Claim 28 (#78, 79)

Removal Site Evaluation Report

Final | September 18, 2018

Stantec

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

Claim 28 (#78, 79) Removal Site Evaluation Report - Final

September 18, 2018

Prepared for:

Navajo Nation AUM Environmental Response Trust
– First Phase

Prepared by:

Stantec Consulting Services Inc.

Title and Approval Sheet

Title: Claim 28 Removal Site Evaluation Report - Final

Approvals

This Removal Site Evaluation Report is approved for implementation without conditions.

10/1/18

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Revision Log

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0	May 15, 2018	Submission of Draft RSE report to Agencies for review
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Sign-off Sheet

This document entitled *Claim 28 Removal Site Evaluation Report* was prepared by MWH, now part of Stantec Consulting Services Inc. (Stantec) on behalf of the Navajo Nation AUM Environmental Response Trust – First Phase (the "Client") for submittal to the Navajo Nation Environmental Protection Agency (NNEPA) and United States Environmental Protection Agency (USEPA) (collectively, the "Agencies"). The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Per the *Navajo Nation AUM Environmental Response Trust Agreement – First Phase*, *Section 5.4.1,* (United States [US], 2015) the following certification must be signed by a person who supervised or directed the preparation of the Removal Site Evaluation report: "Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted herein is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

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Executive Summary

Introduction

The Claim 28 site (the Site) is located within the Navajo Nation, Chinle Bureau of Indian Affairs (BIA) Agency, Tachee/Blue Gap Chapter in northeastern Arizona. The Site is also identified as one abandoned uranium mine (AUM) claim with two mine site identifications of #78 and #79. The Site is one of 46 "priority" AUMs within the Navajo Nation selected by the United States Environmental Protection Agency (USEPA) in collaboration with the Navajo Nation Environmental Protection Agency (NNEPA) for further evaluation based on radiation levels and potential water contamination USEPA, 2013. Mining for uranium occurred prior to, during, and after World War II, when the United States (US) sought a domestic source of uranium located on Navajo lands (USEPA, 2007a).

On April 30, 2015, the *Navajo Nation AUM Environmental Response Trust Agreement – First Phase* (the *Trust Agreement*) became effective. The *Trust Agreement* was made by and among the US, as Settlor, and as Beneficiary on behalf of the USEPA, and the Navajo Nation, as Beneficiary, and the Trustee (Sadie Hoskie). The *Trust Agreement* was developed in accordance with a settlement on April 8, 2015 between the US and Navajo Nation for the investigation of 16 specified priority AUMs. The Site was added to the list of 16 priority AUMs based on the results of surface water sampling investigations conducted for the Site that documented exceedances of drinking water standards (USEPA, 2018).

The purpose of this report is to summarize the objectives, field investigation activities, findings, and conclusions of Site Clearance and Removal Site Evaluation (RSE) activities conducted between August 2015 and October 2017 at the Site. The RSE study included review of relevant information and collection of data related to historical mining activities to support future Response Action evaluations at the Site. It was not intended to establish cleanup levels or determine cleanup options or potential remedies. The primary objective of the RSE process was to determine the volume of technologically enhanced naturally occurring radioactive material (TENORM) at the Site in excess of Investigation Levels (ILs) as a result of historical mining activities. ILs were based on the background gamma measurements (in counts per minute [cpm]), and Radium-226 (Ra-226) and metals concentrations, determined through statistical analyses, that were used to evaluate potential mining-related impacts. The area inclusive of the Site has naturally occurring radioactive materials (NORM), which was the reason the area was prospected and mined.

Site History and Physical Characteristics

The Site is located within the Colorado Plateau physiographic province, which is an area of approximately 240,000 square miles in the Four Corners region of Utah, Colorado, Arizona, and New Mexico. Regionally the Site is located in the southwestern portion of the Colorado Plateau, on Black Mesa, which is within the Black Mesa structural basin area. Black Mesa bedrock consists of the Toreva and Wepo Formations, where uranium deposits occur within the fluvial upper sandstone of the Toreva Formation. Regionally the Toreva Formation is the largest uranium producer from the Black Mesa area. The Site is also located within the Little Colorado River Valley watershed, an area of approximately 27,000 square miles spanning Arizona and New Mexico. Topographically the Site is located on a mesa bench, mesa sidewall, foothills and valley bottom at an elevation range of approximately 6,750 to 7,000 feet above mean sea level. On-site overland surface water flow, when present, is controlled by a decrease in elevation to the southwest from the mesa top to the valley bottom. Overland surface water flow occurs in several ephemeral drainages located on-site that drain to the southwest until they drain under Baird Route 29 and then drain to the southeast.

The Site was in operation between 1957 and 1968. Mine workings at the Site consisted of an open pit. The USAEC reported total ore production from the Site was 4,181.08 tons (approximately 8,362,160 pounds) of ore that contained 17,327.367 pounds of 0.21 percent U_3O_8 (uranium oxide) and 13,400.06 pounds of 0.27 percent V_2O_5 (vanadium oxide).

In 1992 and 2000 the Navajo Abandoned Mine Lands Reclamation Program (NAML) performed reclamation activities at the Site which included backfilling pits and rim strip trenches with mine waste and covering the mine waste with suitable backfill material. In 2011 Weston Solutions (Weston) performed site screening on behalf of the USEPA. Between 2013 and 2017 three academic studies were conducted using the analytical results of media samples (i.e., soil, mine waste, spring water, and seep water) collected from the Site (Shuey, et al., 2014, Blake et al., 2015, and Avasarala, et al. 2017).

Summary of Removal Site Evaluation Activities

The Trust's Site RSE investigation consisted of Site Clearance activities and RSE activities.

- **Site Clearance** consisted of a desktop study of historical information, site mapping, potential background reference area evaluation, biological (vegetation and wildlife) surveys, and cultural resource survey.

The Trust's RSE activities consisted of Baseline Studies and Site Characterization and Assessment.

- **Baseline Studies** activities included a background reference area study, site gamma radiation surveys, and a Gamma Correlation Study. Results of the Baseline Studies were used to plan and prepare the Site Characterization Activities and Assessment. Data collected in the background reference area study (soil sampling, laboratory analyses, surface gamma surveying, and subsurface static gamma measurements) were used to establish ILs for the Site. Data collected from the site gamma radiation survey were the primary method to evaluate potential mining-related impacts or areas containing elevated radionuclides. The Gamma Correlation Study objectives were to determine the correlations between: (1) gamma measurements and concentrations of Ra-226 in surface soils; and (2) gamma measurements and exposure rates; to be used as screening tools for site assessments.

- **Site Characterization Activities and Assessment** included surface and subsurface soil and sediment sampling, surface water and well water sampling, and a geophysical survey. The results of the surface and subsurface soil and sediment sampling analyses were used to evaluate mining impacts and define the lateral and vertical extent of TENORM at the Site. The results of the surface water and well water analyses were used to evaluate mining impacts to surface water and well water. The results of the geophysical survey were used to inform the TENORM volume estimate.

Findings and Discussion

Surface and subsurface soil and sediment sampling results. Two background reference areas were selected to develop surface gamma, subsurface static gamma, Ra-226, and metals ILs for the Site. Arsenic, molybdenum, selenium, uranium, vanadium, and Ra-226 concentrations and gamma radiation measurements in soil/sediment exceeded their respective ILs and are confirmed constituents of potential concern (COPCs) for the Site. Based on the data analyses performed for this report along with the multiple lines of evidence, approximately 44.7 acres, out of the 73.1 acres of the Survey Area (i.e., the full areal of the Site surface gamma survey), were estimated to contain TENORM. Of the 44.7 acres that contain TENORM, 31.6 acres contain TENORM exceeding ILs. The volume of TENORM in excess of ILs was estimated to be 91,012 cubic yards (yd^3) (69,584 cubic meters).

Gamma Correlation Study results. Results of the Gamma Correlation Study indicated that surface gamma survey results do not correlate sufficiently well with Ra-226 concentrations in soil. Therefore, users of the regression equation should be aware of the limitations of the dataset and be cautious when estimating radium-226 concentrations. Additional correlation studies may be needed to identify the relationship between gamma and Ra-226.

Water sampling results. Water samples were collected from one surface water pond, one seep, and one windmill well. Sample analyses indicated that the seep water sample had radionuclides (Ra-226, Ra-228, and adjusted gross alpha) and total and dissolved metals (beryllium, cadmium, thallium, uranium, and zinc) concentrations greater than their respective ILs. Based on these results, the above radionuclides and metals were confirmed as COPCs for the seep water. Results of general chemistry parameters indicated that TDS and sulfate were also above their respective ILs for all three water features. Based on these results, TDS and sulfate are confirmed COPCs for all three water features. Because radionuclides and metals exceeded their respective ILs for the seep, and TDS and sulfate exceeded their respective ILs in the samples collected at all three water features, further characterization may be necessary at these locations to evaluate potential mining-related impacts.

Based on the Site Clearance and RSE data collection and analyses for the Site, potential data gaps were identified and are presented in Section 4.10 of this RSE report. These potential data gaps can be taken into consideration for subsequent evaluations in support of future Removal or Remedial Action evaluations at the Site.

Acronyms/Abbreviations

°F	degrees Fahrenheit
bcy	bank cubic yard
yd^3	cubic yard
e.g.	exempli gratia
et seq.	and what follows
etc.	et cetera
ft	feet
ft^2	square feet
i.e.	id est
µg/L	micrograms per liter
mg/kg	milligram per kilogram
µR/hr	microRoentgens per hour
pCi/g	picocuries per gram
Adkins	Adkins Consulting Inc.
Ampet	Ampet Corporation
ags	above ground surface
AMLR	Abandoned Mine Lands Reclamation
amsl	above mean sea level
AUM	abandoned uranium mine
bgs	below ground surface
BIA	Bureau of Indian Affairs
$CaCO_3$	calcium carbonate
CCV	continuing calibration verification
Cooper	Cooper Aerial Surveys Company
CFR	Code of Federal Regulations
COPC	constituent of potential concern
cpm	counts per minute
Dinétahdóó	Dinétahdóó Cultural Resource Management
DMP	Data Management Plan
DQO	data quality objective
ERG	Environmental Restoration Group, Inc.
ESA	Endangered Species Act
FSP	Field Sampling Plan
GIS	geographic information system
GPS	global positioning system
HASP	Health and Safety Plan
HGI	Hydrogeophysics Inc.

ICAL	initial calibration
ICB/CCB	initial/continuing calibration blank
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICV	initial calibration verification
IL	Investigation Level
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
MARSSIM	Multi-agency Radiation Survey and Site Investigation Manual
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
METALS	Metal Exposure Toxicity Assessment on Tribal Lands in the Southwest
MLR	multivariate linear regression
MS/MSD	matrix spike/matrix spike duplicate
MWH	MWH, now part of Stantec Consulting Services Inc. (formerly MWH Americas, Inc.)
NaI	sodium iodide
NAML	Navajo Abandoned Mine Lands Reclamation Program
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NNDFW	Navajo Nation Department of Fish and Wildlife
NNDOJ	Navajo Nation Department of Justice
NNDNR	Navajo Nation Division of Natural Resources
NNDWR	Navajo Nation Department of Water Resources
NNEPA	Navajo Nation Environmental Protection Agency
NNESL	Navajo Nation Endangered Species List
NNHP	Navajo Natural Heritage Program
NNHPD	Navajo Nation Historic Preservation Department
NORM	Naturally Occurring Radioactive Material
NSDWR	National Secondary Drinking Water Regulations
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
R^2	Pearson's Correlation Coefficient
Ra-226	Radium 226
Ra-228	Radium 228
Redente	Redente Ecological Consultants
RSE	Removal Site Evaluation
SEM	scanning electron microscope
SOP	standard operating procedure
Stantec	Stantec Consulting Services Inc.
T&E	threatened and endangered
Th-230	thorium-230
Th-232	thorium-232
TCP	traditional cultural property

TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
TDS	total dissolved solids
U-235	uranium 235
U-238	uranium 238
U_3O_8	uranium oxide
UCL	upper confidence limit
UNM	University of New Mexico
US	United States
USAEC	US Atomic Energy Commission
USC	United States Code
USDA	US Department of Agriculture
USDOI	US Department of the Interior
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
UTL	upper tolerance limit
XPS	X-ray photoelectron spectroscopy
XRF	X-ray fluorescence
Weston	Weston Solutions
V2O5	vanadium oxide

Glossary

Alluvium – material deposited by flowing water.

Arkosic – containing at least 25 percent feldspar.

Arroyo – a steep sided gully cut by running water in an arid or semiarid region.

Bank cubic yard – a unite designating one cubic yard of earth or rock, measured or calculated before removal from the bank (Dictionary of Construction, 2018).

Bin Range – as presented in the RSE report, a range of values to present surface gamma measurement data in relation to: (1) the surface gamma Investigation Level (IL); (2) multiples of the surface gamma IL; or (3) the mean and standard deviation of the predicted Radium-226 (Ra-226) concentrations for the Site based on the correlation equation.

Carnotite – A secondary mineral resulting from the alteration of uraninite, montroseite, or davidite. Occurs in sandstones, especially in paleochannels, near fossil carbonaceous matter in calcretes and near playas (Mindat, 2018).

Class A material - mine waste piles, overburden, subsoil, topsoil or other suitable backfill material with Ra-226 concentration equal to or less than the average Ra-226 concentration of the background area in the immediate vicinity of the project as computed from ground-contact radiological measurements. The material will be free from solid waste, hazardous waste, toxic waste, oil/grease, trash, vegetation, combustible materials and materials that retard vegetative growth (NAML, 2000).

Colluvium – unconsolidated, unsorted, earth material transported under the influence of gravity and deposited on lower slopes (Schaetzl and Thompson, 2015).

Composite sample – "Volumes of material from several of the selected sampling units are physically combined and mixed in an effort to form a single homogeneous sample, which is then analyzed" (USEPA, 2002a).

Constituent of potential concern (COPC) – analytes identified in the *RSE Work Plan* where their levels were confirmed based on the results of the RSE.

Data Validation – "an analyte- and sample-specific process that extends the evaluation of data beyond, method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set" (USEPA, 2002b).

Data Verification – "the process of evaluating the completeness, correctness and conformance/compliance of a specific data set against the method, procedural, or contractual requirements" (USEPA, 2002b).

Earthworks - human-caused disturbance of the land surface.

Electrical Resistivity – geophysical investigation method that measures a material's resistance to electrical current.

Eolian – a deposit that forms as a result of the accumulation of wind-driven products from the weathering of solid bedrock or unconsolidated deposits.

Ephemeral – ephemeral streams flow only in direct response to surface runoff precipitation or melting snow, and their channels are at all times above the water table (USGS, 2003). This concept also applies to ephemeral ponds that contain water in response to surface runoff precipitation or melting snow and are at all times above the water table.

Escarpment - a steep slope or long cliff that forms as an effect of faulting or erosion and separates two relatively leveled areas having differing elevations.

Ethnographic – relating to the scientific description of peoples and cultures with their customs, habits, and mutual differences.

Feldspar – an abundant rock-forming mineral typically occurring as colorless or pale-colored crystals and consisting of aluminosilicates of potassium, sodium, and calcium.

Furrowed – to make a rut, groove, or trail in the ground.

Gamma – a type of radiation that occurs as the result of the natural decay of uranium.

Geochemical – the chemistry of the composition and alterations of the solid matter of the earth (American Heritage Dictionary, 2016).

Geomorphology – the physical features of the surface of the earth and their relation to its geologic structures (English Oxford Dictionary, 2018).

Grab sample – a sample collected from a specific location (and depth) at a certain point in time.

Investigation Level (IL) – based on the background gamma measurements (in counts per minute [cpm]) and, Radium-226 (Ra-226) and metals concentrations, determined through statistical analyses, that are used to evaluate potential mining-related impacts.

Isolated Occurrences – in relation to the Site Cultural Resource Survey: Any non-structural remains of a single event: alternately, any non-structural assemblage of approximately 10 or fewer artifacts within an area of approximately 10 square meters or less, especially if it is of questionable human origin or if it appears to be the result of fortuitous causes. The number and/or composition of observed artifact classes are a useful rule of thumb for distinguishing between a site and an isolate (NNHPD, 2016).

Mineralized – economically important metals in the formation of ore bodies that have been geologically deposited. For example, the process of mineralization may introduce metals, such as uranium, into a rock. That rock may then be referred to as possessing uranium mineralization (World Heritage Encyclopedia, 2017).

Multi-channel analysis of surface wave (MASW) – geophysical investigation method that measures the elastic condition of the subsurface to produce an image based on differences in transmission time of the seismic wave.

Naturally occurring radioactive material (NORM) – "materials which may contain any of the primordial radionuclides or radioactive elements as they occur in nature, such as radium, uranium, thorium, potassium, and their radioactive decay products, that are undisturbed as a result of human activities" (USEPA, 2017).

