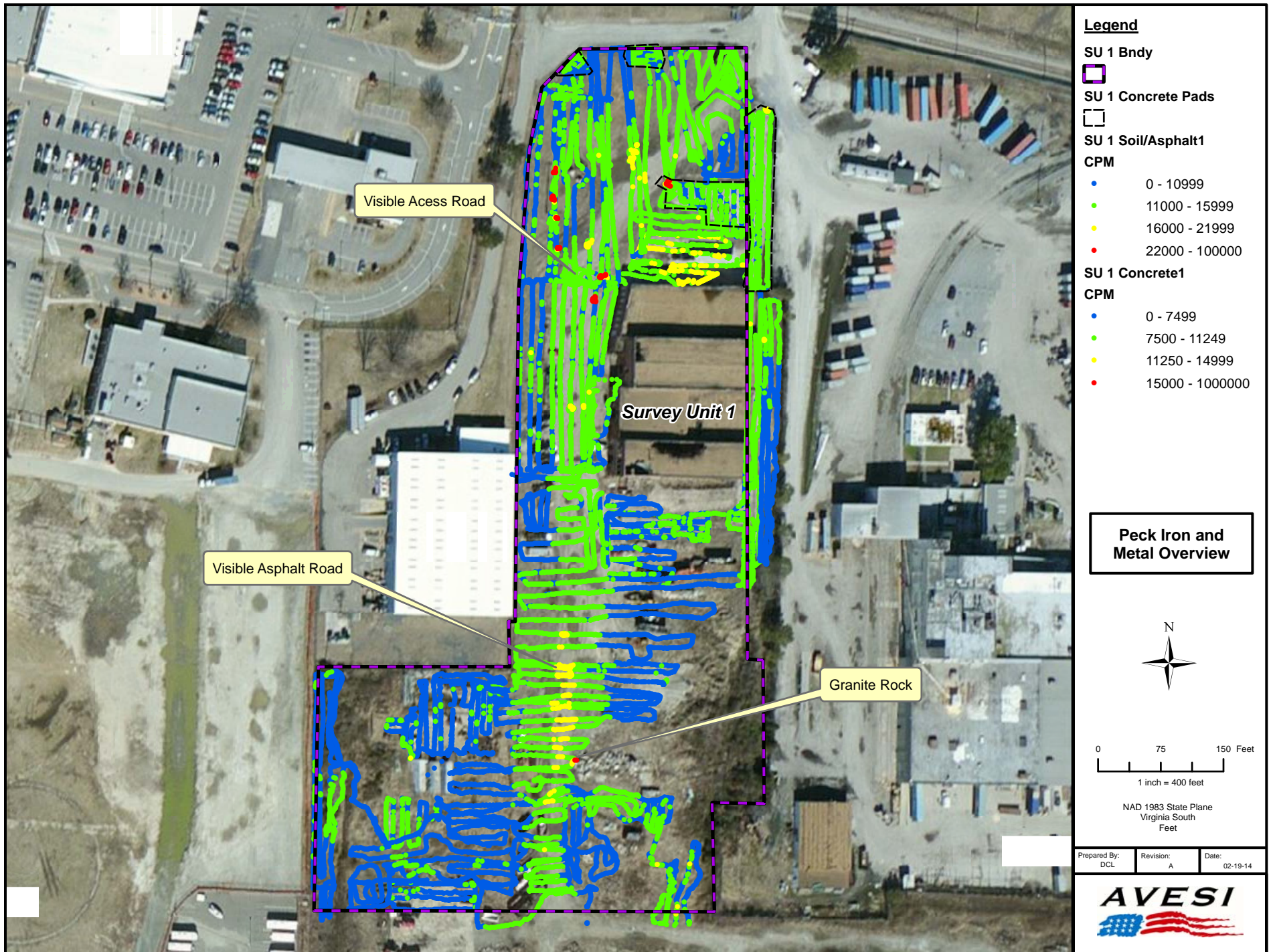


Figure 1-1: Peck Iron and Metal Survey Unit 1 Initial Survey

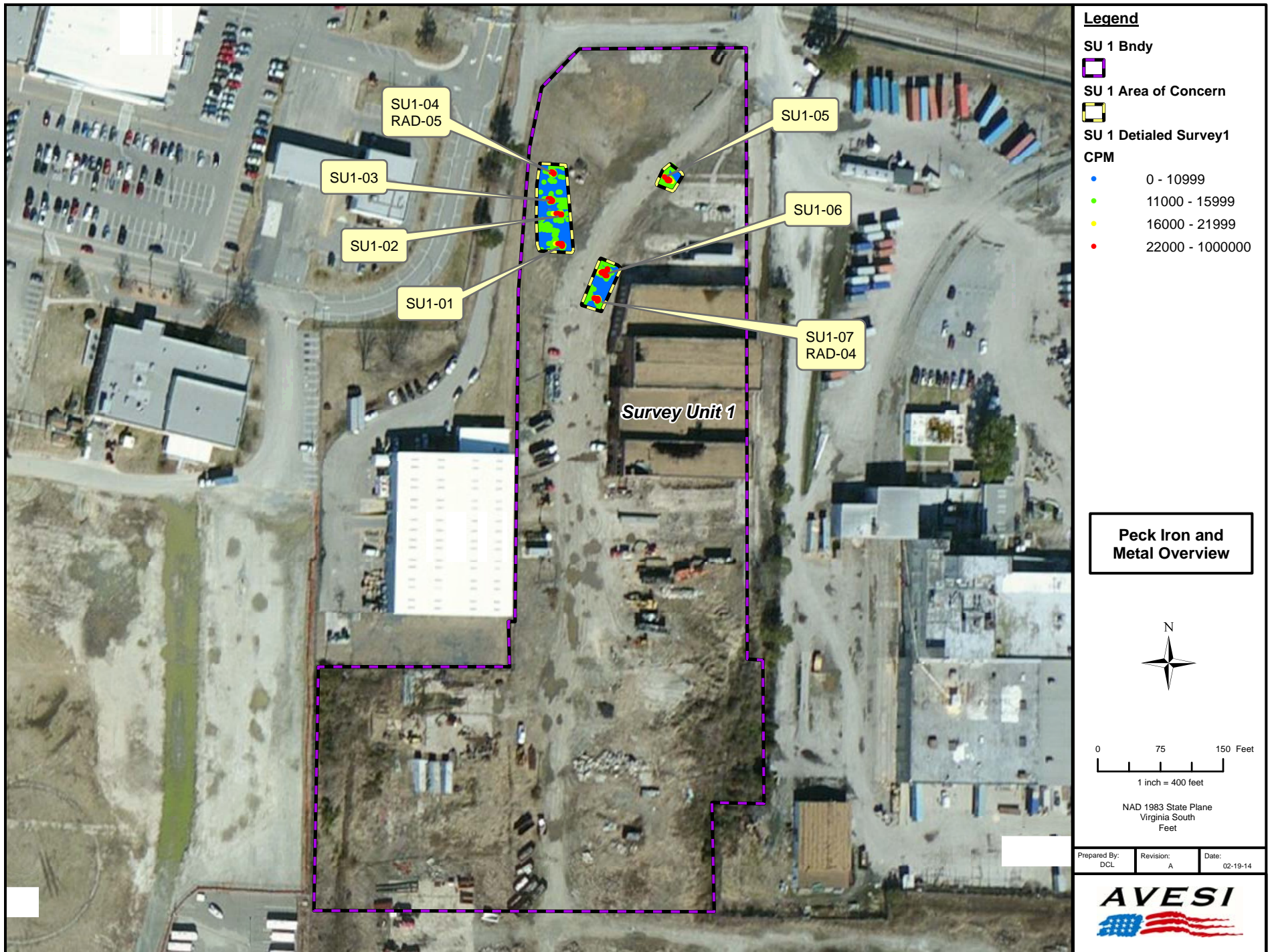


Figure 1-2: Peck Iron and Metal Survey Unit 1 Detailed Survey

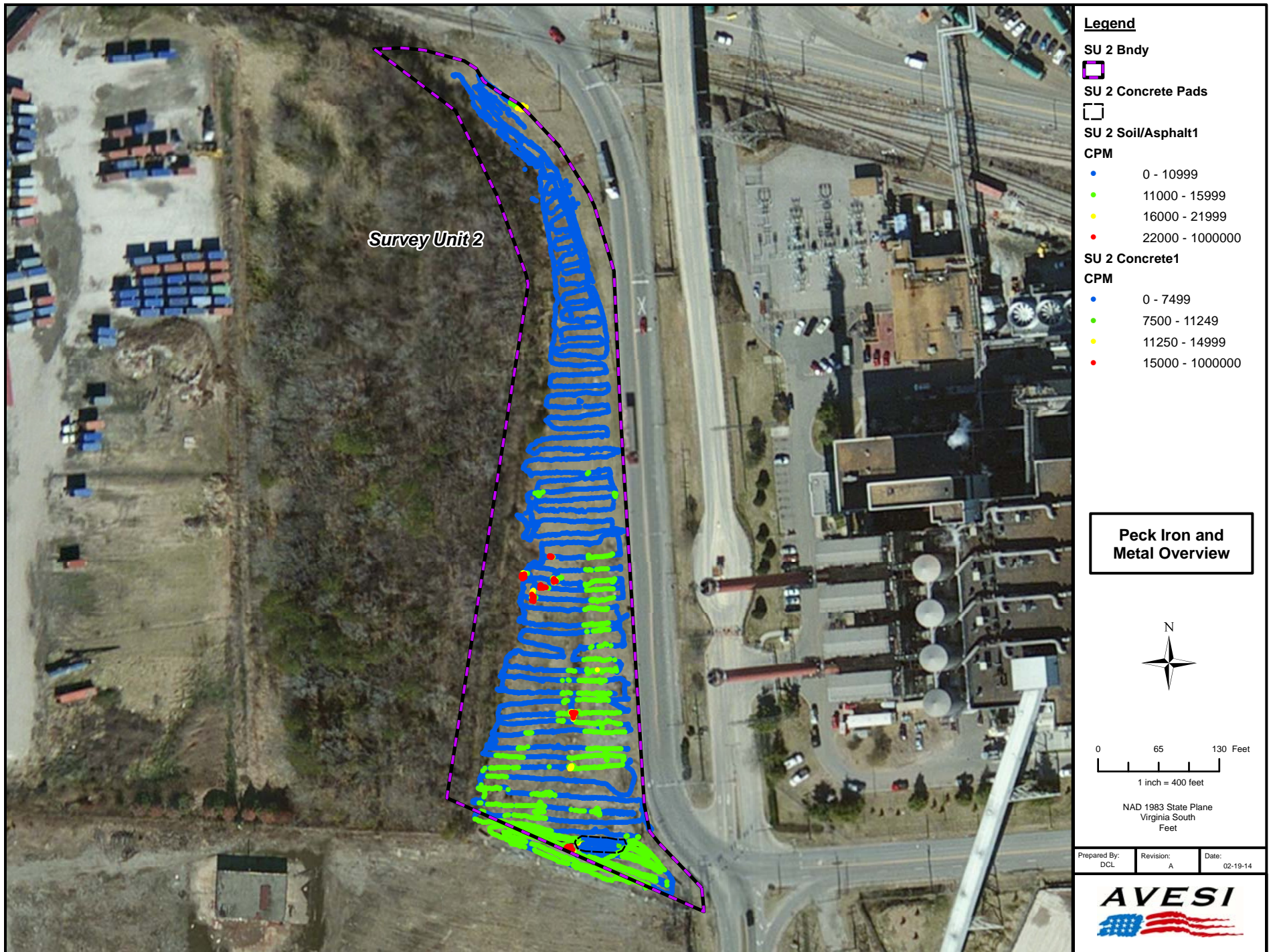


Figure 2-1: Peck Iron and Metal Survey Unit 2 Initial Survey

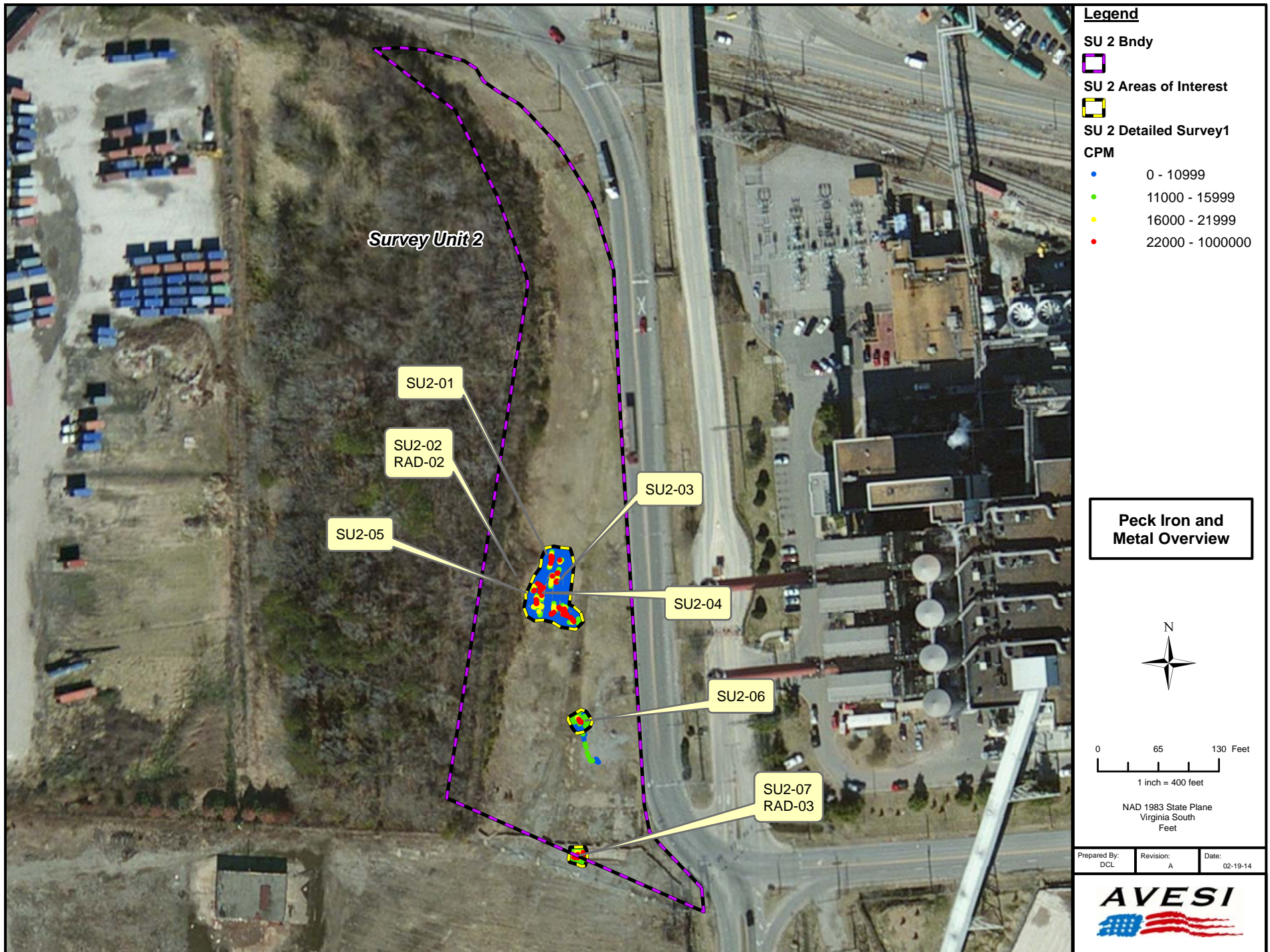


Figure 2-2: Peck Iron and Metal Survey Unit 2 Detailed Survey