Orthophotograph – an aerial photograph or image geometrically corrected such that the scale is uniform: the photograph has the same lack of distortion as a map. Unlike an uncorrected aerial photograph, an orthophotograph can be used to measure distances, because it is an accurate representation of the earth's surface, having been adjusted for topographic relief, lens distortion, and camera tilt.

Pan Evaporation – evaporative water losses from a standardized pan.

Radium-226 (Ra-226) – a radioactive isotope of radium that is produced by the natural decay of uranium.

Radium-228 (Ra-228) – a radioactive isotope of radium that is produced by the natural decay of uranium.

Remedial Action (or remedy) – "those actions consistent with permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment…For the purpose of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the term also includes enforcement activities related thereto" (USEPA, 1992).

Remove or removal – "the cleanup or removal of released hazardous substances from the environment; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare of the United States or to the environment, which may otherwise result from a release or threat of release…" (USEPA, 1992).

Respond or response – "remove, removal, remedy, or remedial action, including enforcement activities related thereto" (USEPA, 1992).

Runnel – a narrow channel in the ground for liquid to flow through.

Secular equilibrium – a type of radioactive equilibrium in which the half-life of the precursor (parent) radioisotope is so much longer than that of the product (daughter) that the radioactivity of the daughter becomes equal to that of the parent with time; therefore, the quantity of a radioactive isotope remains constant because its production rate is equal to its decay rate. In secular equilibrium the activity remains constant.

Static gamma measurement – stationary gamma measurement collected for a specific period of time (e.g., 60 seconds).

Subarkosic – containing 5 to 15 percent feldspar.

Technologically enhanced naturally occurring radioactive material (TENORM) – "naturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing", which includes disturbance from mining activities. Where "technologically enhanced means that the radiological, physical, and chemical properties of the radioactive material have been concentrated or further altered by having been processed, or beneficiated, or disturbed in a way that increases the potential for human and/or environmental exposures" (USEPA, 2017).

Thorium (Th) – "a naturally occurring radioactive metal found at trace levels in soil, rocks, water, plants and animals. Thorium (Th) is solid under normal conditions. There are natural and man-made forms of thorium, all of which are radioactive" (USEPA, 2017).

Th-230 – a radioactive isotope of thorium that is produced by the natural decay of thorium.

Th-232 – a radioactive isotope of thorium that is produced by the natural decay of thorium.

Traditional Cultural Property (TCP) – "a location of an event (a ceremony, belief, prayer, sweat lodge, plant gathering areas, and others as defined within the Navajo Nation Policy to Protect Traditional Cultural Properties) where the location itself maintains historic or traditional cultural value regardless of the value of any existing structure." (NNHPD, 2016)

Undulation – having a wavy form or outline.

Upper Confidence Limit (UCL) – the upper boundary (or limit) of a confidence interval of a parameter of interest such as the population mean (USEPA, 2015).

Upper Tolerance Limit (UTL) – a confidence limit on a percentile of the population rather than a confidence limit on the mean. For example, a 95 percent one-sided UTL for 95 percent coverage represents the value below which 95 percent of the population values are expected to fall with 95 percent confidence. In other words, a 95 percent UTL with coverage coefficient 95 percent represents a 95 percent UCL for the 95th percentile (USEPA, 2015).

Uranium (U) – a naturally occurring radioactive element that may be present in relatively high concentrations in the geologic materials in the southwest United States.

U-235 – a radioactive isotope of uranium that is produced by the natural decay of uranium.

U-238 – a radioactive isotope of uranium that is produced by the natural decay of uranium.

Walkover gamma radiation survey – referred to as a scanning survey in the Multi-agency Radiation Survey and Site Investigation Manual (*MARSSIM*; USEPA, 2000). A walkover gamma radiation survey is the process by which the operator uses a portable radiation detection instrument to detect the presence of radionuclides on a specific surface (i.e., ground, wall) while continuously moving across the surface at a certain speed and in a certain pattern (USEPA, 2000). Referred to in the RSE report as surface gamma survey after the first mention in the report.

Wind rose – a circular graph depicting average wind speed and direction.

1.0 INTRODUCTION

1.1 BACKGROUND

This report summarizes the purpose and objectives, field investigation activities, findings, and conclusions of Site Clearance and Removal Site Evaluation (RSE) activities conducted between August 2015 and October 2017 at the Claim 28 site (the Site) located in northeastern Arizona, as shown in Figure 1-1. The Site is also identified by the United States Environmental Protection Agency (USEPA) as one abandoned uranium mine (AUM) claim with two mine site identifications of #78 and #79 in the *Navajo Nation AUM Screening Assessment Report and Atlas with Geospatial Data* (the *2007 AUM Atlas*; USEPA, 2007a). The *2007 AUM Atlas* was prepared for the USEPA in cooperation with the Navajo Nation Environmental Protection Agency (NNEPA) and the Navajo Abandoned Mine Lands Reclamation Program (NAML). The claim boundary polygons (refer to Figure 2-1) used for the RSE encompassed an area of approximately 15.4 acres (670,824 square feet [ft^2]) and were provided as part of the *2007 AUM Atlas*. Per the *2007 AUM Atlas* these polygons and other factors represents the locations and surface extent of the AUMs. In addition, exploration area boundary polygons (refer to Figure 2-1) that encompass an area of approximately16.8 acres were also provided as part of the *2007 AUM Atlas*.

Stantec Consulting Services Inc. (Stantec; formerly MWH), performed Site Clearance activities in accordance with the *Site Clearance Work Plan* (MWH, 2016a), and performed RSE activities in accordance with the *Removal Site Evaluation Work Plan* ([*RSE Work Plan*] MWH, 2016b). The *Site Clearance Work Plan* and the *RSE Work Plan* were approved in April and October 2016, respectively, by the NNEPA and the USEPA (collectively, the Agencies). Stantec conducted this investigation on behalf of Sadie Hoskie, Trustee pursuant to Section 1.1.21 of the *Navajo Nation AUM Environmental Response Trust Agreement – First Phase* (the *Trust Agreement*), effective April 30, 2015 (United States [US], 2015). The *Trust Agreement* is made by and among the US, as Settlor, and as Beneficiary on behalf of the USEPA and the Navajo Nation, as Beneficiary, and the Trustee. The *Trust Agreement* was developed in accordance with a settlement on April 8, 2015 between the US and Navajo Nation for the investigation 16 specified “priority” AUMs.

A “Site” is defined in the *Trust Agreement* as:

> “each of the 16 AUMs listed on Appendix A to the Settlement Agreement, including the proximate areas where waste material associated with each such AUM has been deposited, stored, disposed of, placed, or otherwise come to be located.” *Trust Agreement*, § 1.1.25.

The Site is one of 46 priority AUMs within the Navajo Nation selected by the USEPA in collaboration with the NNEPA for further evaluation based on radiation levels and potential water contamination (USEPA, 2013). The 16 priority AUMs included in the *Trust Agreement* are located on Navajo Lands throughout southeastern Utah, northeastern Arizona, and western New

Mexico, as shown in Figure 1-1. Per the USEPA, the Site was added to the list of 16 priority AUMs based on the results of surface water sampling investigations conducted for the Site that documented exceedances of drinking water standards (NNEPA, 2018). These investigations were performed by academic researchers and are discussed in Sections 2.1.4.7 and 2.1.4.8. The remaining 15 priority AUMs were selected by the US and Navajo Nation, as described in the *Trust Agreement*:

> "based on two primary criteria, specifically, demonstrated levels of Radium-226[1]: (a) at or in excess of 10 times the background levels and the existence of a potentially inhabited structure located within 0.25 miles of AUM features; or (b) at or in excess of two times background levels and the existence of a potentially inhabited structure located within 200 feet (ft)." *Trust Agreement*, Recitals.

In addition, the 16 priority AUMs are, for the purposes of this investigation, a subset of priority mines for which a viable private potentially responsible party has not been identified. Mining for uranium occurred prior to, during, and after World War II, when the US sought a domestic source of uranium located on Navajo lands (USEPA, 2007a). *Trust Agreement*, Recitals.

1.2 PURPOSE AND OBJECTIVE OF THE REMOVAL SITE EVALUATION

The purpose of the RSE process is to review relevant information and collect data related to historical mining activities to support future Removal or Remedial Action evaluations at the Site. It is not intended to establish cleanup levels or determine cleanup options or potential remedies. The primary objective of the RSE process is to determine the volume of technologically enhanced naturally occurring radioactive material (TENORM) at the Site in excess of Investigation Levels (ILs) as a result of historical mining activities. ILs are based on the background gamma measurements (in counts per minute [cpm]), and Radium-226 (Ra-226) and metals concentrations, determined through statistical analyses, that are used to evaluate potential mining-related impacts. The USEPA (2017) defines TENORM as:

> "naturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing" (mine waste or other mining-related disturbance).
>
> "Technologically enhanced means that the radiological, physical, and chemical properties of the radioactive material have been concentrated or further altered by having been processed, or beneficiated, or disturbed in a way that increases the potential for human and/or environmental exposures."

An understanding of the extent and volume of TENORM that exceeds the ILs at the Site is key information for future Removal or Remedial Action evaluations, including whether, and to what

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[1] The Agencies selected the priority mines based on gamma radiation, but the *Trust Agreement* erroneously states: "levels of Radium -226".

extent, a Response Action is warranted under federal and Navajo law. Definitions presented in the glossary for "Removal", "Remedial Action", and "Response" are defined in 40 Code of Federal Regulations (CFR) Section 300.5 of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; USEPA, 1992).

The Trust conducted Site Clearance activities prior to commencing the RSE tasks to obtain information necessary to develop the *RSE Work Plan*. Site Clearance activities consisted of two separate tasks: a "desktop" study (e.g., literature and historical documentation review) and field activities.

Desktop study – included review of readily available and reasonably ascertainable information including:

- Historical and current aerial photographs to identify any potential historical mining features, and to identify if buildings, homes and/or other structures, and potential haul roads were present within 0.25 miles of the Site
- Topographic and geologic maps
- Available data concerning perennial surface water features and water wells
- Previous studies and reclamation activities
- Meteorological data (e.g., predominant wind direction in the region of the Site)

Site Clearance field activities – included the following:

- Site reconnaissance to evaluate in the field: access routes to the Site, location of site boundaries, and observations presented in the Weston Solutions (Weston) (2011) report
- Mapping of site features and boundaries
- Evaluation of potential background reference areas
- Biological surveys (wildlife and vegetation)
- Cultural resource surveys

Following Site Clearance activities, RSE activities consisted of two separate tasks: Baseline Studies and Site Characterization and Assessment. Baseline Studies activities were completed to establish the basis for the Site Characterization and Assessment activities.

Baseline Studies activities – included the following:

- Background Reference Area Study – walkover gamma radiation survey (referred to hereafter as surface gamma survey), subsurface static gamma radiation measurements (referred to hereafter as subsurface static gamma measurements), surface and subsurface soil sampling, and laboratory analyses

- Site gamma survey – surface gamma survey
- Gamma Correlation Study – co-located surface static gamma measurements and exposure-rate measurements at fixed points, high-density surface gamma surveys (intended to cover 100 percent of the survey area), surface soil sampling, and laboratory analyses

Site Characterization Activities and Assessment – included the following:

- Characterization of surface soils and sediment – surface soil and sediment sampling and laboratory analyses.
- Characterization of subsurface soils and sediment – static gamma measurements (at surface and subsurface hand auger and drilling borehole locations), and subsurface sampling and laboratory analyses. Hand auger and drilling borehole locations are referred to hereafter as boreholes.
- Characterization of perennial surface water and well water – surface water and well water sampling and laboratory analyses. Investigation of groundwater is not included in the scope of this RSE.

Details regarding the Site Clearance activities are provided in the *Claim 28 Site Clearance Data Report* (*Site Clearance Data Report*; MWH, 2016c) and summarized in Section 3.2 of this report. Details regarding the Baseline Study activities are provided in the *Claim 28 Site Baseline Studies Field Report* (Stantec, 2017) and summarized in Section 3.3 of this report. Details regarding the Site Characterization Activities and Assessment are provided in Section 3.3 of this report. Findings are presented in Section 4.0 of this report.

1.3 REPORT ORGANIZATION

This report presents a comprehensive discussion of all RSE activities, including applicable aspects of the outline suggested in the *Multi-Agency Radiation Survey and Site Investigation Manual – Appendix A* ([*MARSSIM*] USEPA, 2000), and consists of the following sections:

Executive Summary – Presents a concise description of the principal elements of the RSE report.

Section 1.0 Introduction – Describes the purpose and objectives of the RSE process, and organization of this RSE report.

Section 2.0 Site History and Physical Characteristics – Presents the history, land use, and physical characteristics of the Site.

Section 3.0 Summary of Site Investigation Activities – Summarizes the Site Clearance and RSE activities.

Section 4.0 Findings and Discussion – Presents the results of the Site Clearance and RSE activities, areas that exceed ILs, areas of Naturally Occurring Radioactive Material (NORM) and TENORM, and the volume of TENORM that exceeds the ILs. Potential data gaps are also presented, as applicable.

Section 5.0 Summary and Conclusions – Summarizes data and presents conclusions based on results of the investigations completed to date.

Section 6.0 Estimate of Removal Site Evaluation Costs – A statement of actual or estimated costs incurred in complying with the *Trust Agreement*, as required by the *Trust Agreement*.

Section 7.0 References – Lists the reference documents cited in this RSE report.

Tables Included at the end of this RSE report.

Figures Included at the end of this RSE report.

Appendices – Appendices A through F.1 are included at the end of this RSE report and Appendix F.2 is provided as a separate electronic file due to its file size and length.

- **Appendix A** – Includes the radiological characterization report and the geophysical survey report for the Site
- **Appendix B** – Includes photographs of the Site
- **Appendix C** – Includes copies of RSE field activity forms
- **Appendix D** – Provides the potential background reference areas selection and the methods and results of the statistical data evaluation for the Site
- **Appendix E** – Includes the biological evaluation report and the biological and cultural resources compliance forms
- **Appendix F** – Includes the Data Usability Report, laboratory analytical data, and data validation reports for the RSE analyses

Attachments – Site-specific geodatabase, tabular database files, and available historical documents referenced in this RSE report.

2.0 SITE HISTORY AND PHYSICAL CHARACTERISTICS

2.1 SITE HISTORY AND LAND USE

2.1.1 Mining Practices and Background

The Site is located on the Navajo Nation, in northeastern Arizona and approximately 5.9 miles northeast of the Tachee/Blue Gap Chapter House, Arizona, as shown in Figure 1-1 inset. The Site is located within the Black Mesa Mining District on Black Mesa (refer to Section 2.2.2). A summary of historical mining on the Site is presented below.

In 1947, the US Atomic Energy Commission (USAEC) began a procurement program for uranium concentrate. In January 1954, uranium-bearing outcrops on the eastern side of Black Mesa were brought to the attention of the USAEC (Chenoweth, 1990). The uranium discovery was made in an area of the Colorado Plateau where uranium discoveries had not previously occurred and was also in a geologic formation (the Toreva Formation, refer to Section 2.2.2) that was typically unproductive for uranium. Based on the discovery, the USAEC performed an aerial reconnaissance survey of the eastern side of Black Mesa between February and November 1954. The survey identified 37 radioactive anomalies within the Toreva Formation. With the discovery of uranium on the eastern side of Black Mesa, an increase in prospecting occurred in the area and numerous mining permits were issued in 1954 and 1955.

In May 1956, the Navajo Tribal Minerals Department held a lease sale for an area within the Black Mesa Mining District, which had previously been closed to mining. Leases would be granted to the highest bidder (Chenoweth, 1990). The Minerals Department issued a map of the previously closed area to the bidders. The map was subdivided into four tracts that consisted of individual mining claims. The Site (i.e., the Trust Claim 28 AUM) was located on Tract 1. On May 31, 1956, Uranium Industries, Inc. of Grand Junction, Colorado won the bid to lease Tract 1. Tract 1 was 513.8 acres and contained eight mining claims (Claim #s 15, 16, 25, 26, 27, 28, 29, and 30). For Tract 1, Uranium Industries Inc. assigned prospecting rights to Ampet Corporation (Ampet) of Denver, Colorado and on July 13, 1956, a prospecting permit was issued to Ampet. In the summer of 1957, a drilling permit was issued to Ampet for Tract 1. During drilling efforts, Ampet drilled 127 boreholes on the Tract 1 Claim 28 area, with a total footage of 6,000 ft (Hill, 1957 and Chenoweth, 1990). Of note, the Tract 1 Claim 28 area was approximately 45.4 acres (Chenoweth, 1990) whereas the Trust Claim 28 AUM boundary polygons (refer to Figure 2-1) used for this RSE encompassed an area of approximately 15.4 acres (USEPA, 2007a), plus the exploration area of 16.8 acres (USEPA, 2007a) that was gamma scanned as part of this investigation (refer to Section 3.3.1.2). From the drilling efforts, Ampet discovered a large ore body located behind the mineralized exposure on the rim. Based on the drilling results, Ampet selected four claims (Claim #s 27, 28, 29, and 30) within Tract 1 to be leased, with lease no. 14-20-603-3184 pertaining to Claim 28 (i.e., the Site). While waiting for the lease to be finalized, Ampet began mining at the Site by stripping a small open pit. The mining involved drilling and blasting, picking, and using a jackhammer to extract the ore from the open pit (Martin, 1991). In

September 1957, the first shipment of ore from the Site was sent to the USAEC ore-buying station in Tuba City, Arizona and contained 24 tons of ore averaging 0.12 percent U_3O_8 (uranium oxide), 0.12 V_2O_5 (vanadium oxide), and 0.06 $CaCO_3$ (calcium carbonate) (Chenoweth, 1990). The lease was issued on September 13, 1957, and mining at the Site continued until September 1958. Between 1957 and 1958, Ampet produced 2,833.73 tons of ore from the Site averaging 0.26 percent U_3O_8 and 0.27 percent V_2O_5. On July 29, 1959 Ampet cancelled the lease for the Site (no. 14-20-603-3184).