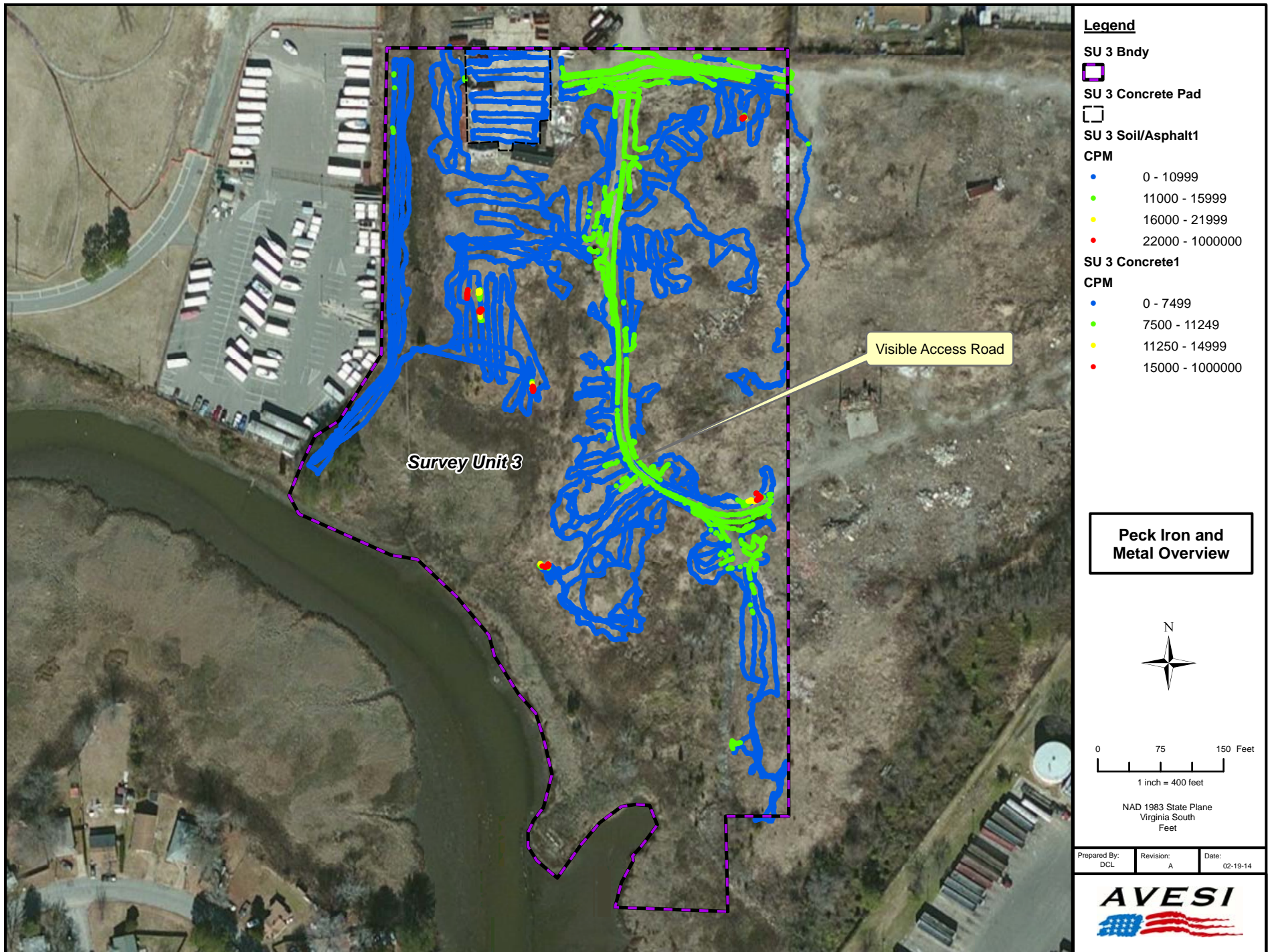


Figure 3-1: Peck Iron and Metal Survey Unit 3 Initial Survey

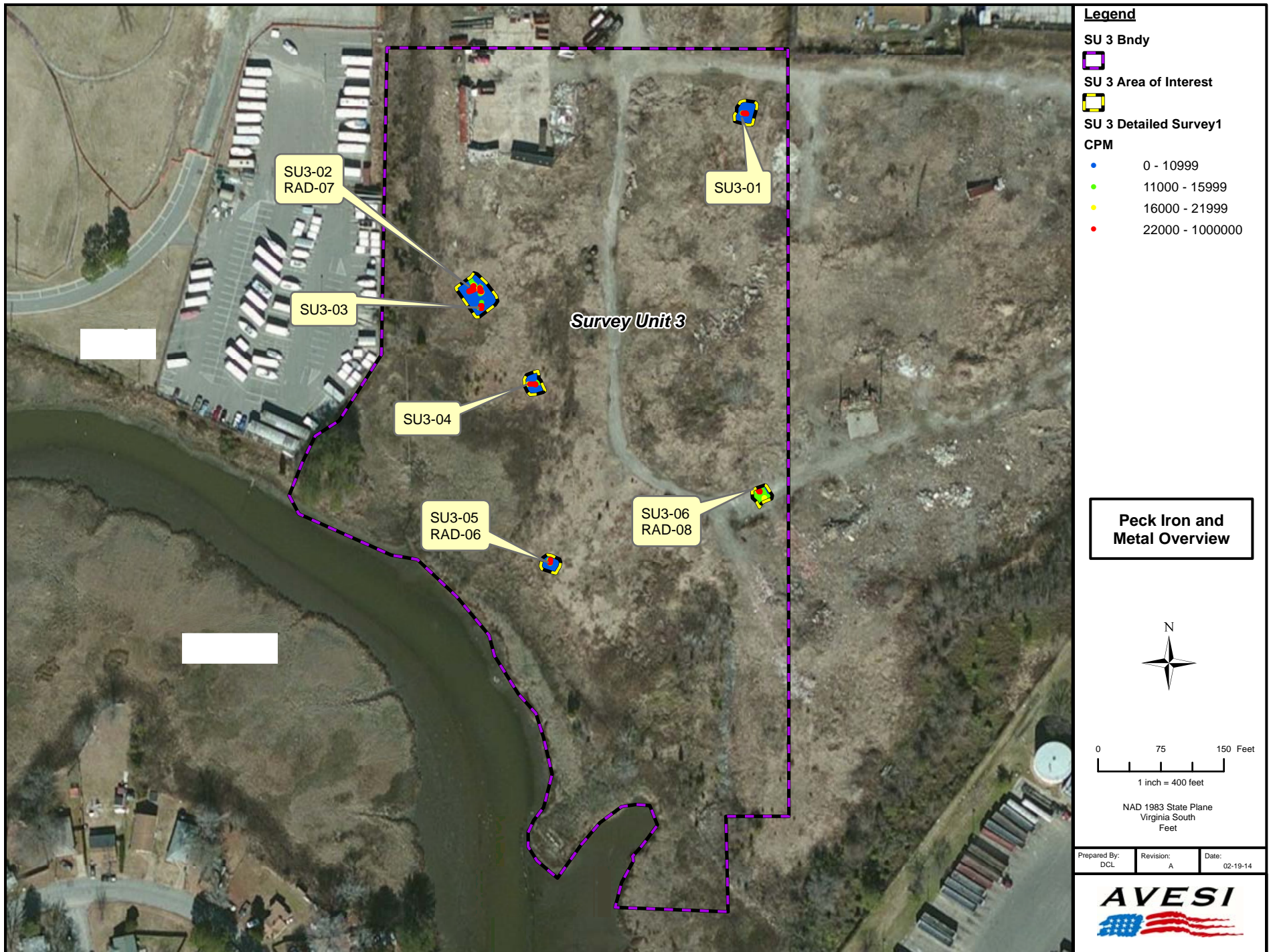