On July 19, 1961, Tachine Yazzie, Etsiddy Bitsie, and Charles James were issued Mining Permit 557 for the Site. The mining rights were then assigned to LaSalle Mining Company of Grand Junction, Colorado and approved on August 17, 1961 by the Bureau of Indian Affairs (BIA). The mining permit was cancelled on July 19, 1962 before mining was started under Mining Permit 557 (Martin, 1991).

On June 6, 1966, Joseph I. Costanza was issued Mining Permit 613 for the Site and on July 26, 1966, Mr. Costanza was assigned the permit. Mr. Costanza began mining at the open pit on-site in November 1966, under the company name Pioneer Drilling Company (Martin, 1991). In December 1966, Pioneer Drilling Company shipped an ore shipment from the Site to United Nuclear-Homestake Partners mill near Grants, New Mexico (Chenoweth, 1990). The shipment contained 2.0 tons of ore averaging 0.19 percent U_3O_8. During 1967 and 1968, Mr. Costanza used Gilbert Shumway and Wendell Jones as mining contractors to mine the Site. The final shipment of ore from the Site was sent in January 1968 from Pioneer Drilling Company. The shipment contained 138.59 tons of ore averaging 0.14 percent U_3O_8.

The USAEC reported total ore production from the Site (between 1957 and 1968) was 4,181.08 tons (approximately 8,362,160 pounds) of ore that contained 17,327.367 pounds of 0.21 percent U_3O_8 and 13,400.06 pounds of 0.27 percent V_2O_5 (Chenoweth 1990, and Scarborough, 1981).

2.1.2 Ownership and Surrounding Land Use

The Site is located within the Navajo Nation, Chinle BIA Agency in Section 20 of Township 33 North, Range 23 East, Gila and Salt River Principal Meridian. Land ownership where the Site is located falls under Navajo Trust lands. The Site is located within the Tachee/Blue Gap Chapter of the Navajo Nation, as shown in Figure 1-1, and is in Grazing Unit 4, as designated by the Navajo Nation Division of Natural Resources (NNDNR, 2006). The Site is currently uninhabited, but one home-site is located southwest of and within 0.25 miles of the Site, as shown in Figure 2-1. Eight other home-sites are located within 1 mile of the Site, as shown in Figure 2-1.

2.1.3 Site Access

In 2015, the Navajo Nation Department of Justice (NNDOJ) provided the Trustee with legal access to all Navajo Trust lands to implement work in accordance with the *Trust Agreement*. The Trustee also obtained individual written access agreements from residents living at or near the Site, or with an interest in lands at or near the Site, such as home-site leases and grazing rights, as applicable. In addition, the Trustee consulted with the Tachee/Blue Gap Chapter officials and nearby residents and notified them of the work.

2.1.4 Previous Work at the Site

2.1.4.1 1991 Reclamation Grant

In 1991, the Site was identified for reclamation under a US Department of the Interior (USDOI) Office of Surface Mining construction grant application for the NAML for fiscal year 1991 (USDOI, n.d.a). The date the grant was issued is unknown. The purpose of the grant was to provide financial funding to NAML for the construction phase of reclamation activities at four project areas, one of which included the Site, located within the Black Mesa Mining District. The Site was identified as NC-0701 in the grant application. The grant listed the following reclamation activities for areas that had open pits, of which the Site was one:

- Improve access roads leading to the site
- Determine the stability of the walls, floor conditions, and possible groundwater presence at the open pit
- Remove loose material from the highwalls for stabilization
- Remove any trash or contaminated materials if initial hydrological assessments indicated the presence of groundwater
- Backfill the open pit using uncontaminated material obtained from predesignated borrow areas to a level of 3 ft above the existing water table
- Backfill the remainder of the open pit to ground level using radiological material exceeding 200 microRoentgens per hour [μR/hr] first and then continue backfilling using material with descending radiological content
- Contour the backfilled area to blend with the natural topography
- Install appropriate drainages and terraces where erosion is probable
- Re-contour access roads and sparsely vegetate them
- Re-seed in disturbed areas and not on rocky cliff terrains

Reclamation activities were conducted in 1992 and 2000 as described in Sections 2.1.4.3 and 2.1.4.4.

2.1.4.2 1991 Archaeological Clearance Investigations

In 1991, an archival and ethnographic investigation was conducted by the Navajo Nation Archaeology Department at the Site to determine if archaeological clearance could be granted for the above listed reclamation activities to occur on Site (Martin, 1991). The Site was identified as Claim 28 and NC-0701 in the investigation report. The Navajo Nation Archaeology Department investigation resulted in archaeological clearance for reclamation activities to commence on-site.

2.1.4.3 1992 Reclamation Activities

Between June 1992 and October 1992, NAML oversaw reclamation activities at the Site. NAML reported the progress of the activities in field notes (NAML, 1992a). On October 6, 1992, NAML issued an internal memorandum detailing the progress of reclamation activities on-site (NAML, 1992b). The memorandum reported reclamation on-site was 98 percent complete, with the following details:

- The access road still needed to be partially re-contoured for future maintenance work.
- The total impacted area reclaimed was 20 acres, which included two rim strips (with associated trenches) and three pits.
- The north side of the site still needed to be revegetated. Revegetation was only on the north side because of the carbonaceous nature of the soil.
- The post-reclamation radiological survey was completed. Areas of high anomalies still needed to be addressed with clean material for top soil prior to revegetation.
- Rock riprap was installed and stabilized with concrete cement for erosion control.
- 4,995 cubic yards (yd^3) of contaminated material was used to backfill the pits and rim strip trenches.
- 1,173 yd^3 of material was used to upgrade the access road to the Site.
- 24,355 yd^3 of clean material was used for top soil and to stabilize the highwall.

2.1.4.4 2000 Reclamation Activities

In 2000, NAML identified the Site for additional reclamation of mine waste material. NAML issued an invitation for bids for the reclamation of 12 AUMs, referred to as the Mesa Grande Abandoned Mine Lands Reclamation (AMLR) Project (NAML, 2000). The 12 AUMs were divided between two project areas, depending on their location: The Black Mesa 2 AMLR Project or the Cove 3 AMLR Project. The Site was included in the Black Mesa 2 Project and was referred to in the bid document as NA-0701(the Site is also identified in the *2007 AUM Atlas* as NA-0701). The bid document stated that the Site had approximately 8,000 bank cubic yards (bcy) of waste material that needed to be excavated, buried, and covered with Class A material. The bid document included a historical drawing of the Site that showed the locations of work Area A (eastern mine waste burial pit), Area B (mesa bench and mesa sidewall), and Area C (mesa sidewall), the location of check dams, and the potential haul road. For comparison, the historical NAML drawing is presented next to a current image of the Site in Figure 2-2.

The bid document listed the following reclamation activities were needed for the Site:

- Excavate a burial pit 250 ft long by 100 ft wide by 3 ft deep in Area A and stockpile the excavated Class A material nearby the burial pit. Earthwork quantities for this work item were estimated to be 2,800 bcy. Class A material was defined in the bid document as: mine waste piles, overburden, subsoil, topsoil or other suitable backfill material with Ra-226 concentration equal to or less than the average Ra-226 concentration of the background area in the immediate vicinity of the project as computed from ground-contact radiological measurements. The material will be free from solid waste, hazardous waste, toxic waste, oil/grease, trash, vegetation, combustible materials and materials that retard vegetative growth.

- Excavate the uranium mine waste material from Area B and any other radioactive material from the slopes in Area C per the direction of the Project Representative. Haul and place the waste materials in Area A and compact them for burial in the burial pit. Earthwork quantities for this work item were estimated to be 8,000 bcy.

- Cover the deposited radioactive mine waste with the stockpiles Class A material spreading it in as uniform thickness as possible. The reclaimed surface should form a mound with side slopes no steeper than 3h:1v (horizontal to vertical). Cover any radioactive hot spots with Class A material. Earthwork quantities for this work item were estimated to be 2,800 bcy.

- Repair the riprap check dams located on the previously reclaimed Area B with 50 yd^3 of additional riprap.

- Total work quantity shall not exceed an estimated13,600 bcy of earthwork and 50 yd^3 of riprap.

A closeout report for the Black Mesa 2 Project, for the reporting period of April 1, 1997 through March 31, 2001, was issued by the USDOI Office of Surface Mining (USDOI, n.d.b). The date the closeout report was issued is unknown. The report stated that on February 15, 2001, the work at the Black Mesa Project sites (of which the Site was one) was completed by LC/TWC – A Joint Venture of Lansing Construction and Triad Western Constructors. The Black Mesa project was started on December 4, 2000 and ended on February 15, 2001. USDOI Office of Surface Mining issued a Notice of Final Acceptance on March 21, 2001 with a two-year warranty period until March 21, 2003.

2.1.4.5 1994 through 1999 Aerial Radiological Surveys

Between 1994 and 1999, aerial radiological surveys were conducted at 41 geographical areas within the Navajo Nation, including the Black Mesa East area, which included the location of the Site (Hendricks, 2001). The surveys were done at the request of the USEPA Region 9 and were performed by the Remote Sensing laboratory, a US Department of Energy facility, National Nuclear Security Administration Nevada Operations Office. The intent of the surveys was to characterize the overall radioactivity levels and excess bismuth-214 activity (i.e., an indicator of uranium ore deposits and/or uranium mines) within the surveyed areas. Data collected from the surveys was used to assess the risks (i.e., average gross exposure rate) in mined areas and determine what action, if any, was needed.

The aerial radiological survey for the Black Mesa East area covered approximately 72.56 square miles and included the location of the Site. The aerial radiological survey results for the area within a 0.25 mile radius of the Site indicated a gross exposure rate range of 7 μR/hr to 16 μR/hr and excess bismuth (i.e., bismuth activity greater than approximately 3.5 μR/hr) present in approximately 0.03 square miles (21.2acres) of the area within a 0.25 mile radius of the Site (*2007 AUM Atlas*). The aerial radiological survey results for the Black Mesa East area indicated a gross exposure rate range of 3.31 μR/hr to 30.51 μR/hr and excess bismuth (i.e., bismuth activity greater than approximately 3.5 μR/hr) present in approximately 0.36 square miles of the 72.56 square miles of the Black Mesa East flight area (Hendricks, 2001).

2.1.4.6 2011 Site Screening

In 2011, Weston performed site screening on behalf of the USEPA (Weston, 2011). The screening included: (1) recording site observations (i.e., number of homes, water sources, and sensitive environments[2] around the Site); (2) recording the type, number, and reclamation status of mine features; and (3) performing a surface gamma survey. Weston reported the Site was reclaimed and the area of the Site associated with USEPA mine identification #78 appeared to have waste rock scattered throughout the slope/bench area and below a potential adit. Weston also reported one home-site with three structures was within 0.25 miles of the Site, a residential pond was within a one-mile radius of the Site and located 0.25 miles southwest of the Site, and no sensitive environments. Based on Weston's performance of a surface gamma survey, it determined that the highest gamma measurements were greater than nine times the site-specific background level used for its gamma screening.

2.1.4.7 2013-2014 Study of Uranium in Soil, Mine Waste, and Spring Water

In 2013 and 2014, the University of New Mexico (UNM) Metal Exposure Toxicity Assessment on Tribal Lands in the Southwest (METALS) Center conducted a study of soil, "mine waste", and spring water in relation to the Site (Shuey, et al., 2014). The study was conducted based on Tachee/Blue Gap Chapter and Black Mesa Chapter community concerns about "possible ongoing release of hazardous substances from AUMs and possible contamination of water in a spring used by local families for drinking water".

One water sample, one soil sample, two "soil-waste mixture" samples, and one "non-impacted" sample were collected for the Study. The water sample was collected from a spring (locally called Waterfall Spring) located 3.1 miles northeast of the Site. The soil was collected from mine identification #79, the "soil-waste mixture" samples were collected from mine identification #78, and the "non-impacted" sample was collected from a background sample location approximately 0.5 mile southeast of the Site.

The water sample was analyzed for 27 analytes, including trace metals, major ions, and total dissolved solids (TDS) by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) consistent with

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[2] Weston defined sensitive environments as "all sensitive environments located within visible range of the mine site, including: wetlands, endangered species, habitats and approximate locations of sites that may be under protection of the government of the Navajo Nation"

USEPA standard methods. The metal content of soil and “soil-waste mixture” samples were determined by X-ray photoelectron spectroscopy (XPS) and X-ray fluorescence (XRF). A scanning electron microscope (SEM) was also used to examine the distribution, sizes, and composition of metal-rich particles within the soil and “soil-waste mixture” samples.

Shuey, et al. (2014) reported the water sample had uranium concentrations 2.3 times greater than the federal and tribal drinking water standard, and the “XPS and XRF analyses showed concentrations of uranium, vanadium, and arsenic in mine wastes exceeding both their respective crustal averages and local background in non-impacted soils”. Furthermore, Shuey, et al. (2014) reported that “preliminary SEM analyses indicated the wastes contained uranium-vanadium compounds on fine-grained particles that are vulnerable to re-suspension in windy conditions, posing a potential inhalation risk”.

2.1.4.8 2014-2015 Study of Chemical Interactions of Uranium and Co-occurring Metals

In 2014 and 2015, a study was conducted to assess the presence, chemical interaction, and mobility of uranium and other co-occurring metals in soils at the Site and in springs located adjacent to and nearby the Site (Blake et al., 2015). The study was conducted because “elevated concentrations of metals were of concern due to human exposure pathways and exposure of livestock that were ingesting water in the area”.

Four water samples and three “solid” samples were collected for the Study. Two water samples were collected from a seep located on-site and two water samples were collected from a spring (locally called Waterfall Spring) located 3.1 miles northeast of the Site. The solid samples were referred to for the study as mine waste 1 (MW1), mine waste 2 (MW2), and baseline reference soil (BRS). MW1and MW2 were “solid” samples collected on-site from an erosional channel that was eroding through “mine waste”. The BRS was a soil sample collected from “local range land that had not been impacted by mining activities” located approximately 1.24 miles from the Site. The BRS sample location direction from the Site was not provided in Blake et al (2015), nor was a map provided that showed the sample locations in relation to the Site.

Blake, et al. (2015) conducted spectroscopy, microscopy, diffraction, and aqueous chemistry analyses of the media samples to assess the chemical composition and structure of the “abandoned mine waste solids”. Results of the analyses showed concentrations of uranium in the water samples that were 2 to 5 times greater than the USEPA drinking water standard for uranium. As reported by Blake, et al. (2015), the “study demonstrates that mine wastes are significant potential sources of heavy metals that can be released rapidly in the water system and, hence, can present a major source of potential exposure to metals to people living close to abandoned mine waste sites.” Blake, et al. (2015) also reported that “the results from the study contribute to a better understanding of the metal contents of the wastes and the chemical interactions that affect metal occurrence and mobility.”

2.1.4.9 2017 Study of the Reactive Transport of Uranium and Vanadium from Abandoned Uranium Mine Wastes

In 2017, Avasarala, et al. (2017) published a paper reporting their findings on a study they conducted for the reactive transport of water-soluble uranium and vanadium from AUM wastes. The objective of the study was to investigate the reactive transport of uranium and vanadium from samples collected in relation to the Site "by integrating flow-through column experiments with reactive transport modeling, and electron microscopy…to better understand the mechanisms affecting the reactivity of mine wastes and the transport of uranium and vanadium under environmentally relevant conditions".

The study was conducted using the "soil-waste mixture" samples collected for the Shuey, et al. (2014) study and the baseline reference soil sample collected for the Blake, et al. (2015) study (refer to Sections 2.1.4.7 and 2.1.4.8). The samples were sequentially reacted in flow-through columns at pH 7.9 and pH 3.4 to evaluate the effect of environmentally relevant conditions encountered in relation to the Site on the release of uranium and vanadium.

Avasarala, et al. (2017) reported the results of the study suggested that the release of uranium and vanadium is affected by water pH and the crystalline structure of uranium-vanadium bearing minerals. Avasarala, et al. (2017) further stated that the information obtained from the study "can be useful to better understand the mobility of uranium and vanadium in neighboring community water sources to assess risks for human exposure. Additionally, the identification of factors affecting the dissolution of uranium-vanadium bearing minerals under environmentally relevant conditions evaluated in this study is relevant to inform remediation and resource recovery initiatives in sites where these uranium-vanadium bearing minerals are abundant".

2.2 PHYSICAL CHARACTERISTICS

2.2.1 Regional and Site Physiography

The Site is located within the Colorado Plateau physiographic province, which is an area of approximately 240,000 square miles in the Four Corners region of Utah, Colorado, Arizona, and New Mexico. Figure 2-3 presents a current regional aerial photograph (NAIP, 2018) of the Site within a portion of the Colorado Plateau. The Colorado Plateau is typically high desert with scattered forests and varying topography having incised drainages, canyons, cliffs, buttes, arroyos, and other features consistent with a regionally uplifted, high-elevation, semi-arid plateau (Encyclopedia Britannica, 2017). The physiographic province landscape includes mountains, hills, mesas, foothills, irregular plains, alkaline basins, some sand dunes, and wetlands. This physiographic province is a large transitional area between the semi-arid grasslands to the east, the drier shrub-lands and woodlands to the north, and the lower, hotter, less-vegetated areas to the west and south.

The Colorado Plateau includes the area drained by the Colorado River and its tributaries: the Green, San Juan, and Little Colorado Rivers (Kiver and Harris, 1999). The physiographic province is composed of six sections: Uinta Basin, High Plateaus, Grand Canyon, Canyon Lands, Navajo, and Datil-Mogollon. The Site is located within the Navajo section.

Figure 2-4 presents the regional US Geological Survey (USGS) topographic map of a portion of the Colorado Plateau in the vicinity of the Site. Figure 2-5 presents the Site topography (Cooper Aerial Surveys Company [Cooper; refer to Section 3.2.2.1]) within a portion of the Colorado Plateau. The Site is located on a mesa bench, mesa sidewall, foothills and valley bottom at an elevation range of approximately 6,750 to 7,000 feet above mean sea level (ft amsl) (refer to Figure 2-5).

2.2.2 Geologic Conditions

2.2.2.1 Regional Geology

Regionally the Site is located in the southwestern portion of the Colorado Plateau, on Black Mesa, which is within the Black Mesa structural basin area (USGS, 2000). The Black Mesa basin is a Laramide orogeny structure that is asymmetrical with a steep dip on the eastern flank and a gentler dip on the western margin, and is crossed by numerous small-scale folds. The basin is bounded by the Kaibab uplift to the west, the Defiance uplift to the east, the Monument uplift to the north, and the Mogollon slope to the south. Black Mesa is defined by prominent escarpments along its north and east sides that resulted from erosion of cliff forming strata, including the Late Jurassic Morrison Formation and Cow Springs Sandstone. Black Mesa is capped by resistant sandstone strata of the Late Cretaceous Yale Point, Wepo, and Toreva Formations. Black Mesa is roughly circular, approximately 65 miles in diameter, and covers an area of 3,300 square miles. Elevations range from approximately 6,000 ft amsl in the southwestern portion to 8,000 ft amsl along the northeastern escarpment. Black Mesa is a dissected mesa that rises as much as 2,000 ft above the surrounding terrain along its eastern margin, and slopes gently to the southwest, where the cliffs are between 200 ft and 300 ft high. The top of Black Mesa slopes gently to the southwest, tending to expose younger strata in higher areas to the north and northeast and gradually older strata to the southwest.

Black Mesa bedrock consists of the Lower and Upper Cretaceous Mancos Shale and the Upper Cretaceous Mesaverde Group (Scarborough, 1981). These geologic formations represent a complex inter-tonguing of marine and non-marine depositional environments (Chenoweth, 1990). Figure 2-6 depicts a regional geology map showing the Site in relation to the regional extent of the Cretaceous Formations. Regionally the Mesaverde group, where the Site is located, can be further subdivided into the Toreva and Wepo Formations, where uranium deposits occur within the fluvial upper sandstone of the Toreva Formation. The Toreva Formation consists of 25 ft to 120 ft of very coarse to fine-grained arkosic to subarkosic sandstone that grades upward into coal, carbonaceous shale, siltstone, and finer grained sandstone in the overlying carbonaceous member of the Wepo Formation. Regionally the Toreva Formation is the largest uranium producer from the Black Mesa area (Scarborough, 1981). All of the known ore deposits lie above the regional water table and are oxidized (Chenoweth, 1990).

2.2.2.2 Site Geology

Bedrock outcrops on or adjacent to the Site consist of Toreva Formation and Mancos Shale, as shown in Figure 2-7a. The Toreva Formation consists of light-brown and yellowish-gray fine- to coarse-grained sandstone and lesser amounts of gray siltstone and carbonaceous shale. The Mancos Shale consists of predominantly light- to dark-gray marine shale with subordinate tan fine-grained sandstone and siltstone and sand-bedded or concretionary limestone with locally discontinuous coal seams. Uranium was located at the Site in carnotite within the Toreva sandstone, beneath the carbonaceous siltstone (Scarborough, 1981). Of the mines that were producing uranium from the Toreva Formation, the Site was the largest uranium producer (Scarborough, 1981). A geologic profile of the geologic formations forming the mesa bench, mesa sidewall, foothills, and valley bottom is shown in Figure 2-6a. Shallow or outcropping mineralized bedrock on Site is shown in Figure 2-7b.

Unconsolidated deposits on-site (i.e., Quaternary deposits) are eolian deposits, alluvium, and colluvium consisting of organic soil and poorly and well graded sand and silt, with varying amounts of clay and gravel, as shown on the borehole logs in Appendix C.2. During the Site Characterization field activities, boreholes were advanced through the unconsolidated deposits using either a 3-inch diameter hand auger or a Geoprobe™ 8140LC rotary sonic drilling rig (refer to Section 3.3.2.2 and the borehole logs in Appendix C.2). The unconsolidated deposits ranged in depth from 0.25 ft to 34.0 ft below ground surface (bgs) at borehole locations.

A cross-section for the Site was produced (refer to Figure 2-8) that shows the extent and orientation of the consolidated and unconsolidated deposits coincident with earthworks related to the eastern reclamation mine waste burial pit (refer to Figure 2-2 and Section 2.1.4). The boreholes located closest to the cross-section line were used to generate the cross-section figure and all boreholes were used to determine the average unconsolidated material depth to assist with projecting depth to bedrock in relation to the cross-section.

According to the US Department of Agriculture (USDA) Soil Survey for parts of Apache and Navajo Counties, Arizona, soils on-site that have not been disturbed, are classified as Arabrab-Vessilla-Lindrith soil complex consisting of eolian deposits derived from sandstone over alluvium derived from sandstone and shale (USDA, 2006).

2.2.3 Regional Climate

The Colorado Plateau is located in a zone of arid temperate climates characterized by periods of drought and irregular precipitation, relatively warm to hot growing seasons, and winters with sustained periods of freezing temperatures (National Park Service, 2017). The average monthly high temperature at weather station 020800, Black Mountain Mission, Arizona (Western Regional Climate Center, 2017) located approximately 8 miles south of the Site, ranges between 38.4 degrees Fahrenheit (°F) in January to 89.6°F in July. Daily temperature extremes reach as high as 99°F in summer and as low as -16°F in winter. Black Mountain Mission receives an average annual precipitation of 8.3 inches, with August being the wettest month, averaging 1.82 inches, and May being the driest month, averaging 0.12 inches.

Potential evaporation in the area is greater than the area's average annual precipitation. The potential evaporation noted at the Many Farms School, Arizona weather station, located approximately 17 miles northeast of the Site, averages 91 inches of pan evaporation annually (Western Regional Climate Center, 2017). Average wind speeds in the area are generally moderate, although relatively strong winds often accompany occasional frontal activity, especially during late winter and spring months. Blowing dust, soil erosion, and local sand-dune migration/formation are common during dry months. The Window Rock, Arizona airport located 61 miles to the southeast of the Site, had the most complete record of wind conditions. A wind rose for the Window Rock, Arizona airport is presented on Figure 1-1. The wind rose was produced using data contained in the *2007 AUM Atlas* for the years 1996 to 2006. Predominant winds were from the southwest and south (refer to the wind rose on Figure 1-1).

2.2.4 Surface Water Hydrology

The Site is located within the Little Colorado River Valley watershed, an area of approximately 27,000 square miles spanning Arizona and New Mexico, as shown in Figure 1-1. On-site overland surface water flow, when present, is controlled by a decrease in elevation to the southwest from the mesa top to the valley bottom (refer to Figures 2-4, 2-9a, and 2-9b).

Several ephemeral drainages are present on-site that drain to the southwest until they drain under Baird Route 29 and then drain southeast, as shown in Figures 2-1 and 2-9a. A diversion drainage and culverts were placed along Baird Route 29 to channel water from the Site toward an engineered drainage channel located south of Baird Route 29. One of the drainages (north of claim #79) previously crossed the road near the home-site and terminated in the pond. However, during RSE activities Stantec field personnel (field personnel) observed the drainage was now diverted southeast along Baird Route 29 to a culvert, placed under Baird Route 29, and into the engineered drainage. One drainage terminates in a pond. The other two drainages drain through the culverts placed under Baird Route 29, and into the engineered drainage channel. The seep and areas of the drainage located west of the berms on the mesa bench were deeply incised, up to approximately 10 ft bgs where it flows from the mesa bench to the mesa sidewall and up to 15 ft bgs on the valley bottom, close to the mesa sidewall.

Adkins Consulting Inc. (Adkins), under contract to Stantec, performed a wildlife evaluation as part of the Site Clearance field investigations and did not identify any wetlands, seeps, springs, or riparian areas within the Site (refer to Appendix E).

2.2.5 Vegetation and Wildlife

In April 2016, Adkins conducted a wildlife survey, as part of Site Clearance activities. A vegetation survey was not required for the Site (refer to Section 3.2.2.3). Information about the wildlife survey is provided in Appendix E, which includes the Site biological evaluation reports and the *Navajo Nation Department of Fish and Wildlife* (NNDFW) *Biological Resources Compliance Form*. A summary of the survey activities and findings are provided in Section 3.2.2.3.

Vegetation communities found within the physiographic transitional area described in Section 2.2.1 include shrublands with big sagebrush, rabbitbrush, winterfat, shadscale saltbush, and greasewood; and grasslands of blue grama, western wheatgrass, green needlegrass, and needle-and-thread grass. Higher elevations may support pinyon pine and juniper woodlands. The vegetation communities' on-site included sagebrush and scattered pinyon pine and juniper (refer to Appendix E). During the surveys, Stantec and/or its subcontractors observed on-site wildlife including common raven, cottontail rabbit, coyote, mule deer, turkey vulture, red-tailed hawk, American kestrel. A golden eagle was observed approximately one mile south of the Site and a ferruginous hawk pair were observed approximately 0.5 miles north of the Site (refer to Appendix E).

2.2.6 Cultural Resources

In April 2016, as part of Site Clearance activities, Dinétahdóó Cultural Resource Management (Dinétahdóó), under contract to Stantec, conducted a cultural resource survey, as well as ethnographic and historical data reviews, and interviewed local residents living near the Site (Dinétahdóó, 2016). The local residents recalled that mining occurred at the open pit on-site in the 1950s. They stated that a bull dozer driver scraped the mesa-top to bedrock and then miners would drill and set off explosive charges. After the charges were set off the miners would shovel the ore into wheelbarrows and push the ore to a stockpile area. From the stockpile area, a loader operator would then load the ore into small trucks used to haul the ore down the mesa. The residents also recalled that the miners worked small holes along the mesa sidewall with picks, pry-bars, and shovels.

During the 2016 cultural resource survey Dinétahdóó identified one archaeological site, one isolated occurrence, and one traditional cultural property (TCP). Appendix E includes a copy of the *Cultural Resource Compliance Form,* and findings of the cultural resource survey are summarized in Section 3.2.2.4.

2.2.7 Observations of Potential Mining and Reclamation

During RSE activities, field personnel observed the following features indicative of potential mining or reclamation activities at the Site: berms, potential haul roads, mine waste burial pits, mining/reclaimed disturbed areas, and an exploration area.

On March 21, 2017 representatives from NAML met on-site with field personnel to verify what/where reclamation activities had occurred. NAML verified the following (refer to Figure 2-2):

- Mine waste material from accessible areas of the slopes and benches of the mesa sidewall was removed and placed in the eastern mine waste burial pit.
- The location of the Area A/eastern mine waste burial pit where mine waste material from the mesa sidewall was buried. NAML estimated the mine waste burial pit thickness as approximately 15 ft.

- Confirmation that NAML was not aware of what was buried in the western mine waste burial pit.

- The potential haul road on the mesa sidewall was destroyed by NAML.

- A shallow pit (less than 10 ft deep) was present on the west side of the mesa bench. Nearby mine waste material was used to backfill the pit and then clean cover material was put in place. The area was then re-vegetated. The location of the historical pit is shown in Figures 2-9a and 2-9b.

- Historical reclamation documents and notes mention more than one pit (pits) and rim strip trenches. The presence of one reclaimed pit was discussed with NAML on-site, additional pits and/or rim strip trenches were not discussed with NAML.

- The east side of the mesa bench was scraped and furrowed with weathered bedrock exposed at the surface. The area was not re-vegetated and there was little to no vegetative growth in that area (potentially as the result of the aforementioned carbonaceous soil).

Details regarding these observations are presented in Section 3.2.2.1. These observations and NAML confirmations were used, along with additional lines of evidence (refer to Section 3.3.3), to identify areas at the Site where TENORM was present (refer to Section 4.6).

3.0 SUMMARY OF SITE INVESTIGATION ACTIVITIES

3.1 INTRODUCTION

This section summarizes Site Clearance and RSE activities conducted between August 2015 and October 2017. The purpose of the RSE activities was to review relevant information and collect data related to historical mining activities to support future Removal or Remedial Action evaluations for the Site. Site Clearance activities were conducted before RSE activities to obtain information necessary to develop the *RSE Work Plan*. Site Clearance activities were performed in accordance with the approved *Site Clearance Work Plan.* RSE activities were performed in accordance with the approved *RSE Work Plan.* The RSE is not intended to establish cleanup levels or determine cleanup options or potential remedies.

The *RSE Work Plan* is comprised of a Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), Health and Safety Plan (HASP), and a Data Management Plan (DMP). The FSP guided the fieldwork by defining sampling and data-gathering methods. The QAPP presented quality assurance/quality control (QA/QC) requirements designed to meet Data Quality Objectives (DQOs) for the environmental sampling activities. The HASP listed site hazards, safety procedures and emergency protocols. The DMP described the plan for the generation, management, and distribution of project data deliverables. The FSP, QAPP, HASP, and DMP provided the approved requirements and protocols to be followed for the RSE data collection, data management, and data analyses performed to develop this RSE report. Any deviations or modifications from the *RSE Work Plan* are described in the appropriate RSE report sections.

The RSE process followed applicable aspects of the USEPA DQO Process and *MARSSIM*, to verify that data collected during the RSE activities would be adequate to support reliable decision-making (USEPA, 2006). The USEPA DQO Process is a series of planning steps based on the scientific method for establishing criteria for data quality and developing survey designs. *MARSSIM* provides technical guidance on conducting radiation surveys and site investigations.

The USEPA DQO Process is a seven-step process[3] that was performed as part of the *RSE Work Plan* to identify RSE data objectives. The goal of the USEPA DQO Process is to minimize expenditures related to data collection by eliminating unnecessary, duplicate, or overly precise data and verifies that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. It provides a systematic procedure for defining the criteria that the survey design should satisfy. This approach provides a more effective survey design combined with a basis for judging the usability of the data collected (USEPA, 2006).

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[3] (1) State the problem; (2) Identify the goals of the study; (3) Identify the information inputs; (4) Define the boundaries of the study; (5) Develop the analytical approach; (6) Specify the tolerance on decision errors; and (7) Optimize sampling design (USEPA, 2006).

The USEPA DQO Process performed for the RSE is presented in the *RSE Work Plan*, Section 3, and identifies the purpose of the data collected as follows:

1. Background reference area soil sampling, laboratory analyses, surface gamma surveying, and subsurface static gamma measurements to establish background analyte concentrations and gamma measurements, which will be used as the ILs, for the Site.
2. Site sampling (soil and sediment), laboratory analyses, surface gamma surveying, and subsurface static gamma measurements for comparison with ILs, to define the lateral and vertical extent of contamination at the Site to characterize the Site to support future Removal or Remedial Action evaluations.