Figure 3-2: Peck Iron and Metal Survey Unit 3 Detailed Survey

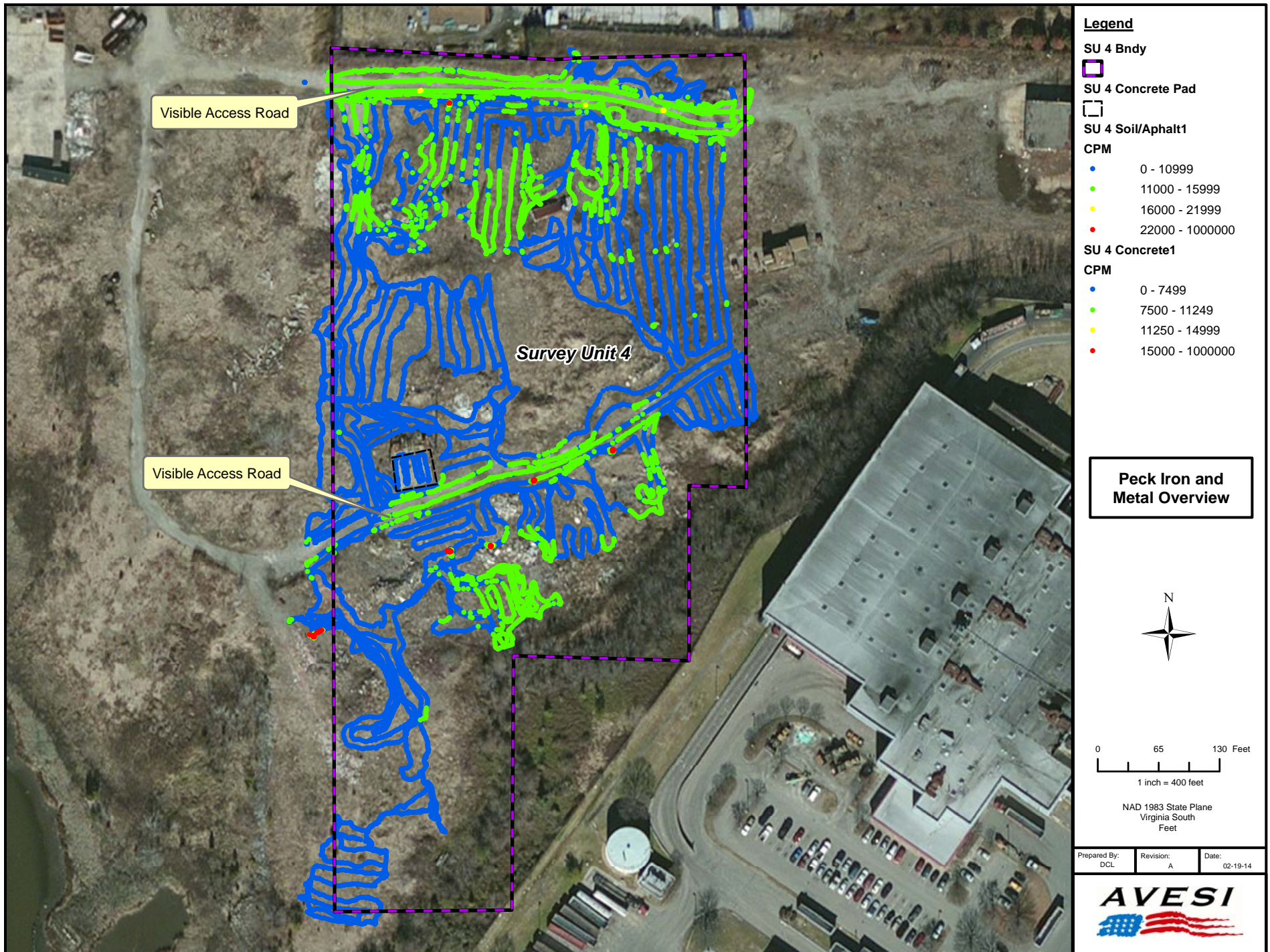


Figure 4-1: Peck Iron and Metal Survey Unit 4 Initial Survey

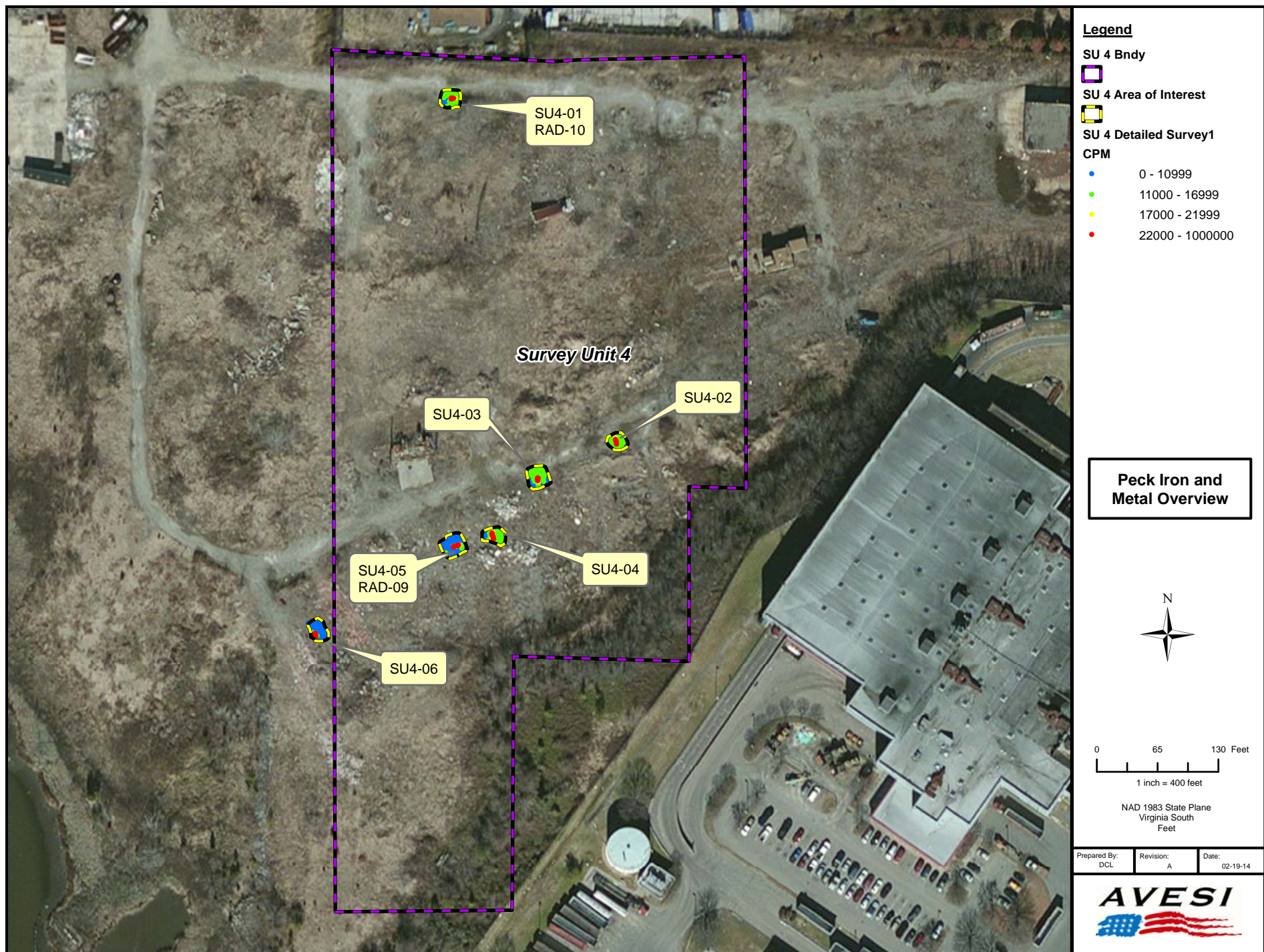


Figure 4-2: Peck Iron and Metal Survey Unit 4 Detailed Survey



Figure 5-1: Peck Iron and Metal Survey Unit 5 Initial Survey

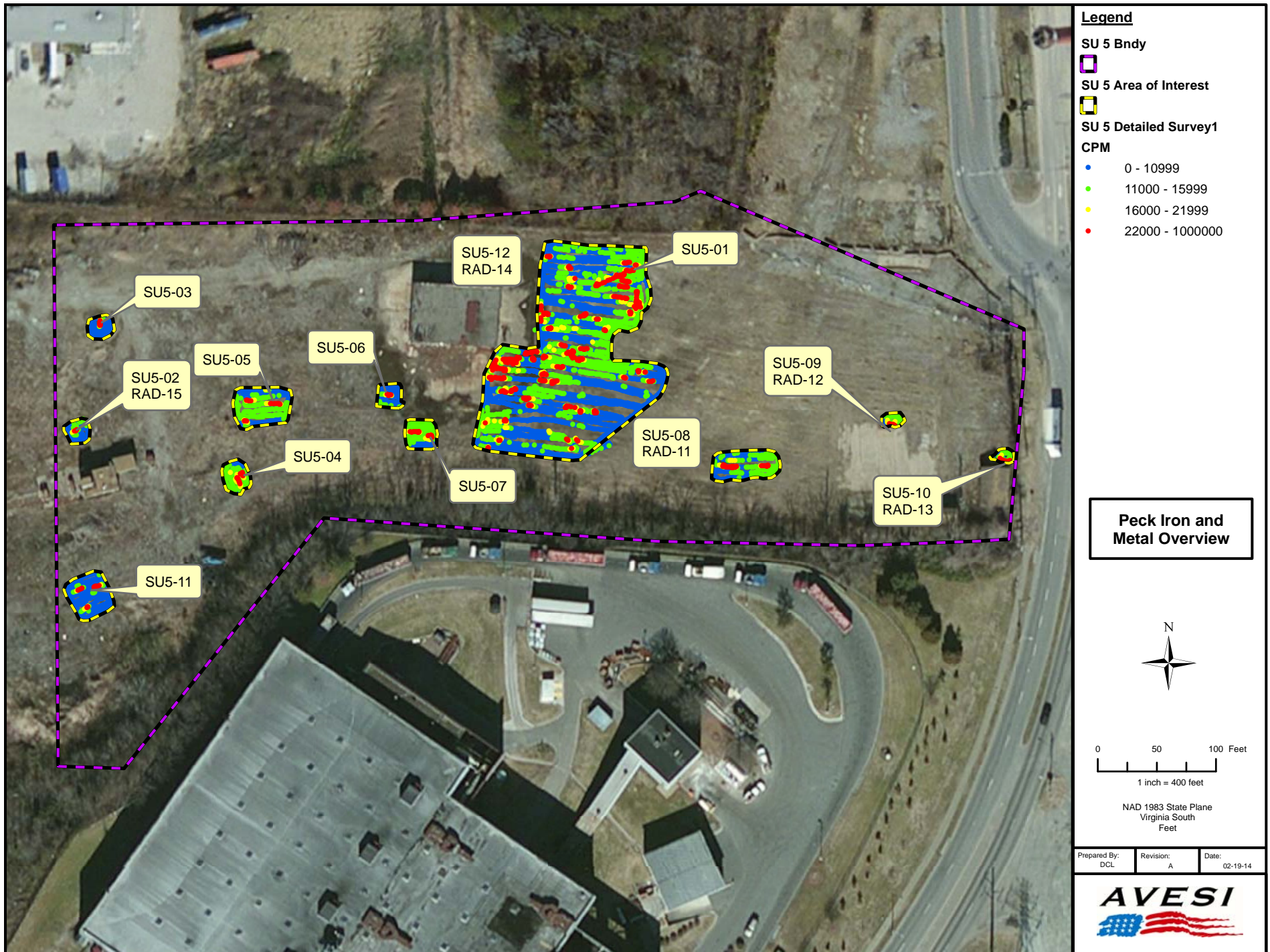
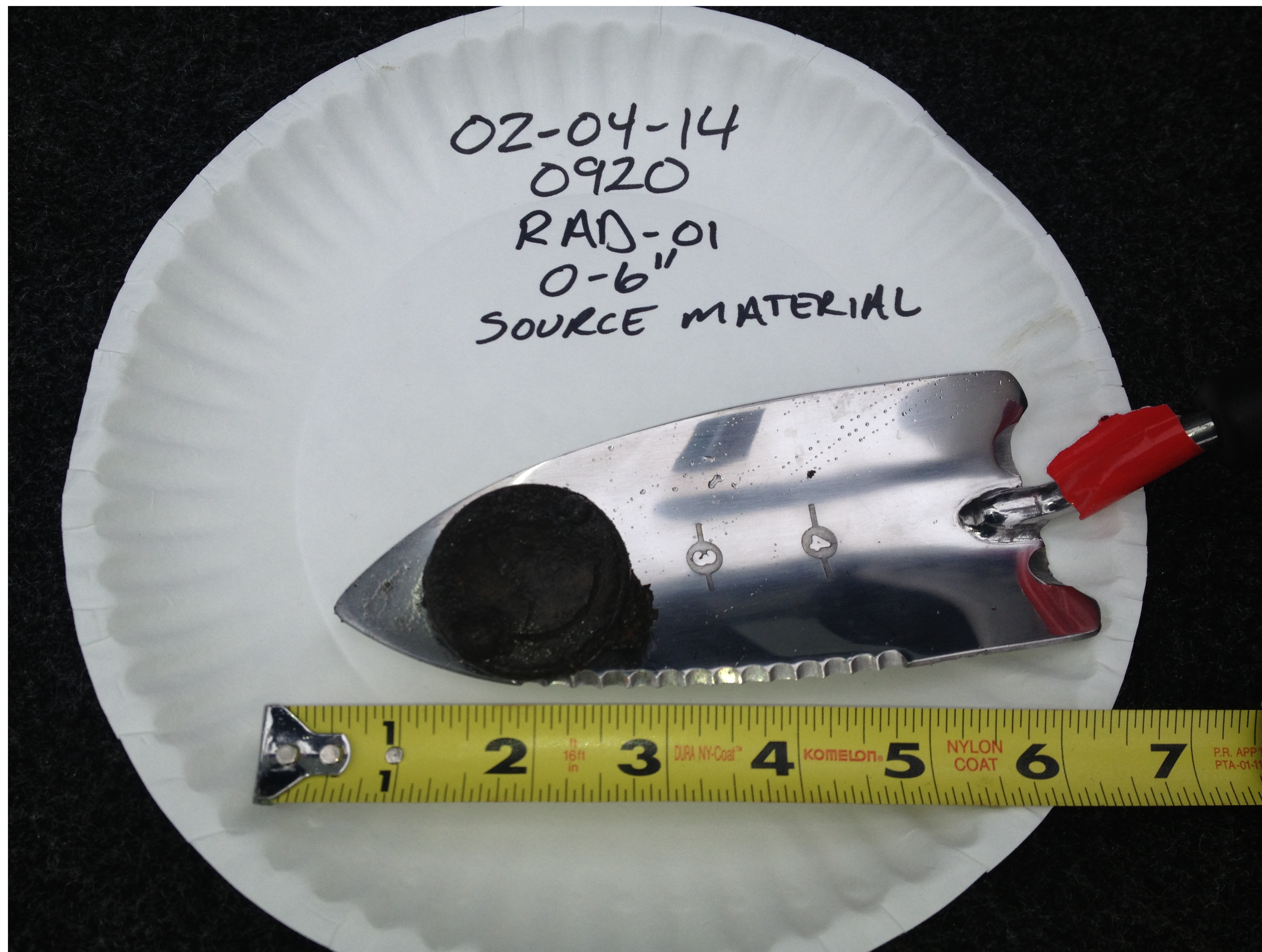