The USEPA DQO Process was used in conjunction with *MARSSIM* guidance for RSE planning and data collection. Per *MARSSIM* guidance, "planning radiation surveys, using the USEPA DQO Process, can improve radiation survey effectiveness and efficiency, and thereby the defensibility of decisions" (USEPA, 2000).

The applicable aspects of *MARSSIM* incorporated into the RSE process include:

- Historical site assessment
- Determining RSE DQOs
- Selecting background reference areas
- Selecting radiation survey techniques
- Site preparation
- Quality control
- Health and safety
- Survey planning and design
- Baseline surface gamma surveys and subsurface static gamma measurements
- Field measurement methods and instrumentation
- Media sampling and preparation for laboratory analyses

The RSE process also used applicable aspects of *MARSSIM* for interpretation of the RSE results, including:

- Data quality assessment through statistical analyses
- Evaluation of the analytical results
- Quality assurance and quality control

Sections 3.2 and 3.3 summarize the field investigation methods and procedures for data collection during the Site Clearance activities and the RSE activities, which are described in detail in the *RSE Work Plan,* Section 4. Appendix A includes the radiological characterization report prepared by Environmental Restoration Group, Inc. (ERG), under contract to Stantec. Appendix B includes photographs of features at the Site and the surrounding area, Appendix C.1 includes field forms, Appendix C.2 includes borehole logs, and Appendix C.3 includes water sample field forms.

3.2 SUMMARY OF SITE CLEARANCE ACTIVITIES

The Site Clearance activities consisted of two tasks: a desktop study and field investigations. The desktop study was completed prior to field investigations, and the findings of the desktop study were used to guide field investigations. The Site Clearance activities are detailed in the *Site Clearance Data Report* and are described below.

3.2.1 Desktop Study

The desktop study included:

- Review of historical aerial photographs (USGS, 2016). Photographs were selected based on sufficient scale, quality, resolution, and whether the photograph met one or more of the following criteria:
    - Showed evidence of active mining or grading of the Site, or provided information on how the Site was developed or operated (e.g., haul roads and open pits).
    - Showed evidence of reclamation (e.g., soil covers).
    - Showed significant changes in ground cover compared to current photographs.
- Review of current aerial photographs for identification of buildings, homes and other structures, and potential haul roads within 0.25 miles of the Site.
- Review of topographic and geologic maps.
- Review of information related to surface water features and water wells on the Navajo Nation within a one-mile radius of the Site, provided by: (1) the Navajo Nation Department of Water Resources (NNDWR); and (2) ESRI Shapefiles data contained in the *2007 AUM Atlas*.
- Review of previous studies, information related to potential past mining, and reclamation activities.
- Identification of the predominant wind direction in the region of the Site.

Based on the list above, the following findings were identified during the desktop study:

- Historical photographs (USGS, 2016) for the Site were selected from 1952, 1966, 1967, 1971, 1997, and 2005 for comparison against a current 2017 image (Cooper, 2017). The selected historical photographs are shown in Figure 3-1a. Figure 3-1b compares the aerial photograph from 1952 and the current 2017 image and Figure 3-1c compares the aerial photograph from 1966 and the current 2017 image. The 1952 image shows the Site before mining occurred, the 1966 image shows the Site during mining operations, and the current image shows the Site after reclamation. The grid of east to west-trending roads in the exploration area were developed between 1967 and 1971.

- The current aerial photograph review confirmed the Site was uninhabited, but one home-site is located southwest of and within 0.25 miles of the Site, as shown in Figure 2-1. Numerous dirt roads were identified within 0.25 miles of the Site, refer to Figures 2-1 and 2-3. The road type (i.e., potential haul road or road unrelated to historical mining) was identified by the current aerial photograph review, historical document review, and visual identification during the Site Clearance field investigations (refer to Section 3.2.2.1).

- Two water features were identified within a one-mile radius of the Site based the review of information provided by the NNDWR and the *2007 AUM Atlas,* refer to Table 3-1a, Table 3-1b, and Figure 2-1.

- The predominant regional winds were from the southwest and south (refer to Section 2.2.3 and Figure 1-1).

Previous studies and information related to past mining/reclamation are discussed in Sections 2.1.1 and 2.1.4.

3.2.2 Field Investigations

3.2.2.1 Site Mapping

The *Site Clearance Work Plan* specified that the following features at and near the Site, if present, should be mapped, marked, and/or their presence confirmed:

- Claim boundaries and the 100-ft buffers of the claim boundaries

- Roads, fences/gates, utilities: haul roads to a distance of 0.25 miles or to the intersection with the next major road, whichever is closer

- Structures, homes, buildings, livestock pens, etc.

- Surface water and water well locations: surface water channels that drain the Site to a distance of 0.25 miles away from the Site or to the confluence with a major drainage, whichever is closer; surface water features and water wells identified within a one-mile radius of the Site

- Topographic features

- Potential background reference areas

- Type of ground cover, including rock, soil, waste rock, etc.

- Physical hazards

Based on the list above, the following site features were mapped during field investigations:

- Claim boundaries – 100-ft buffers of the claim boundaries, as shown in Figure 2-9a, were marked in the field with stakes and/or flagging and mapped with a global positioning system (GPS).

- Drainages – Several ephemeral drainages were mapped, as shown in Figures 2-1 and 2-9a. The drainages drained to the southwest until they drained under Baird Route 29 and then they drained southeast. A diversion drainage and culverts were placed along Baird Route 29 to channel water from the Site toward an engineered drainage channel located south of Baird Route 29. One of the drainages (north of claim #79) previously crossed the road near the home-site and terminated in the pond. It was diverted southeast along Baird Route 29 to a culvert, placed under Baird Route 29, and into the engineered drainage. One drainage terminated in a pond, and the other two drainages drained through the culverts, placed under Baird Route 29, and into the engineered drainage channel. Drainages are shown in Appendix B-1 photograph numbers 2, 7, 9, and 10, and Appendix B-2 photograph numbers 16, and 17. The pond where one of the drainages terminated is shown in Appendix B-2 photograph number 18. Areas of the seep and drainage located west of the berms on the mesa bench and the mesa sidewall were deeply incised up to approximately 10 ft bgs where it flows from the mesa bench to the mesa sidewall and up to 15 ft bgs on the valley bottom, close to the mesa sidewall.

- Topographic features – The mapped area can be divided into five topographic areas: the (1) mesa top; (2) mesa sidewall (i.e., vertical cliffs and steep colluvium-covered bedrock slope); (3) mesa bench (i.e., a shelf-like feature that occurs along the mesa sidewall); (4) foothills; and (5) valley bottom, as shown in Figure 2-5. The mesa top is somewhat distinctive at the Site because it is not a flat surface that is typically associated with a mesa. Instead, the mesa top is characterized by an undulating surface that is the result of a north-trending monocline that was superimposed on the mesa structure. These undulations continue into the valley bottom, forming the small foothills that are located at the base of the mesa, just east of the claim boundary. The Site is located primarily on the mesa bench, sidewall, and on the valley bottom.

- Mine waste burial pits – Two mine waste burial pits were mapped, as shown in Figures 2-9a and 2-9b. The easternmost mine waste burial pit was coincident with Area A of the reclamation, as shown in Figure 2-2 and discussed in Section 2.1.4. The eastern mine waste burial pit was placed in an east-west trending minor drainage (approximately 300 ft long) that drained to the drainage channel that ran along the southeast 100-ft claim buffer. A berm was present in the area of the western mine waste burial pit, portions of it were surrounded by a fence, and it was assumed to also be related to the reclamation that occurred on-site. The mine waste burial pits are also shown as part of the earthworks in Figures 2-7a and 2-7b. The western mine waste burial pit is shown in Appendix B-1 photograph number 3. The eastern mine waste burial pit is shown in Appendix B-1 photograph numbers 11 and 15.

- Berms – Berms were mapped, as shown in Figure 2-9a and 2-9b. The berms were located along the eastern claim boundaries of both claim #78 and claim #79 and were used to slow storm water runoff to prevent erosion on the mesa bench and the mesa sidewall. The berm along the eastern claim boundary of claim #79 was also along the eastern boundary of the western mine waste burial pit. The check dams installed by NAML along the eastern boundary of claim #78 were mapped as berms. Berms are shown in Appendix B-1 photograph numbers 6, 8, and 14.

- Exploration area – The exploration area north of the Site was identified by a grid of east to west-trending roads, as shown in Figure 2-9a. Installation of the roads in the exploration area occurred between 1967 and 1971 (refer to Figure 3-1a). Drilling-related disturbances (e.g., boreholes and/or piles of drill cuttings) were not observed by field personnel within the exploration area. Field personnel also did not observe waste piles or reclamation features in the exploration area. The exploration area roads are also shown as part of the earthworks in Figures 2-7a and 2-7b.

- Mining/reclaimed disturbed area – A mining/reclaimed disturbed area was mapped for areas that were actively disturbed by mining and/or reclamation activities, as shown in Figures 2-9a and 2-9b. The area was coincident with Area B of the reclamation, as shown in Figure 2-2 and discussed in Section 2.1.4. The mining/reclaimed disturbed area is also shown as part of the earthworks in Figures 2-7a and 2-7b. A portion of the mining/reclaimed disturbed area is shown in Appendix B-1 photograph number 12. On the mesa bench the western portion includes cover material that was revegetated, and the eastern portion was scraped and furrowed to weathered bedrock. Large impassable erosional runnels were present on the mesa sidewall.

- Potential mine waste material – Potential mine waste material was mapped along the mesa sidewall where mine waste was transported from areas that were actively disturbed by mining, as shown in Figures 2-9a and 2-9b. The area of the potential mine waste material included areas downslope of the potential haul road and a portion of the sidewall where mine waste may have been pushed off the mesa bench (northern portion of the polygon). The potential mine waste material was mapped based on field personnel observations of color changes of sediments (e.g., the dark sediments in the western corner of claim #78) and erosion along the mesa sidewall. The potential mine waste material was not shown as part of the earthworks in Figures 2-7a and 2-7b because it was uncertain whether the material was present due to natural mass wasting, being bulldozed off of the mesa bench, or a mixture of both.

- Potential haul roads – Potential haul roads were mapped, as shown in Figures 2-1, 2-4, 2-9a, and 2-9b. Two potential haul roads ran from Baird Route 29 to claim #79 and one of the mine waste burial pits, and then converge into one road on the foothills. The area of the potential haul road that ran along the mesa sidewall from the portion of the mining disturbed area south of the seep to the mesa bench was removed during reclamation and was inaccessible in places due to erosion on the mesa sidewall. A third potential haul road branched several times and ran along the mesa bench, and through the exploration area and the mining/reclaimed disturbed area. The potential haul roads are also shown as part of the earthworks in Figures 2-7a and 2-7b. A view of the re-claimed potential haul road is shown in Appendix B-1 photograph numbers 4 and 5.

- Former retention pond – A former retention pond was mapped, as shown in Figure 2-9a and 2-9b. The pond was dry during RSE activities, but likely collects water during storm events. The high watermark on the pond suggested that the pond was 100 ft in diameter and less than five ft deep when filled with water. The former retention pond is shown in Appendix B-1 photograph number 13.

- Structures – The Site is currently uninhabited, but one home-site was located southwest of and within 0.25 miles of the Site, as shown in Figure 2-1.
- Utilities – A power line was mapped, as shown in Figure 2-9a. The power line was located near the home-site.
- Water Features – Field personnel assessed the two water features identified during the desk top study and findings are summarized in Table 3-1a. In addition, during site mapping activities field personnel identified a seep located near the southeast portion of the claim #78 boundary, refer to Table 3-1a and Figure 2-1 location S078-Seep-1. The seep daylighted on the mesa side wall along a geologic contact. The area where water daylighted was approximately 50 ft wide.

Field personnel did not observe the potential adit reported by Weston (2011) or the two rim strips and three pits discussed in Section 2.1.4. The rim strips and pits were not observed because they were reclaimed. In addition, the *2007 AUM Atlas* identified a pit and a waste pile on-site; these features were not observed by field personnel. Field personnel did observe a berm in the same area as the waste pile but did not observe a pit. This is likely because the *2007 AUM Atlas* located the pit in the mining/reclaimed disturbed area.

In June 2018, the USEPA provided the Trust with a copy of a NNDWR database that was generated in 2018. The USEPA stated that there were discrepancies between the NNDWR water feature locations in the 2018 database and those provided in the 2016 NNDWR database used by the Trust. This information was provided after Site Characterization activities had occurred and was therefore not included in the RSE for the Site. Comparison of the 2018 NNDWR dataset against the *2007 AUM Atlas* will require addition field work and it is recommended that this be addressed in future studies for the Site.

In addition to the Site mapping activity, the Trust took high-resolution aerial photographs and collected topographic data at the Site. The objective of the high-resolution aerial photography survey was to develop orthophotographs and topographic data of the Site to:

- Assist with identifying ground cover (e.g., soil versus bedrock)
- Assist with delineating historical mine features (e.g., haul roads, portals, and waste piles)
- Allow additional evaluation of areas that were inaccessible due to steep or unsafe terrain
- Provide site base maps (high resolution imagery and elevation data) that could be used to support future Removal or Remedial Action evaluations at the Site

Stantec proposed to perform aerial photography in order to provide an overview of the Site and identify features that could not otherwise be accomplished safely on foot. USEPA is not authorized to allow drones on sites it oversees: therefore, drone use was not an option. Although aerial photography was not included in the approved *Scope of Work* (MWH, 2016d), the Trustee notified the Agencies and obtained approval prior to commencement of the work. The Trust also consulted with Tachee/Blue Gap Chapter officials and nearby residents and notified them of the aerial photography survey. On June 16, 2017 Cooper flew over the Site in a piloted fixed-wing aircraft and collected 3.5-centimeter digital color stereo photographs of the Site. Cooper provided the following data:

- Digital, high-resolution color orthophotograph imagery
- AutoCAD files (2-dimensional and 3-dimensional) that included elevation contours (refer to Figure 2-4) and plan features
- Elevation point files
- Triangular Irregular Network surface files

The site orthophotographs and supporting data files were used for data analyses, including estimating volumes of potentially mining-impacted material at the Site. They also were used as the base image for selected figures included in this RSE report, to the extent applicable.

3.2.2.2 Potential Background Reference Area Evaluation

The desktop study findings and field investigation observations were used to identify two potential background reference areas (BG-1 and BG-2) for the Site, as shown in Figure 3-2 and described in Appendix D.1. BG-1 and BG-2 were also selected as suitable surface background reference areas for the Site for the following reasons:

- BG-1 encompassed an area of 816 ft^2 (approximately 0.02 acres), was located 1,170 ft west of claim #79, was cross-wind and hydrologically cross-gradient from the Site and was across a drainage. The soils, limited colluvium, and bedrock outcrops represented the lower mesa sidewall and foothills areas of the Site within the Mancos Shale and the transition to undifferentiated Quaternary deposits on the valley floor. The vegetation and ground cover at BG-1 were similar to the Site.
- BG-2 encompassed an area of 1,229 ft^2 (approximately 0.03 acres), was located 1,220 ft northwest of claim #79, and was cross-wind and hydrologically cross-gradient from the Site. The thin soils, colluvium, and bedrock outcrops represented the Toreva Formation. The vegetation and ground cover at BG-2 were similar to the mesa top, mesa bench, and portions of the mesa sidewall.

Of note, based on review of the RSE results it was determined that mining-related impacts extend further along the valley bottom than was originally assumed. Based on these findings, the lack of a background reference area for the Quaternary deposits was identified and is included as a data gap in Section 4.10.

The potential background reference areas were selected based on *MARSSIM* guidance (i.e., similar geology and ground conditions, distance from the Site, etc.) to:

1. Represent undisturbed conditions at the Site (e.g., pre-mining conditions)
2. Provide a basis for establishing the ILs

The approved *RSE Work Plan* did not specify any minimum or maximum size criteria for these areas. Stantec does not view the size of the selected background reference areas as affecting the validity of the background concentrations. The sizes were based on professional judgment that the identified areas were generally representative of the Site

The background reference areas were selected in areas outside of the Site that were considered to be representative of the general conditions observed at the Site. However, an important consideration is that the background gamma radiation and metals concentrations within soil and bedrock can be variable and often contain a wider range of concentrations, than what was measured at the selected background reference areas. The ILs derived from the background reference areas provided a useful reference for comparison to the Site. However, it will be important to consider the variations in concentrations when conducting future site assessment work and/or to support future Removal or Remedial Action evaluations at the Site.

3.2.2.3 Biological Surveys

The objective of the biological surveys was to determine if identified species of concern or potential federal or Navajo Nation Threatened and Endangered (T&E) species and/or critical habitat are present on or near the Site. Biological (vegetation and wildlife) clearance was required at the Site before RSE activities could begin to determine if the RSE activities could affect potential species of concern or federal or Navajo Nation listed T&E species and/or critical habitat. The Site biological evaluation reports, the *NNDFW Biological Resources Compliance Form*, and the US Fish and Wildlife Service (USFWS) consultation email are provided in Appendix E.

The Federal Endangered Species Act (ESA) of 1973, 16 United States Code (USC) §1531 et seq., requires that each Federal agency confer with the USFWS on any agency action that is likely to jeopardize the continued existence of any proposed T&E species or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (15 USC §1531(a)(2); USFWS, 1998). An "action area", as defined in the regulations implementing the ESA, includes "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.2; USFWS, 1998).

The vegetation and wildlife surveys were conducted according to guidelines of the ESA and the NNDFW-Navajo Natural Heritage Program (NNHP), including the procedures set forth in the Biological Resource Land Use Clearance Policies and Procedures, RCS-44-08 (NNDFW, 2008), the Species Accounts document (NNHP, 2008), and the USFWS survey protocols and recommendations (USFWS, 1996).

Based on the results of the vegetation and wildlife surveys, the NNDFW's opinion was that the RSE Baseline Studies and Site Characterization Activities,

> "with applicable conditions, [were] in compliance with Tribal and Federal laws protecting biological resources including the Navajo Endangered Species and Environmental Policy Codes, US Endangered Species, Migratory Bird Treaty, Eagle Protection and National Environmental Policy Acts".

A copy of the *NNDFW Biological Resources Compliance Form* is included in Appendix E. In addition, after the Trust submitted the results of the biological survey, USEPA consulted with John Nystedt of the USFWS on August 26, 2016, and received an email response on August 29, 2016 stating:

> "Based on the information you [Stantec] provided [i.e., there is no habitat for any Federally listed species in the action area], we [the USFWS] believe no endangered or threatened species or critical habitat will be affected by the project; nor is this project likely to jeopardize the continued existence of any proposed species or adversely modify any proposed critical habitat" (Nystedt, 2016).

A copy of the Nystedt email is included in Appendix E. In light of the results of the biological surveys described below, the USFWS recommended no further action from the USFWS for the project unless the project or regulations change, or a new species is listed.

Vegetation Survey - In preparation for the vegetation survey, Redente Ecological Consultants (Redente) submitted data requests for species of concern to the NNDFW-NNHP, and for Federal T&E species, to the USFWS. The NNDFW-NNHP responded to MWH by letter dated November 19, 2015. A copy of this letter is included in Appendix E. The letter stated that no species of concern were known to occur within the proximity of the Site. Therefore, a vegetation survey was not required for the Site. Based on the data request results, Redente also completed a desktop vegetation assessment for the Site and concurred with NNDFW-NNHP and USFWS findings.

Wildlife Survey - In April 2016, Adkins performed a wildlife evaluation survey as part of the Site Clearance field investigations. The completed wildlife survey, including the *NNDFW Biological Resources Compliance Form*, are included in Appendix E and are summarized below.

Adkins performed the survey under a permit issued by NNDFW for the purpose of assessing habitat potential for ESA-listed or Navajo Nation Endangered Species List (NNESL) animal species. Adkins biologists with experience identifying local wildlife species led the field survey, which consisted of walking transects 10 ft apart throughout the Site, including a 100-ft buffer beyond the claim boundaries. The surrounding areas were visually inspected with binoculars for nests, raptors, or signs of raptor use.

The wildlife evaluation was performed for species listed as NNESL, Federally Endangered, Federally Threatened, or Federal Candidate, and species protected under the Migratory Bird Treaty Act (MBTA) that have the potential to occur on-site. Prior to the start of the wildlife survey, Adkins submitted data requests to USFWS and NNDFW for animal species listed under the ESA. The NNESL species were further classified as G2, G3, or G4. The USFWS included eight ESA-species with the potential to occur in the area of the Site; three birds (California Condor, Mexican spotted owl, and western yellow-billed cuckoo), two fish (roundtail chub and Zuni bluehead sucker), two mammals (black-footed ferret and gray wolf), and one reptile (northern Mexican garter snake). The NNDFW included: four birds (mountain plover [G4], golden eagle [G3], ferruginous hawk [G3], and American peregrine falcon [G4]), and one mammal (banner tailed kangaroo rat [G4]). All species on the USFWS list and all species from the NNDFW list, with the exceptions of the golden eagle and ferruginous hawk, were eliminated from further evaluation because there was no potential for those species to occur on the Site due to lack of suitable habitat. Based on the preparation data, two birds remained as species of concern warranting further analysis during the survey: golden eagle and ferruginous hawk.

In addition, Adkins reviewed species protected under the MBTA that have the potential to occur in the area of the Site. The MBTA review resulted in the potential for identification of 16 bird species in addition to those listed above, known as priority birds of conservation concern with the potential to occur in the areas of the Site: black-throated sparrow, Brewer's sparrow, gray vireo, loggerhead shrike, mountain bluebird, mourning dove, sage sparrow, sage thrasher, scaled quail, Swainson’s hawk, vesper sparrow, bald eagle, Bendire’s thrasher, pinyon jay, prairie falcon, and western burrowing owl. These 16 MBTA bird species were added for further analysis during the survey for effects to potential habitat.

The wildlife survey revealed two NNESL species of concern that had the potential to occur within or near the Site based on habitat suitability or actual recorded observation: golden eagle and ferruginous hawk. Based on these findings Adkins recommended the use of best management practices to protect potential habitat during RSE activities, specifically: (1) confining equipment travel to within the boundaries of the Site; (2) minimizing travel corridors as much as possible; (3) limiting truck and equipment travel within the Site when surfaces are wet and soil may become deeply rutted; and (4) using previously disturbed areas for travel when possible. The recommended best management practices were followed to protect potential habitat during RSE activities. In addition to these recommendations, Adkins also recommended that additional surveys may need to be performed at the cliffs located within 0.25 miles of the Site, if RSE activities: (1) involved large groups of people and vehicles (greater than six), machinery, or loud equipment; and (2) occurred during ferruginous hawk breeding season (March 1st to May 1st for nests with no eggs and until mid-to late-July for productive nests), refer to Section 3.3.2.2.

3.2.2.4 Cultural Resource Survey

In April 2016, Dinétahdóó conducted a cultural resource survey as part of the Site Clearance field investigations. Navajo Nation Historic Preservation Department (NNHPD) issued a Class B permit to Dinétahdóó to conduct the cultural resource survey. Following the cultural resource survey, the NNHPD issued a Cultural Resources Compliance Form that included a "Notification to Proceed" with RSE field work. A copy of the Cultural Resources Compliance Form is included in Appendix E. According to NNHPD, this form is the equivalent of a “permit” to conduct the work.

The survey included the areas of the claim boundaries and the 100-ft claim boundary buffer, as shown in Figures 2-9a and 2-9b. Dinétahdóó did not survey areas on steep terrain due to safety concerns. The survey identified one archaeological site, one isolated occurrence, and one TCP. The TCP was located within the 100-ft claim boundary buffer. For confidentiality reasons, details regarding the cultural resource survey findings are not provided herein. A copy of the cultural resources survey report is not included in Appendix E for confidentiality reasons; NNHPD can be contacted for additional information. NNHPD contact information is located on the *Cultural Resource Compliance Form* included in Appendix E. According to NNHPD, this form is the equivalent of a "permit" to conduct the work.

Based on the survey findings Dinétahdóó recommended during RSE activities that the boundaries of the archaeological site and the TCP must be flagged. In addition, they recommended that an archaeologist monitor all ground disturbing activities, including soil sampling, within 50 ft of the archaeological site and TCP boundaries. Dinétahdóó also stated that visible fencing must be installed along the eastern boundary of the TCP and along the boundaries of the archaeological site prior to any ground-disturbing activities occurring within 50 ft of these features. While conducting RSE activities on–site, flagging placed by Dinétahdóó was still visible and field personnel used a GPS loaded with the TCP and archaeological site boundaries to verify that drilling was not conducted within 50 ft of the TCP or archaeological site boundaries. Dinétahdóó also stipulated that RSE activities must be halted at any time if cultural resources were encountered.

Dinétahdóó also escorted field personnel during: (1) the collection of subsurface soil samples at the background reference areas (refer to Section 3.3.1.1); and (2) during Site Characterization borehole subsurface soil/sediment sample collection in locations outside the 100-ft buffer (refer to Section 3.3.2.2). The Trust requested that Dinétahdóó's archeologist be present because the subsurface sample locations were outside of the area originally surveyed during the Site Clearance cultural resource survey.

3.3 SUMMARY OF REMOVAL SITE EVALUATION ACTIVITIES

The RSE activities consisted of two separate tasks: Baseline Studies and Site Characterization activities. The Baseline Studies included a Background Reference Area Study, Site gamma survey, and Gamma Correlation Study. The results of the Baseline Studies were used to plan and prepare the Site Characterization field investigations, which included surface and subsurface soil and sediment sampling, and surface water and well water sampling. Results of the RSE activities are presented in Section 4.0 and Baseline Studies and Site Characterization activities are summarized in Sections 3.3.1 and 3.3.2, respectively.

3.3.1 Baseline Studies Activities

3.3.1.1 Background Reference Area Study

The Background Reference Area Study activities were completed at the background reference areas selected for the Site. Refer to Section 3.2.2.2 for an explanation of the selection of the background reference areas for the Site. The Background Reference Area Study included a surface gamma survey, static surface and subsurface gamma measurements, surface soil sampling, and subsurface soil sampling. The soil sample locations in the background reference areas were initially selected using a triangular grid, set on a random origin. Where possible, samples were collected at the center points of the triangles. However, in some instances, the actual sample locations had to be moved in the field if sampling was not possible (e.g., the location consisted of exposed bedrock or there was a large bush blocking access). In these cases, the closest accessible location was selected instead.

The background reference areas were selected based on a variety of factors, including *MARSSIM* criteria, which indicated whether the areas were representative of unmined locations, regardless of the sizes of the areas. These factors are described in this RSE report and accompanying appendices. The objectives of the background reference area study were to measure gamma radiation levels emitted by naturally occurring, undisturbed uranium-series radionuclides, and concentrations of other naturally occurring constituents. The results were used to establish background gamma levels and concentrations of Ra-226 and specific metals (uranium, arsenic, molybdenum, selenium, and vanadium). The soil sampling locations at the background reference areas are presented in Figure 3-3. Field personnel performed the Background Reference Area Study in accordance with the *RSE Work Plan,* Sections 4.2, 4.4, and 4.5.

The surface gamma surveys at BG-1 and BG-2 were completed in May 2016. ERG performed the surface gamma surveys using Ludlum Model 44-10 2-inch by 2-inch sodium iodide (NaI) high-energy gamma detectors (the detectors). Each detector was coupled to a Ludlum Model 2221 ratemeter/scaler that in turn was coupled to a Trimble ProXRT GPS unit with a NOMAD 900 series datalogger. The detector tagged individual gamma measurements with associated geopositions recorded using the Universal Transverse Mercator Zone 12 North coordinate system. ERG matched and calibrated the detector to a National Institute of Standards and Technology-traceable cesium-137 check source, and function-checked the equipment prior-to and after each workday. ERG performed the surveys by walking the background reference areas with the detector carried by hand, along transects that varied depending on encountered topography. The gamma measurements were collected with the height of the detector varying from 1ft to 2 ft above ground surface (ags) with an average height of 1.5 ft ags to accommodate vegetation, rocks, or other surface features. If field personnel encountered an immovable obstruction (e.g., a tree) during the surface gamma surveys they went around the obstruction. Subsequent to each workday, ERG downloaded the gamma measurements to a computer and secure server.

The same equipment used for the surface gamma survey was also used to collect static one-minute gamma measurements at the ground surface and down-hole (subsurface) at borehole location S078-BG1-013 (BG-1). Refer to Appendix C.2 for borehole logs. Static gamma measurements were categorized as surface measurements where they were collected at ground surface (0.0 ft) and as subsurface measurements where depths were below ground surface due to the influence of downhole geometric effects on subsurface static gamma measurements (refer to Section 4.1). Gamma measurements were collected according to the methods described in the *RSE Work Plan,* Section 4.2 and Appendix E.

Soil samples collected as part of the background study are detailed in Table 3-2 and sample locations are shown in Figure 3-3. Soil samples were categorized as surface samples where sample depths ranged from 0.0 to 0.5 ft bgs and as subsurface samples where sample depths were greater than 0.5 ft bgs. Field personnel collected the following samples from the background reference areas:

- BG-1 – In October and November 2016, 12 surface soil grab samples were collected from 12 locations, and two subsurface soil grab samples were collected from borehole S078-BG1-13. While reviewing potential subsurface hand auger locations at BG-1, Dinétahdóó recommended that the hand auger borehole location should be stepped out from BG-1 to avoid a nearby archaeological finding. In accordance with this suggestion, the subsurface background location (S078-BG1-013) was advanced southwest of BG-1 (refer to Appendix D.1).

- BG-2 – In October 2016, 10 surface soil grab samples were collected from 10 locations. No subsurface soil samples were collected from BG-2 because of shallow soil on bedrock.

The lack of a subsurface soil samples from BG-2 will not affect the derivation of Ra-226 or metal ILs because the Ra-226 and metals ILs (i.e., surface and subsurface) were based on surface soil samples (refer to Section 4.1).

Samples were shipped to a USEPA approved laboratory, ALS Environmental Laboratories in Fort Collins, Colorado for analyses. Samples were collected according to the methods described in the *RSE Work Plan,* Section 3.8.1.1. The results of the surface gamma survey, static surface and subsurface gamma measurements, and surface and subsurface soil sample analytical results provided background reference data to guide the Site Characterization surface and subsurface soil/sediment sampling (refer to Section 3.3.2). The Background Reference Area Study results are presented in Section 4.1. The ERG survey report in Appendix A provides further details on the gamma surveys. Field forms, including borehole logs, are provided in Appendix C.1 and C.2.

3.3.1.2 Site Gamma Radiation Surveys

Baseline Studies activities included a surface gamma survey of the Site in accordance with the *RSE Work Plan,* Section 4.2 and Appendix E. Approximately1.4 acres of the mesa sidewall were not surveyed during the surface gamma survey because field personnel were unable to safely access these areas, as shown on Figure 3-4. This is identified as a data gap in Section 4.10. In addition, the approximate centerline of the western and eastern extents of the northern potential haul roads were surveyed, but the shoulders were not due to miscommunication with the field personnel. This is identified as a potential data gap in Section 4.10.

The surface gamma survey was used as the primary method to evaluate the extent of potential mining-related impacts or areas containing elevated radionuclides associated with uranium mineralization.

In November 2016 and April 2017, the surface gamma survey was performed using the same methods and equipment, as described in Section 3.3.1.1, with the exception that the detector was carried in a backpack when topographical features did not allow field personnel to carry the detector by hand for safety reasons. The surface gamma survey included the claim areas, a 100-ft buffer around the claim areas, and roads and drainages out to approximately 0.25 miles from the Site. The *RSE Work Plan* specified that the surface gamma survey would be an iterative process where the surface gamma survey would be extended laterally until gamma measurements appeared to be within background levels. Subsequent to each workday, the gamma measurements were evaluated by ERG and Stantec, and compared to the background reference areas to determine if additional surface gamma surveying was needed.

In addition to the Site surface gamma survey, at the USEPA's request, field personnel conducted a surface gamma survey of a section of the exploration area (approximately 13 acres) adjacent to the claim boundary on the mesa bench/mesa top (as shown in Figures 2-1 and 2-9a). Results of this gamma survey are included in Section 4.2.

The full areal of the Site surface gamma survey is referred to as the Survey Area, as shown in Figure 3-4. The Survey Area was 73.1 acres and was subdivided into two separate survey areas, as shown in Figure 3-4, based on *MARSSIM* criteria, including different geologic conditions on-site where potential mining-related impacts were observed. Survey Area A geologically represents the Mancos Shale (based on BG-1), and Survey Area B geologically represents the Toreva Formation (based on BG-2).

It was necessary to subdivide the Survey Area based on geologic conditions and present the findings in Section 4.0 based on the subdivision, because geologic formations can have different geochemical compositions (i.e., gamma levels and concentrations of Ra-226, uranium, arsenic, molybdenum, selenium, and vanadium). The surface gamma survey results are presented in Section 4.2. The ERG survey report in Appendix A provides further detailed information on the surface gamma survey.

3.3.1.3 Gamma Correlation Study

Baseline Studies activities included a Gamma Correlation Study in accordance with the *RSE Work Plan,* Section 4.3. The objectives of the Gamma Correlation Study were to determine correlations between the following constituents to be used as screening tools for site assessments:

- Gamma measurements (in cpm) and concentrations of Ra-226 in surface soils (in picocuries per gram [pCi/g])
- Gamma measurements (in cpm) and exposure rates (in μR/hr)

Two regression analyses were conducted for these correlations. The first regression analysis was performed using co-located high-density surface gamma measurements and laboratory concentrations of Ra-226 in surface soil to develop a correlation equation (refer to Section 4.2.2). The correlation equation allows for Ra-226 concentrations in soil and sediment to be estimated (predicted) based on gamma measurements in the field.