Figure 5-2: Peck Iron and Metal Survey Unit 5 Detailed Survey

ATTACHMENT B: PHOTOS

PIC-RAD-01



PIC-RAD-02



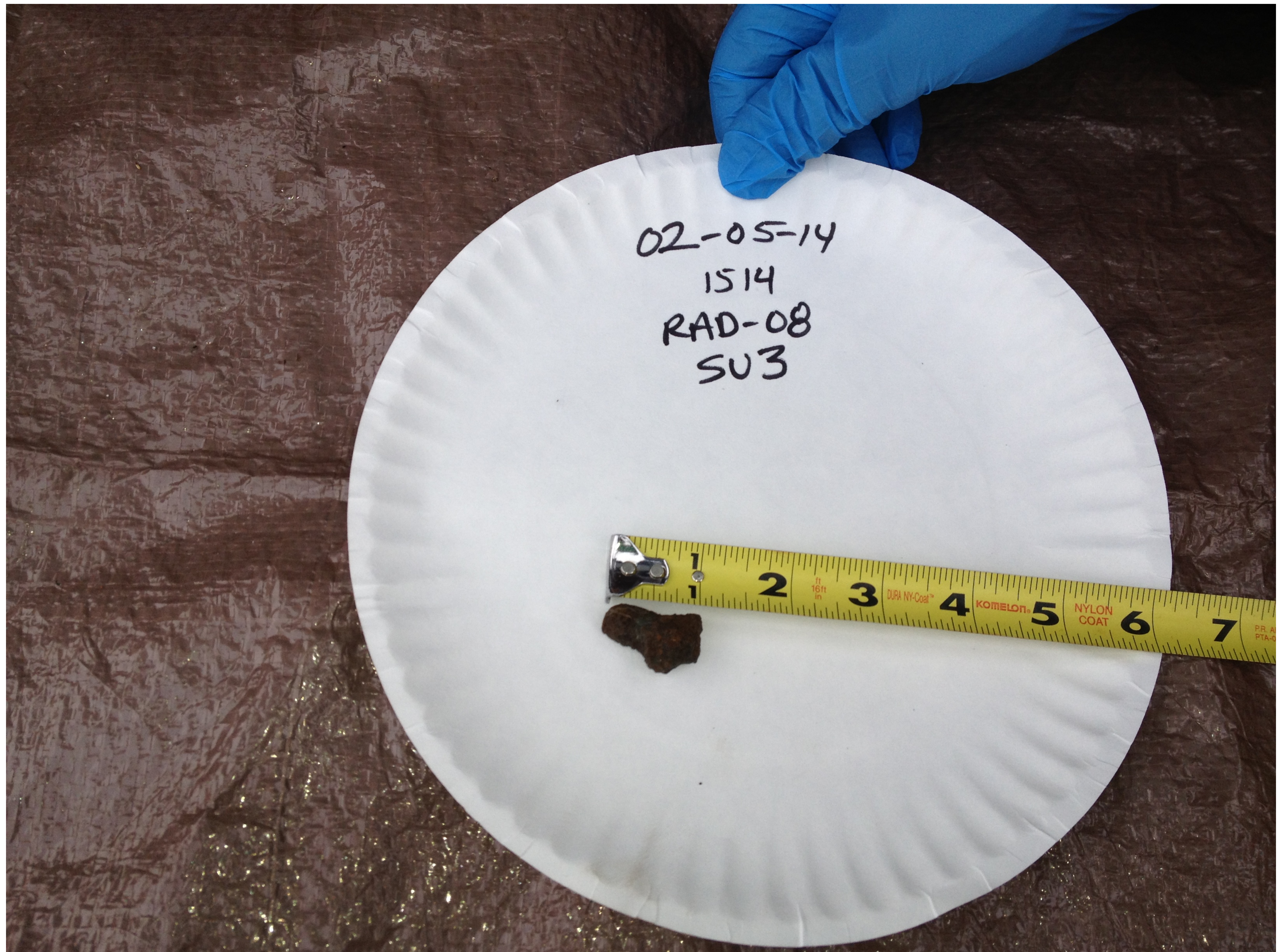
PIC-RAD-04



PIC-RAD-05



PIC-RAD-08



PIC-RAD-09





PIC-RAD-10



PIC-RAD-11



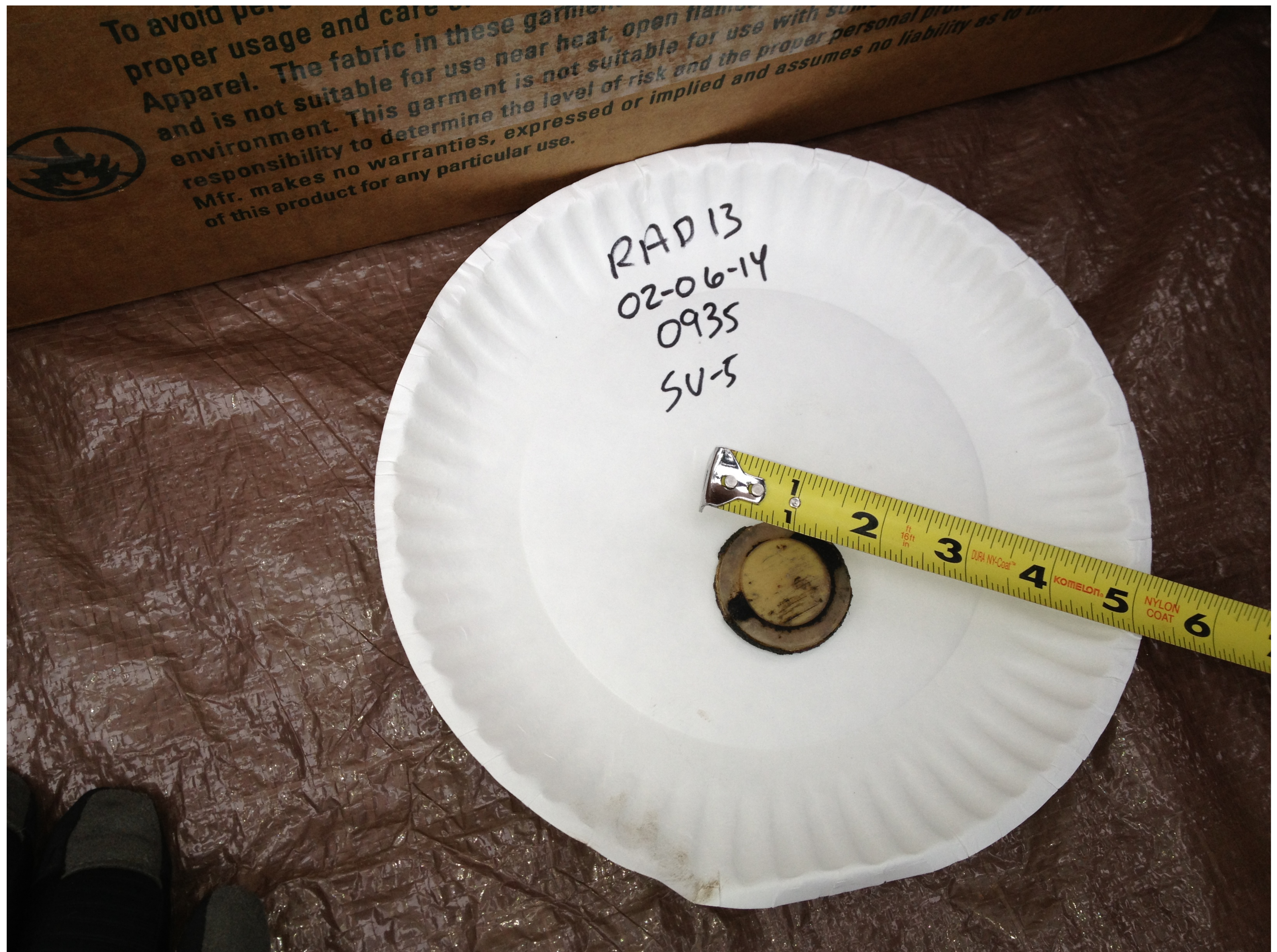
PIC-RAD-12



PIC-RAD-12-1



PIC-RAD-13



PIC-RAD-13-1



PIC-RAD-14

SUS-12
RAD 14
02-06-14
1011



PIC-RAD-14-1



PIC-RAD-15



PIC-RAD-15-1



ATTACHMENT C: INSTRUMENTATION

Initial Instrument Check In

Meter Number:	282985	Detector Number:	303725
Meter Model:	2221	Detector Model:	44-10
Cal. Due:	2/8/2013	Cal. Due:	2/8/2013

ALPHA	Source Type:		Threshold:	N/A
ALPHA	Source #:		High Voltage:	N/A
ALPHA	Source Activity:	N/A		
ALPHA	Source count time:		Background count time:	N/A (min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	#DIV/0!
ALPHA			Average Source (GCPM):	#DIV/0!
ALPHA			Average Net Source (NCPM):	#DIV/0!
ALPHA			Source Range (GCPM):	#DIV/0! to #DIV/0!
ALPHA			Background Range (CPM):	#DIV/0! to #DIV/0!
ALPHA	N/A	N/A	Determined Efficiency:	#DIV/0!
ALPHA			20% of Bkg.	#DIV/0!
ALPHA			1 Standard Deviation of Bkg.	#DIV/0!
ALPHA			3 Standard Deviations of Bkg.	#DIV/0!
ALPHA				

Beta / Gamma (circle one)

BETA	Source Type:	CS-137	Threshold:	10 mV
BETA	Source #:	235	High Voltage:	1100 V
BETA	Source Activity:	1 uCi		
BETA	Source count time:	1 min.	Background count time:	1 minute (min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	9,647
BETA	50,404	9,252	Average Source (GCPM):	49,660
BETA	49,529	9,275	Average Net Source (NCPM):	40,014
BETA	49,541	9,668	Source Range (GCPM):	39,728 to 59,592
BETA	49,631	9,587	Background Range (CPM):	7,717 to 11,576
BETA	49,666	9,680	Determined Efficiency:	N/A
BETA	49,712	9,608		
BETA	49,466	10,034	20% of Bkg.	1929
BETA	49,272	9,855	1 Standard Deviation of Bkg.	243
BETA	50,087	9,669	3 Standard Deviations of Bkg.	729
BETA	49,295	9,838		

Performed By:  Date: 1-27-14

Reviewed By:  Date: 2/9/14
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

METER: 2221/44-10 # 303725

DATE (MO/YR): Jan/Feb 2014

[illegible]

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By: Randy Tom

Date: 2/9/14

Certificate of Calibration

Meter Calibration

Serial Number : 282985

Model : 2221

Manufacturer : Ludlum

Calibration Date : 02/13/2014

Customer : AVESEI

Service Ticket Number : 0000000949

Calibration Interval : 1 Year

Calibration Next Due : 02/13/2015

Environmental Measurements

Temperature : 76 F

Humidity : 21 %

Altitude : 660

Barometric Pressure : 29.26 " Hg

Analog Readout

Ref. Count	Multiplier	Pre-Cal	Post-Cal
400	1,000.0	400	400
100	1,000.0	100	100
400	100.0	400	400
100	100.0	100	100
400	10.0	400	400
100	10.0	100	100
400	1.0	400	400
100	1.0	100	100

Digital Readout

Ref. Count	Pre-Cal	Post-Cal
400,000	399,954	399,878
40,000	39,996	39,997
4,000	3,999	4,000
400	400	400
40	40	40

Log Scale Readout

Ref. Count	Pre-Cal	Post-Cal
500,000	500,000	500,000
50,000	50,000	50,000
5,000	5,000	5,000
500	500	500
50	50	50

Reference Instruments

Multimeter S/N : 93470436

Pulser S/N : 201462

Comments : None

Calibrated By :

Bob J. French

Bob French

Reviewed By :

Mark [Signature]

Review Date :

2-13-14

Calibrated in accordance with ANSI N323A-1997 and manufacturers procedures

SAIC
From Science to Solutions
(314) 770-3000

Calibration Summary/Additional Instrument Checks

Ticket Number: 0000000949

Customer: AVESEI

Serial Number: 282985

Calibration Date: 02/13/2014

Frequency: 1 Year

Calibration Due Date: 02/13/2015

Additional Instrument Checks

- | | | | |
|---|---|---|---|
| <input checked="" type="checkbox"/> Mechanically OK | <input checked="" type="checkbox"/> F/S Response OK | <input checked="" type="checkbox"/> Audio OK | <input checked="" type="checkbox"/> Meter Zero OK |
| <input checked="" type="checkbox"/> Reset OK | <input checked="" type="checkbox"/> Battery OK | <input checked="" type="checkbox"/> Geotropism OK | <input checked="" type="checkbox"/> Window OK |

Cable: 3 foot

Technician: Bob French

Comments: None

Certificate of Calibration

Detector Calibration

Serial Number : 303725

Model : 44-10

Manufacturer : Ludlum

Calibration Date : 02/13/2014

Customer : AVESEI

Service Ticket Number : 0000000950

Calibration Interval : 1 Year

Calibration Next Due : 02/13/2015

Gamma Source Information

Serial Number : SAIC-0003

Isotope : Cs-137

Assay Date : 04/06/2004

2pi Activity : N/A

dpm 4pi Activity : 12,497,836 dpm

Background Counts (cpm)

Gamma As Left
4,240

Source Counts (cpm)

Gamma As Left
90,779

Calibration Instrument Used

Serial Number : 282985

Model : 2221

Manufacturer : Ludlum

Calibration Due Date : 02/13/2015

Instrument Settings

High Voltage : 1,200 Volts

Gamma Threshold 10.0 mV

Comments : No efficiency calculated, use for qualitative data only

Calibrated By :

Bob J. French

Bob French

Reviewed By :

Mark V. Latta

Review Date :

2-13-14

Calibrated in accordance with ANSI N323A-1997 and manufacturers procedures

SAIC
From Science to Solutions
(314) 770-3000

**Calibration Certificate
PLATEAU CALIBRATION**

Model #: 44-10

Source I.D.: Sa ic - 0003

Serial #: 303725

Attach. N/A

Calibration Points (Volts)	Background Counts	Source Counts
300		
350		
400		
450		
500		
550		
600		
650		
700		
750		
800		
850		
900		
950	3748	89782
1000	3856	90422
1050	4032	91237
1100	4186	90542
1150	4173	90586
1200	4240	90779
1250	4230	91275
1300	4211	91883
1350	4649	101433
1400		
1450		
1500		

Determined HV Settings: 1200 Determined Threshold Setting: 10mV

Reviewed By: Wish V. Star Date: 2-13-14



500 Northwest Plaza
Suite 1250
St. Ann, MO 63074

Initial Instrument Check In

Meter Number:	271427	Detector Number:	PR150784
Meter Model:	2221	Detector Model:	44-10
Cal. Due:	1/6/2015	Cal. Due:	1/6/2015

ALPHA	Source Type:		Threshold:	N/A
ALPHA	Source #:		High Voltage:	N/A
ALPHA	Source Activity:	N/A		
ALPHA	Source count time:		Background count time:	N/A (min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	#DIV/0!
ALPHA			Average Source (GCPM):	#DIV/0!
ALPHA			Average Net Source (NCPM):	#DIV/0!
ALPHA			Source Range (GCPM):	#DIV/0! to #DIV/0!
ALPHA			Background Range (CPM):	#DIV/0! to #DIV/0!
ALPHA	N/A	N/A	Determined Efficiency:	#DIV/0!
ALPHA			20% of Bkg.	#DIV/0!
ALPHA			1 Standard Deviation of Bkg.	#DIV/0!
ALPHA			3 Standard Deviations of Bkg.	#DIV/0!
ALPHA				

Beta / Gamma (circle one)

BETA	Source Type:	CS-137	Threshold:	10 mV
BETA	Source #:	235	High Voltage:	1200 V
BETA	Source Activity:	1 uCi		
BETA	Source count time:	1 min.	Background count time:	1 minute (min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	9,599
BETA	46,150	9,368	Average Source (GCPM):	47,306
BETA	47,421	8,984	Average Net Source (NCPM):	37,707
BETA	47,526	9,630	Source Range (GCPM):	37,845 to 56,768
BETA	47,211	9,525	Background Range (CPM):	7,679 to 11,519
BETA	47,390	9,296	Determined Efficiency:	N/A
BETA	47,445	9,278		
BETA	47,620	10,457	20% of Bkg.	1920
BETA	47,404	9,771	1 Standard Deviation of Bkg.	410
BETA	47,503	9,832	3 Standard Deviations of Bkg.	1231
BETA	47,393	9,848		

Performed By: [Signature] Date: 1-27-14

Reviewed By: [Signature] Date: 2/9/14
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

METER: 2221/44-10 # PR150784

DATE (MO/YR): Jan/Feb 2014

[illegible]

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By: David Lyu

Date: 2/9/14



Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 271427
Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR150784

☒ Mechanical Check ☒ THR/WIN Operation
☒ F/S Response Check ☒ Reset Check
☒ Geotropism ☒ Audio Check
☒ Meter Zeroed ☒ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ☒ 500 V ☒ 1000 V ☒ 1500 V

Cable Length: ☐ 39-inch ☒ 72-inch ☐ Other:

Source Distance: ☐ Contact ☒ 6 inches ☐ Other:

Threshold: 10 mV

Barometric Pressure: 24.86 inches Hg

Temperature: 73 °F

Source Geometry: ☒ Side ☐ Below ☐ Other:

Window:

Relative Humidity: 20 %

Instrument found within tolerance: ☒ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	400720	400
x 1000	100	100	100		100
x 100	40	400	400	40069	400
x 100	10	100	100		100
x 10	4	400	400	4007	400
x 10	1	100	100		100
x 1	400	400	400	401	400
x 1	100	100	100		100

High Voltage

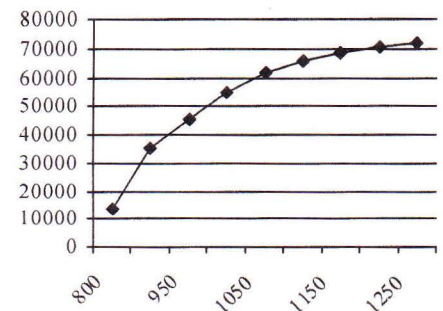
Source Counts

Background

Voltage Plateau

800	13458
900	35493
950	45495
1000	54990
1050	62013
1100	65797
1150	68770
1200	70221
1250	71869

10983



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1200

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☒ 201932

Fluke multimeter serial number: ☐ 8749012

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

☒ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

☐ Other Source:

Calibrated By:

Calibration Date: 1-6-14

Calibration Due: 1-6-15

Reviewed By:

Date: 1/6/14

Initial Instrument Check In

Meter Number:	157329	Detector Number:	207851
Meter Model:	2929	Detector Model:	43-10-1
Cal. Due:	10/22/2014	Cal. Due:	10/22/2014

ALPHA	Source Type:	Th-230	Threshold:	180 mV
ALPHA	Source #:	4006-02	High Voltage:	850 V
ALPHA	Source Activity:	26,100		
ALPHA	Source count time:	1	Background count time:	10 (min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	2.6
ALPHA	9,490	1	Average Source (GCPM):	9,392
ALPHA	9,340	3	Average Net Source (NCPM):	9,389
ALPHA	9,392	2	Source Range (GCPM):	7,511 to 11,267
ALPHA	9,362	3	Background Range (CPM):	-0.3 to 5.5
ALPHA	9,363	1	Determined Efficiency:	36.0%
ALPHA	9,383	3		
ALPHA	9,352	3	20% of Bkg.	0.5
ALPHA	9,486	3	1 Standard Deviation of Bkg.	1.0
ALPHA	9,468	3	3 Standard Deviations of Bkg.	2.9
ALPHA	9,281	4		

Beta / Gamma (circle one)

BETA	Source Type:	SrY-90	Threshold:	4 mV
BETA	Source #:	5442-05	High Voltage:	850 V
BETA	Source Activity:	3,534		
BETA	Source count time:	1 min.	Background count time:	10 (min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	548
BETA	1,359	537	Average Source (GCPM):	1,347
BETA	1,321	560	Average Net Source (NCPM):	798
BETA	1,367	532	Source Range (GCPM):	1,077 to 1,616
BETA	1,379	562	Background Range (CPM):	499 to 597
BETA	1,367	544	Determined Efficiency:	22.6%
BETA	1,307	579		
BETA	1,258	532	20% of Bkg.	110
BETA	1,368	531	1 Standard Deviation of Bkg.	16
BETA	1,379	546	3 Standard Deviations of Bkg.	49
BETA	1,361	561		