This correlation equation was not used in the field to estimate Ra-226 concentrations or to evaluate the extent of Ra-226 concentrations. The correlation was used to develop a site-specific prediction for Ra-226 concentrations from the actual gamma survey data and was compared to actual concentrations from the soil/sediment samples to evaluate the usability of the correlation for future Removal or Remedial Action evaluations, as presented in Section 4.2.2. The correlation can be used as a site-specific field screening tool during site assessments, using the same gamma survey methods as in this RSE (e.g., walkover gamma survey) and based on site-specific conditions. The data related to the correlations are provided in Appendices A and C.

The second regression analysis was performed using co-located static one-minute gamma measurements and exposure rates to develop an exposure-rate correlation equation. Exposure rates can be predicted, based on gamma measurements, using the developed exposure-rate correlation equation. The exposure rate correlation also provides a standard by which future gamma measurements can be compared to previous gamma measurements, if those previous gamma measurements were also correlated with exposure. In addition, exposure rates can be used to provide an estimate of gamma radiation levels when an exposure meter is used as a health and safety tool for field personnel working on-site. The exposure rate correlation was not used for Site Characterization. Because the exposure rates are used as a health and safety tool, and are not part of the data analyses for the RSE report, a summary of the exposure rate correlation is not presented in this report. Appendix A provides a discussion of the correlations and the regression equations for both correlations.

In November 2016, field personnel identified five areas for the Gamma Correlation Study, as shown in Figure 3-5, by considering the results of the Site surface gamma survey (described in Section 3.3.1.2), field conditions (e.g., suitable terrain), and feasibility of sampling. To minimize variability when determining a correlation between gamma measurements (in cpm) and concentrations of Ra-226 in soil, the study area soils must: (1) represent a specific gamma measurement within the range of gamma measurements collected at the Survey Area; and (2) be as homogenous as possible with respect to soil type, and gamma measurement within the correlation area. At each area, field personnel completed a high-density surface gamma survey (intended to cover 100 percent of the survey area) and collected one five-point composite surface soil sample per area (refer to Table 3-2). Field personnel made a field modification from the *RSE Work Plan* by adjusting the size of the 900 ft^2 area smaller at two of the Gamma Correlation Study locations, to minimize the variability of gamma measurements observed. The area used for the Gamma Correlation Study is shown in Figure 3-5, where the box shown at the five study locations represents a 900 ft^2 area in comparison to the actual area covered for the study, as shown by the extent of the gamma measurements within each area.

Field personnel collected, logged, classified, packaged, and shipped the samples in accordance with the *RSE Work Plan,* Sections 4.4, 4.9, 4.11, and Appendix E. Soil samples were collected for analyses of Ra-226 and isotopic thorium, as described in the *RSE Work Plan,* Section 3.4.1.

The objectives of the thorium analyses were for site characterization and evaluation of potential effects of thorium on the correlation. The data can be used to assess the potential effects of thorium-232 (Th-232) series radioisotopes on the correlation of gamma measurements to concentrations of Ra-226 in surface soils (i.e., if gamma-emitting radioisotopes in the Th-232 series, such as actinium-228, lead-212, and thallium-208, are impacting gamma measurements at the Site), as discussed in Section 4.2.2. Uranium, radium, and thorium occur in three natural decay series (uranium-238 [U-238], Th-232, and U-235), each of which include significant gamma emitters (USEPA, 2007b). Therefore, in order to develop a correlation between gamma radiation and Ra-226 concentrations, the gamma radiation from each significant decay series present at the Site, may need to be taken into account. Typically, only U-238, and sometimes Th-232, are present in significant quantities. The contribution from the U-235 decay series can be excluded because U-235 is only approximately 0.72 percent of the total uranium concentration. If the Th-232 decay series is present in significant quantities, it should be accounted for in the correlation to accurately predict Ra-226 concentrations based on all significant sources of gamma radiation.

3.3.1.4 Secular Equilibrium

The Gamma Correlation Study soil samples (refer to Section 3.3.1.3) were also analyzed for thorium-230 (Th-230), in accordance with the *RSE Work Plan,* Section 3.4.1. The activities of Th-230 and Ra-226 can be compared to evaluate the status of secular equilibrium within the U-238 decay series (USEPA, 2007b). The U-238 decay series is in secular equilibrium when the radioactivity of a parent radionuclide (e.g., U-238) is equal to its decay products (refer to Appendix A). If the U-238 decay series is out of secular equilibrium, the quantities of the daughter products become depleted. This could be considered for potential site assessments (e.g., when evaluating the contribution of the daughter products to the total risk related to U-238 during a human health and/or ecological risk assessment). As part of the RSE, the secular equilibrium evaluation was a general indicator (e.g., screening level assessment) of the status of equilibrium at the sites. It was not used to characterize the extent of constituents of potential concern (COPCs) at the Site. The secular equilibrium evaluation is discussed here only because Th-230 was included in the isotopic thorium analysis.

3.3.2 Site Characterization Activities and Assessment

3.3.2.1 Surface Soil and Sediment Sampling

Site Characterization activities included surface soil and sediment sampling and associated laboratory analyses. The soil/sediment surface sampling locations within the Survey Area were selected based on professional judgment (i.e., non-randomly) to evaluate concentrations of Ra-226 and metals in relation to the surface gamma survey measurements and site features (e.g., historical mining features and geologic features). Based on the surface gamma survey results and site features, a limited number of samples were collected and analyzed where the gamma survey measurements were within background levels, mining and or exploration-related features were not present, and no ground disturbance was observed. The results were compared to the site-specific ILs and published regional concentrations to support the overall evaluation of potential mining impacts (refer to Section 4.3). Soil/sediment samples were categorized as surface samples where sample depths ranged from 0.0 to 0.5 ft bgs and as subsurface samples where sample depths were greater than 0.5 ft bgs. Samples collected in drainages were classified as sediment samples.

In April and October 2017, samples were collected from the locations shown in Figure 3-6a and are summarized in Table 3-2. Sample locations and the locations of mining-related features are shown in Figure 3-6b. The number of surface samples collected within specific mine features are listed in Table 3-3. Seventy-three surface soil/sediment grab samples were collected from 73 locations in the Survey Area (47 from Survey Area A and 26 from Survey Area B).

Field personnel collected, logged, classified, packaged, and shipped the samples in accordance with the *RSE Work Plan,* Sections 4.4, 4.9, 4.11, and Appendix E. Samples were shipped to ALS Environmental Laboratories in Fort Collins, Colorado for analyses of: Ra-226, uranium, arsenic, molybdenum, selenium, and vanadium, as described in the *RSE Work Plan,* Section 4.13.1. The surface soil/sediment analytical results are presented in Section 4.3. Field forms are provided in Appendix C.1 and the laboratory analytical data, data validation reports, and Data Usability Report for the analyses are provided in Appendix F.

3.3.2.2 Subsurface Soil and Sediment Sampling

Site Characterization activities included subsurface soil/sediment sampling and associated laboratory analyses. Similar to the surface soil/sediment sampling discussed in Section 3.3.2.1, subsurface sampling locations were selected based on professional judgment (i.e., non-randomly) to evaluate concentrations of Ra-226 and metals in relation to the surface gamma survey measurements and site features (e.g., historical mining features and geologic features). Grab samples were collected with the intent to characterize specific intervals of interest (e.g., material within zones with elevated static gamma measurements). Composite samples were collected to provide a screening level assessment across an interval (e.g., where historical mining features were located). Additionally, surface and subsurface static gamma measurements were collected in the boreholes using the same equipment as described in Section 3.3.1.1. Static gamma measurements were collected by holding the detector in the borehole for a one-minute integrated count and are not comparable to the surface gamma survey measurements, which were collected as a walkover survey.

Subsurface samples were collected by advancing subsurface boreholes to a desired sample depth using either a 3-inch diameter hand auger or a Geoprobe™ 8140LC rotary sonic drilling rig. Before subsurface samples could be collected using the drill rig, improvements to two access roads needed to be completed so that the drill rig could access sample locations. Therefore, on September 27 and 28, 2017, Stantec, and their subcontractors Dinétahdóó, Clawson Excavating, Inc., and ERG, performed access road improvement activities. A Linkbelt 290 excavator was used to move and break boulders with either a hydraulic hammer or the bucket of the excavator, and a Caterpillar 140G road grader was used to level the ground surface (where needed). The excavator was then used to compact the soil within the roadway. All materials used for road improvements were sourced from the Site and no fill materials were brought to the Site. A water truck sprayed water during improvement activities to assist with compaction and provide dust suppression. In addition, during the road improvement activities Dinétahdóó was on-site to monitor all ground disturbing activities and verify that cultural resources were not disturbed. Based on their observations, Dinétahdóó did not observe cultural resources during the access road improvement activities, as presented in a memorandum submitted to NNHPD (Dinétahdóó, 2017). ERG was also on-site during the access road improvement activities and acted as the radiation safety officer. The access roads will not be maintained, and in April 2018 the upper access road was blocked with a K-rail. The lower access road was not blocked because it terminated in an open area and any placed barrier could be readily bypassed.

In addition, the potential supplementary biological surveys recommended by Adkins (refer to Section 3.2.2.3) were not required because sample collection using the sonic drilling rig occurred in October 2017, which was outside of the ferruginous hawk breeding season (March 1st to May 1st for nests with no eggs and until mid- to late-July for productive nests).

To collect subsurface samples, field personnel advanced the hand auger to the desired sample depth manually, or the sonic drilling rig advanced the boreholes to the desired sample depth. The sonic drilling rig was equipped with a 4-inch diameter sonic core barrel that used cutting rotation and vibration to advance the boreholes. The sonic drilling method is ideal for use in rocky soils to obtain continuous samples in materials that are difficult to sample using other drilling methods (ASTM, 2016) and it recovers a continuous and relatively undisturbed core sample for review and analysis that is representative of the lithological column at that borehole location (refer to Appendix C.2).

Sixty-two boreholes were advanced in the Survey Area (40 in Survey Area A and 22 in Survey Area B). Boreholes were advanced until: (1) refusal at bedrock/hard surface; (2) termination within bedrock or native material; (3) the borehole collapsed; (4) subsurface static gamma measurements were decreasing (it was a field error to use this criterion, this has been identified as a potential data gap in Section 4.10, additional field work may be necessary); or (5) the borehole depth was below depths where waste was observed. Borehole depths ranged from 0.25 to 36.5 ft bgs, and the depth of unconsolidated deposits to bedrock in boreholes ranged from 0.25 to 34.0 ft bgs. Some boreholes were terminated prior to reaching bedrock. S078-SCX-034 was the deepest borehole (extending to 35.0 ft bgs) terminated before bedrock was reached. The boreholes were advanced through organic soil and poorly and well graded sand and silt with varying amounts of clay and gravel, clay, coal, shale, and sandstone (refer to Appendix C.2 for borehole logs). Subsurface sampling was limited in some areas on the mesa sidewall due to unsafe terrain.

In April and October 2017, samples were collected from the locations shown in Figure 3-6a and are summarized in Table 3-2. Sample locations compared to the location of mining-related features are shown in Figure 3-6b. The number of subsurface samples collected within specific mine features are listed in Table 3-3. One hundred and five subsurface samples (90 soil/sediment, three soil/bedrock, three boulder, and nine bedrock) samples were collected from 48 borehole locations in the Survey Area. Multiple samples were collected from many of the boreholes. Eighty-four samples were collected from Survey Area A and 21 from Survey Area B.

One cross-section for the Site was produced using the subsurface borehole information, as shown in Figure 2-8, refer to Section 2.2.2.2. Cross-section A-A' is oriented roughly northwest-southeast. Lithological descriptions from five boreholes (refer to Appendix C.2), in conjunction with subsurface geology observations made by field personnel, were used to model the northwest-southeast extent of earthworks material, consolidated deposits related to the eastern mine waste burial pit. The approximate depth of the earthworks material along cross-section A-A' is 15 ft bgs and the depth to bedrock near A is approximately 35 ft bgs.

Field personnel logged, classified, packaged, and shipped the samples in accordance with the *RSE Work Plan,* Sections 4.5, 4.9, 4.11, and Appendix E. Samples were shipped to ALS Environmental Laboratories in Fort Collins, Colorado for analyses of Ra-226, uranium, arsenic, molybdenum, selenium, and vanadium, as described in the *RSE Work Plan,* Section 4.13.1. The subsurface analytical results are presented in Section 4.3. Field forms, including borehole logs showing static gamma measurements and Ra-226 analytical results, are provided in Appendix C.2. The laboratory analytical data, data validation reports, and Data Usability Report for the analyses are provided in Appendix F.

3.3.2.3 Geophysical Survey

Site Characterization activities included conducting an electrical resistivity geophysical survey at the Site. The geophysical survey was conducted to assist with identifying any potential mine-related subsurface voids or tunnels, because open voids, tunnels, etc. could pose a safety risk at the Site. In addition, these concerns arose because these features had been observed on other AUM sites. Because open voids, tunnels, and the like could pose a safety risk at the Site, the geophysical survey was conducted to assist with identifying any potential mine-related subsurface voids or tunnels. In addition, the results of the geophysical survey can be used for identifying: (1) material type of unconsolidated deposits; and (2) depth of unconsolidated deposits to bedrock. Although a geophysical survey was not included in the *Scope of Work* (MWH, 2016d), the Trustee notified the Agencies and obtained approval prior to work commencing the survey. The Tachee/Blue Gap Chapter officials and nearby residents were consulted and notified of the additional field work. In October 2017, Hydrogeophysics Inc. (HGI), under contract to Stantec, performed the geophysical survey at the Site.

Electrical resistivity surveys are used to identify material types by measuring a material's resistance to electrical current. Materials with low electrical resistivity (high conductivity) will include materials with higher clay or moisture content, or conductive bedrock. Materials with high electrical resistivity (low conductivity) will include air-filled voids or loose unconsolidated fill material, based on the assumption that the void space had increased resistivity compared to the surrounding bedrock or sediments. These assumptions also depended on other factors including sediment grain size, moisture content, chemical composition of the soil or bedrock, and the degree of compaction.

The electrical resistivity survey conducted on-site consisted of 10 electrical resistivity survey lines, as shown in Figure 3-7, and was conducted in three investigation areas:

- Area 1 included two perpendicular lines in the western mine waste burial pit located on claim #79
- Area 2 included four lines in the southern area of claim# 78 at the base of the foothills and mesa sidewall, and in the area of the eastern mine waste burial pit
- Area 3 included four lines in the northern area of claim #78 in the mining/reclaimed disturbed area on the mesa top

Resistivity data were collected using a multichannel electrical resistivity system consisting of cables, stainless steel electrodes, and a battery power supply, with an electrode spacing of approximately 10 ft. Electric current was transmitted into the earth through one pair of electrodes (transmitting dipole) that were in contact with the soil. The resultant voltage potential was then measured across another pair of electrodes (receiving dipole). Numerous electrodes were deployed along the survey lines. A complete set of measurements occurred when each electrode (or adjacent electrode pair) passed current, while all other adjacent electrode pairs were utilized for voltage measurements. Electrode locations were surveyed using a handheld GPS.

HGI's geophysical characterization report, included in Appendix A.2, provides a complete description of the geophysical survey objectives, theory, methods, results and interpretation of results. A summary of the interpretation of the geophysical survey results is presented in Section 4.9.

3.3.2.4 Surface Water and Well Water Sampling

One surface water feature and one well water feature were identified during the Site Clearance desktop study and one surface water feature was identified during site mapping, as shown in Figure 2-1 and Table 3-1a. All three water features were sampled as described below.

On October 19, 2016, a surface water sample (S078-WS-001) was collected from the pond identified as Pond/Well/1050475 in the *2007 AUM Atlas*. The size of the pond varies with seasonal runoff and can be up to 150 ft across. Per the USEPA (2018), a local resident occasionally fills the pond using water supplied by the Navajo Tribal Utility Authority. The pond is shown in Appendix B-2 photograph number 18.

On November 5, 2016, a surface water sample (S078-WS-002) was collected from the seep identified by Stantec as S078-Seep-1. The seep daylighted along a geologic contact located on the mesa sidewall and was approximately 50 ft long. The surface water sample was collected from the area where the seep water pooled, which was approximately 1 ft by 1 ft, refer to Appendix B-1 photograph number 1.

On October 19, 2016, a well water sample (S078-WL-001) was collected from the water well identified as 04T-386/Tank 4T-386/CH981123BGW002 in the NNDWR database and the *2007 AUM Atlas*. Water well 04T-386 was completed in September 1954 at a total depth of 902 ft bgs and was screened from 802 to 902 ft bgs (refer to Table 3-1b for additional well build specifications). Water well 04T-386 was a windmill well located 1.0 mile south of the Site and the well water sample was collected from the valve at the trough associated with the water well. The windmill well is shown in Appendix B-2 photograph number 19.