Performed By: [Signature] Date: 1-27-14

Reviewed By: [Signature] Date: 2/9/14
(RPM / Asst. RPM)

INSTRUMENTATION QC CHECK LOG

METER: 2929/43-10-1

DATE (MO/YR): Jan/Feb 2014

[illegible]

1 An unsatisfactory QC check requires the recording the result in the comment column and repeating the evaluation. Tag the instrument out of service and notify the HP Supervisor upon failing the QC check two times in succession

Reviewed By: David Lopez

Date: 2/9/14



Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter/Detector: Manufacturer: Ludlum Model Number: 2929 & 43-10-1 Serial Number: 157329 & PR207851

- ☒ Mechanical Check ☒ THR/WIN Operation
☐ F/S Response Check ☐ Reset Check
☐ Geotropism ☒ Audio Check
☐ Meter Zeroed ☐ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ☒ 500 V ☒ 1000 V ☒ 1500 V

Cable Length: ☒ 39-inch ☐ 72-inch ☐ Other:

Source Distance: ☐ Contact ☐ 6 inches ☒ Other: In Planchet

Alpha Threshold: 180 mV Barometric Pressure: 24.81 inches Hg

Beta Threshold: 4 mV Temperature: 75 °F

Source Geometry: ☐ Side ☐ Below ☒ Other: In Planchet

Beta Window: 50 mV Relative Humidity: 20 %

Instrument found within tolerance: ☒ Yes ☐ No

Range/Multiplier	Reference Setting	Integrated 1-Min. Count "As Found"		Integrated 1-Min. Count "Reading"	
		α	β	α	β
x 1000	400 Kcpm	400296	400313	400296	400313
x 100	40 Kcpm	40032	40031	40032	40031
x 10	4 Kcpm	4002	4004	4002	4004
x 1	400 cpm	400	401	400	401

High Voltage	Pot. Setting	Alpha Source		Beta Source		Background	
		α	β	α	β	α	β
750	3.02	4507	264	7	2779	1	52
800	3.24	4819	292	3	3577	2	60
850	3.44	4836	509	6	4057	0	77
900	3.64	4860	726	2	4951	2	80

Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 850, Pot. setting = 3.44

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☒ 201932

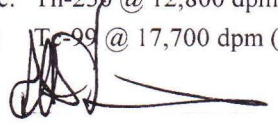
Fluke multimeter serial number ☐ 8749012

☒ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03


☒ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

☐ Other Source:

Calibrated By: 

Calibration Date 10-22-13

Calibration Due 10-22-14

Reviewed By: 

Date: 10/24/13

Initial Instrument Check In

Meter Number:	190171	Detector Number:	PR084357
Meter Model:	2221	Detector Model:	44-9
Cal. Due:	1/6/2015	Cal. Due:	1/6/2015

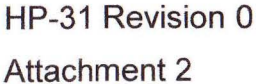
ALPHA	Source Type:		Threshold:	N/A
ALPHA	Source #:		High Voltage:	N/A
ALPHA	Source Activity:	N/A		
ALPHA	Source count time:		Background count time:	N/A (min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	#DIV/0!
ALPHA			Average Source (GCPM):	#DIV/0!
ALPHA			Average Net Source (NCPM):	#DIV/0!
ALPHA			Source Range (GCPM):	#DIV/0! to #DIV/0!
ALPHA			Background Range (CPM):	#DIV/0! to #DIV/0!
ALPHA	N/A	N/A	Determined Efficiency:	#DIV/0!
ALPHA			20% of Bkg.	#DIV/0!
ALPHA			1 Standard Deviation of Bkg.	#DIV/0!
ALPHA			3 Standard Deviations of Bkg.	#DIV/0!
ALPHA				

Beta / Gamma (circle one)

BETA	Source Type:	SrY-90	Threshold:	40 mV
BETA	Source #:	5442-05	High Voltage:	900 V
BETA	Source Activity:	3,534		
BETA	Source count time:	1 min.	Background count time:	1 minute (min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	47
BETA	1,058	45	Average Source (GCPM):	1,028
BETA	1,080	57	Average Net Source (NCPM):	981
BETA	1,066	39	Source Range (GCPM):	823 to 1,234
BETA	1,028	45	Background Range (CPM):	38 to 57
BETA	1,025	45	Determined Efficiency:	N/A
BETA	1,042	52		
BETA	984	51	20% of Bkg.	9
BETA	1,019	54	1 Standard Deviation of Bkg.	6
BETA	1,015	43	3 Standard Deviations of Bkg.	17
BETA	967	43		

Performed By:  Date: 1-27-14

Reviewed By:  Date: 2/9/14
(RPM / Asst. RPM)



METER: 2221/44-9 # PR084357

DATE (MO/YR): Jan/Feb 2014

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By: David Lyne

Date: 2/9/14



Certificate of Calibration

Calibration and Efficiency Determination

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 190171
Detector: Manufacturer: Ludlum Model Number: 44-9 Serial Number: PR084357

☒ Mechanical Check ☒ THR/WIN Operation HV Check (+/- 2.5%): ☒ 500 V ☒ 1000 V ☒ 1500 V
☒ F/S Response Check ☒ Reset Check Cable Length: ☒ 39-inch ☐ 72-inch ☐ Other: _____
☒ Geotropism ☒ Audio Check
☒ Meter Zeroed ☒ Battery Check (Min 4.4 VDC) Barometric Pressure: 24.85 inches Hg
Source Distance: ☒ Contact ☐ 6 inches ☐ Other: Threshold: 40 mV Temperature: 73 °F
Source Geometry: ☐ Side ☒ Below ☐ Other: Window: Relative Humidity: 20 %
Instrument found within tolerance: ☒ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"		Meter Reading		Integrated 1-Min. Count	Log Scale Count	
x 1000	400	400	kcpm	400	kcpm	401293	400	kcpm
x 1000	100	100	kcpm	100	kcpm		100	kcpm
x 100	400	400	kcpm	400	kcpm	40157	400	kcpm
x 100	100	100	kcpm	100	kcpm		100	kcpm
x 10	400	400	kcpm	400	kcpm	4017	400	kcpm
x 10	100	100	kcpm	100	kcpm		100	kcpm
x 1	400	400	cpm	400	cpm	402	400	cpm
x 1	100	100	cpm	100	cpm		100	cpm

Gross Tc-99 counts (cpm): 2481
Background counts (cpm): 54
Net Tc-99 Counts (cpm): 2427

Gross Sr/Y-90 counts (cpm)
Background counts (cpm):
Net Sr/Y-90 counts (cpm):

Comments:

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☒ 201932
☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03
☒ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

Fluke multimeter serial number: ☐ 8749012
☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By: 

Calibration Date: 1-6-14 Calibration Due: 1-6-15

Reviewed By: 

Review Date: 1/6/14



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER ERG

ORDER NO. 20222110/391641

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 144026

Mfg. _____ Model _____ Serial No. _____

Cal. Date 14-May-13 Cal Due Date 14-May-14 Cal. Interval 1 Year Meterface 202-016

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 33 % Alt 706.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. +/-10% ☐ 10-20% ☐ Out of Tol. ☒ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☐ F/S Resp. ck ☒ Reset ck. ☐ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☒ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 525 V Input Sens. 33 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 µR/hr	33	4000
5000	1000 µR/hr	33	1000
500	400 µR/hr= 76,000 cpm	33	400
500	100 µR/hr	N/A	100
250	200 µR/hr= 38,100 cpm	2/17	200
250	100 µR/hr	2/17	100
50	7600 cpm	2/17	50
50	1900 cpm	2/17	10
25	3810 cpm	2/17	20
25	953 cpm	2/17	5

*Uncertainty within ± 10% C.F. within ± 20%

50,25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☒ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☒ m 500 S/N 189506 ☐ Oscilloscope S/N _____ ☒ Multimeter S/N 94000441

Calibrated By: William Tinsley

Date 14 May 2013

Reviewed By: Mark H.

Date 14 May 13



EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233

P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 + 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 + 174 (0.00197 μ Ci)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST

Reviewed by: [Signature]

Calibration Technician: [Signature]

Q.A. Representative: [Signature]

Calibration Date: 3-28-2005

Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com



EBERLINE
SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 3905

P.O.# 0423

Description of Standard:

Model No. DNS-11 Serial No. 4006-02 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

13,200 + 397

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

26,100 + 783 (0.0118 μ Ci)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST

Reviewed by: [Signature]

Calibration Technician: [Signature]

Q.A. Representative: [Signature]

Calibration Date: 6-26-2002

Reviewed Date: 6-27-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com