The water samples collected for dissolved metals analyses were sampled and field filtered using a peristaltic pump, Teflon® tubing, and 0.45-micron inline filter in the field at the time of sample collection per the *RSE Work Plan*, Section 4.6.1. All other analyses did not require in-field filtering. The samples were collected, packaged, and shipped in accordance with the *RSE Work Plan,* Sections 4.6, 4.9, 4.11, and Appendix E. ACZ Laboratories, Inc. in Steamboat Springs, Colorado conducted the mercury analysis and ALS Environmental Laboratories in Fort Collins, Colorado conducted all other analyses including Ra-226 and Radium-228 (Ra-228), gross alpha, and the following total and dissolved metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, vanadium, and zinc.

Additional general water quality analyses or field measurements included: total dissolved solids TDS, anions (carbonate, bicarbonate, chloride, and sulfate), cations (sodium and calcium), and field measurements (pH, conductivity, turbidity, temperature, salinity and oxidation reduction potential). Table 3-4 provides a summary of the water analyses. Results of these analyses were used to evaluate potential mining-related impacts to surface water and well water. Surface water and well water analytical results are presented in Section 4.8. Field forms are provided in Appendix C.3 and the laboratory analytical data and Data Usability Report for the analyses are provided in Appendix F. Investigation of groundwater is not included in the scope of this RSE.

3.3.3 Identification of TENORM Areas

Areas at the Site where TENORM is present were identified using multiple lines of evidence including:

1. Historical Data Review
    a. Aerial photographs
    b. USAEC records
    c. Reclamation records
    d. Other documents relevant to the Site, including those in the *2007 AUM Atlas*
    e. Interviews with residents living closest to the Site (for those sites where residents were available for interview)

   f. Consultation and site visits with NAML staff to identify reclamation features (for those sites reclaimed by NAML)

2. Geology/Geomorphology
   a. Hydrology/transport pathways with drainage delineation
   b. Site-specific geologic mapping including areas of mineralization
   c. Topography
3. Disturbance Mapping
   a. Exploration
   b. Mining
   c. Reclamation
4. Site Characterization
   a. Surface gamma surveys and subsurface static gamma measurements
   b. Soil/sediment sampling and analyses

Any areas where TENORM was not observed are considered to contain NORM, because soil and/or rock at the Site contain some amount of natural uranium and its daughter products. This area was mined because of the high levels of naturally occurring uranium. The areas containing NORM and/or TENORM are presented in Section 4.6. The volume of TENORM is presented in Section 4.7. The areas containing NORM and/or TENORM, along with additional findings of the RSE report, are identified to support future Removal or Remedial Action evaluations at the Site.

3.4 DATA MANAGEMENT AND DATA QUALITY ASSESSMENT

This section summarizes the data management and data quality assessment activities performed for the RSE.

3.4.1 Data Management

The DMP included in the *RSE Work Plan* describes the plan for the generation, validation, and distribution of project data deliverables. Successful data management comes from coordinating data collection, quality control, storage, access, reduction, evaluation, and reporting. A summary of the data management activities performed as part of the RSE process included:

- **Database** – Field-collected and laboratory analytical RSE data were stored in an Oracle SQL relational database, which increased data handling efficiency by using previously developed data entry, validation, and reporting tools. The Oracle SQL database was also used to export project data to a tabular format that can be used in a spreadsheet (e.g., Excel) and to the USEPA Scribe database format.

- **Scribe** – The Stantec Data Manager/Data Administrator was responsible for meeting the project data transfer requirements from the Oracle SQL database to Scribe, which is a software tool developed by the USEPA's Environmental Response Team to assist in the process of managing environmental data. Stantec maintained an Oracle SQL database and exported data from the Oracle SQL database to a Scribe compatible format following completion of each field investigation phase. Custom data queries and "crosswalk" export routines were built in Oracle SQL, to facilitate data export to the Scribe database format with the required frequency.

- **Geographic Information System (GIS)** – Spatial data collected during the RSE (e.g., sample locations and gamma measurements) were stored in a dedicated File Geodatabase for use in the project GIS. The geodatabase format enforces data integrity, version control, file size compression, and ease of sharing to preserve GIS output quality. Periodic geodatabase backups were performed to identify accidentally deleted or otherwise corrupt information that were then repaired or recovered, if applicable.

3.4.2 Data Quality Assessment

The QAPP, included in the *RSE Work Plan*, Appendix B, was followed for RSE data quality assessment, where the QAPP presents QA/QC requirements designed to meet the RSE DQOs. Data quality refers to the level of reliability associated with a particular data set or data point. The Data Usability Report included in Appendix F.1 provides a summary of the data quality assessment activities and qualified data for the RSE. A summary of findings, from the data quality assessment, are included below.

- **Data Verification** – The data were verified to confirm that standard operating procedures (SOPs) specified in the *RSE Work Plan* and *FSP* were followed and that the measurement systems were performed in accordance with the criteria specified in the QAPP. Any deviations or modifications from the *RSE Work Plan* are described in the appropriate RSE report sections. The USEPA definition (USEPA, 2002) for data verification is provided in the glossary.

- **Data Validation** – The data were validated to confirm that the results of data collection activities support the objectives of the RSE as documented in the QAPP. The data quality assessment process was then applied using the validated data and determined that the quality of the data satisfies the intended use. The USEPA definition (USEPA, 2002) for data validation is provided in the glossary. A copy of the Data Usability Report is included in Appendix F.1 and a summary of the validation results is presented below:

    - **<u>Precision</u>** Based on the matrix spike/matrix spike duplicate (MS/MSD) sample, laboratory control sample/laboratory control sample duplicate (LCS/LCSD) sample, laboratory duplicate sample, and field duplicate results, the data are precise as qualified.

    - **<u>Accuracy</u>** Based on the initial calibration (ICAL), initial calibration verification (ICV), continuing calibration verification (CCV), MS/MSD, and LCS, the data are accurate as qualified.

- **Representativeness** Based on the results of the sample preservation and holding time evaluation, the method and initial/continuing calibration blank (ICB/CCB) sample results, the field duplicate sample evaluation, and the reporting limit evaluation, the data are considered representative of the Site as qualified.

- **Completeness** All media and QC sample results were valid and collected as scheduled (i.e., as planned in the *RSE Work Plan*); therefore, completeness for these is 100 percent.

- **Comparability** Standard methods of sample collection and standard units of measure were used during this project. The analyses performed by the laboratory were in accordance with current USEPA methodology and the QAPP.

Based on the results of the data validation, all data are considered valid as qualified.

4.0 FINDINGS AND DISCUSSION

4.1 BACKGROUND REFERENCE AREA STUDY RESULTS AND CALCULATION OF INVESTIGATION LEVELS

The results of the background reference area surface gamma survey are shown in Figures 4-1a through 4-1c with sample locations in the background reference areas shown for BG-1 and BG-2 on Figures 4-1b and 4-1c, respectively. The surface gamma surveys in BG-1 and BG-2 did not cover the areal extent of the sample locations; the lack of coverage in BG-1 is identified as a data gap due to the distance of the samples from the gamma survey area. Analytical results of the samples collected from BG-1 and BG-2 are summarized in Table 4-1. The gamma measurements and surface soil sample analytical results collected from BG-1 and BG-2 were evaluated statistically to calculate ILs (refer to Appendix D.2) for each corresponding Survey Area (i.e., Survey Area A and Survey Area B, respectively). As previously discussed in Section 3.3.1.2, the Site was subdivided into two separate Survey Areas based on the geologic formations on-site. Of note, in review of the RSE results it was determined that mining-related impacts extend further along the valley bottom than was originally assumed. Based on these findings, the lack of a background reference area for the Quaternary deposits is included as a data gap in Section 4.10.

Statistical evaluation of the gamma measurements and soil sample analytical results included identifying potential outlier values, interpreting boxplots and probability plots, comparing group means between the background reference areas and the respective Survey Area data, and calculating descriptive statistics for each of the background reference areas. The descriptive statistics included the 95 percent upper confidence limit (UCL) on the mean gamma measurements and Ra-226/metals concentrations, and the 95-95 upper tolerance limits (UTLs). The data were analyzed using R statistical programming packages and ProUCL 5.1 software (USEPA, 2016c).

The DQOs presented in the RSE Work Plan indicate that the ILs would be developed using the 95 percent UCL on the mean of the background sample results. However, the 95-95 UTL was used as the basis for the ILs instead because it better reflects the natural variability in the background data and lends itself to single-point comparisons to the Survey Area data; this was a change from the *RSE Work Plan*, as agreed upon with the Agencies. The UTL represents a 95 percent UCL for the 95th percentile of a background dataset whereby Survey Area results above this value are not considered representative of background conditions. The UTL is a statistical parameter for the entire population of the variable, whereas the actual results are from a sample of the population. UTLs were calculated in accordance with USEPA's *ProUCL 5.1 Technical Guidance*, Sections 3.4 and 5.3.3 (USEPA, 2015). Appendix D.2 presents a comprehensive discussion on the derivation of the ILs for the Site, which are presented below. The *RSE Work Plan* also stated that gamma radiation measurements from the background surface and subsurface soil would be combined to develop the IL for surface gamma radiation at the Site. However, the surface gamma radiation ILs were instead developed from the surface gamma survey data only; as requested by the Agencies, this is identified as a deviation from the *RSE Work Plan*. The subsurface static gamma measurements were excluded for two reasons: (1) they were collected using a different method (static one-minute measurements versus a walkover gamma survey); and (2) because of the downhole geometric effects that influence subsurface static gamma measurements (refer to the discussion of geometric effects below).

The ILs for Survey Area A (i.e., the Mancos Shale; refer to Figures 2-7a, 2-7b, and 3-4) were established using statistical analysis of background data collected from BG-1 (refer to Figures 3-2 and 3-3) and are as follows:

- Arsenic – 3.35 milligrams per kilogram (mg/kg)
- Molybdenum – 0.568 mg/kg
- Selenium – 1.10 mg/kg
- Uranium – 3.21 mg/kg
- Vanadium – 12.2 mg/kg
- Ra-226 – 3.59 pCi/g
- Surface gamma measurements – 20,677 cpm

The ILs for Survey Area B (i.e., the Toreva Formation; refer to Figures 2-7a, 2-7b, and 3-4) were established using statistical analysis of background data collected from BG-2 (refer to Figures 3-2 and 3-3) and are as follows:

- Arsenic – 18.6 mg/kg
- Molybdenum – 0.371 mg/kg
- Selenium – None (no IL could be calculated because the two detections at BG-2 are not distinct values; refer to Appendix D.2).
- Uranium – 1.46 mg/kg
- Vanadium – 22.3 mg/kg
- Ra-226 – 2.02 pCi/g
- Surface gamma measurements – 14,707 cpm

In addition to the surface gamma survey performed in background reference areas, subsurface static gamma measurements were collected in the borehole completed at BG-1. These measurements were used to establish a subsurface static gamma screening level for Survey Areas A. The selected subsurface static gamma screening level value for Survey Area A met the following criteria: (1) it was the lowest value measured at or below 1 ft bgs and (2) it was not directly measured on bedrock.

A borehole was completed in BG-1 (S078-BG1-013) with a termination depth of 2.6 ft bgs (refer to Appendix C.2) and a subsurface static gamma measurement was identified as an IL for Survey Area A. A subsurface borehole was not completed for BG-2 as a result of shallow soil on bedrock. Therefore, the need for subsurface static gamma data for BG-2 is identified as a potential data gap.

The subsurface static gamma screening level from BG-1 provides a comparison and assessment tool for Survey Area A and is included as an IL for the Site. However, it is important to consider that the subsurface static gamma IL is based on a single measurement, and it is not statistically derived. For this reason, subsurface static gamma IL exceedances should be considered in conjunction with additional lines of evidence including: (1) down-hole trends of static gamma measurements; (2) changes in lithology within the borehole; and (3) a qualitative comparison of subsurface static gamma measurements to Ra-226 and/or metals concentrations in subsurface samples.

Subsurface static gamma measurements from BG-1 are summarized in Table 4-2 and in Appendix C.2. Five subsurface static gamma measurements were evaluated to identify the subsurface static gamma IL for Survey Area A. Measurements of 22,744; 29,180; 31,995; 32,404; and 32,569 cpm were collected from BG-1 borehole S078-BG1-013, at down-hole depths of 0.5, 1.0, 1.5, 2.0, and 2.6 ft bgs, respectively. The lowest measured value (22,744 cpm) was at a depth of 0.5 ft bgs; however, because sample depths of at least 1.0 ft bgs are preferable, the 1.0-ft measurement of 29,180 cpm was selected as the subsurface static gamma IL for Survey Area A.

It is important to consider that the subsurface static gamma IL measurements may be elevated relative to the surface gamma IL because increases in static gamma measurements with depth can result from the detector being in closer proximity to bedrock that has naturally elevated concentrations of radionuclides, and/or geometric effects. Geometric effects are the result of the detector measuring gamma radiation from all directions, regardless of whether it is in a borehole or suspended in air. Gamma radiation measured with the detector held at the ground surface is primarily from the ground beneath the detector. As the detector is advanced down the borehole it measures gamma radiation from the surrounding material emanating from an increasing number of angles. Therefore, as the detector is lowered in the borehole it will generally measure increasingly higher values to a certain depth given a constant source. At approximately 1ft to 2 ft bgs, the detector is essentially surrounded by solid ground and further increases related to borehole geometry are not expected. Because downhole geometric effects influence static gamma measurements just below ground surface, static gamma measurements collected at or greater than 0.1 ft bgs are considered subsurface.

Due to the differing geometric effects, surface static gamma measurements at borehole locations may only be qualitatively compared to subsurface static gamma measurements, and the subsurface static gamma IL does not apply to the surface static gamma measurements.

Instances where the surface static gamma measurement is greater than subsurface static gamma measurements suggest higher levels of radionuclides and may be indicative of the presence of TENORM at the surface, but additional lines of evidence are generally needed to support that conclusion.

The Site gamma measurements, and soil and sediment sample analytical results were compared to their respective ILs to confirm COPCs (refer to Section 4.4) and to identify areas of the Site where ILs are exceeded (refer to Section 4.5). The calculated ILs provide a line of evidence to evaluate potential mining-related impacts, and to support future Removal or Remedial Action evaluations at the Site.

4.2 SITE GAMMA RADIATION SURVEY RESULTS AND PREDICTED RADIUM-226 CONCENTRATIONS

4.2.1 Site Gamma Radiation Results

4.2.1.1 Surface Gamma Survey

Results of the Site surface gamma survey are shown in Figure 4-1a where the calculated surface gamma ILs for each background reference area are used to set bin ranges with color coding to illustrate the spatial extent and patterns of surface gamma measurements within the entire Survey Area. The bins ranges were based on the minimum site gamma measurement, the background reference area ILs, and the maximum site gamma measurement. The maximum survey measurement was 301,035 cpm, which was greater than 14 times the maximum IL (i.e., BG-1 IL of 20,677 cpm), and was measured at a mining disturbed bedrock outcrop within Survey Area B in the western portion of the mining/reclaimed disturbed area (refer to Figures 2-9b and 4-1a).

Surface gamma measurements were generally highest in the western portion of the claim #78 mining/reclaimed disturbed area, in areas of thin soil and exposed bedrock along the mesa sidewall east of the claim #78 boundary, and in the area of the western mine waste burial pit. The western portion of the mining/reclaimed disturbed area, on the mesa bench, includes cover material that was re-vegetated; the eastern portion was scraped and furrowed to weathered bedrock. The mesa sidewall portion of the eastern mining/reclaimed disturbed area is shown in Appendix B-1 photograph number 12.

The spatial distribution of surface gamma measurements and IL exceedances are shown in Figures 4-1b and 4-1c for Survey Areas A and B, respectively, and are described below:

- Survey Area A (refer to Figure 4-1b) – Surface gamma IL exceedances (greater than 20,677 cpm) occurred primarily in five areas: (1) on the mesa sidewall; (2) along the portion of the potential haul road that runs from west of claim #79 to the mesa sidewall; (3) in the western valley bottom portions of Survey Area A, including the western mine waste burial pit; (4) along bedrock outcrops located on the valley bottom; and (5) in the drainage that runs along the southeastern portion of the Site. The highest observed concentrations were located on the eastern mesa sidewall and foothills adjacent to a drainage and potential haul road. Most surface gamma exceedances were less than two times the BG-1 IL.

- Survey Area B (refer Figure 4-1c) – Surface gamma IL exceedances (greater than 14,707 cpm) occurred primarily in three areas: (1) along the portion of the potential haul road on the mesa sidewall where it accesses the mesa bench area; (2) along the eastern portion of the mesa sidewall where it is bisected by the potential haul and a drainage; and (3) east of the claim #78 boundary. The highest concentrations were observed on bedrock outcrops on the western portion of the mining/reclaimed disturbed area (greater than twenty times the IL) and eastern mesa sidewall (greater than eleven times the IL), with measurements decreasing with distance from these areas.

The lateral extent of IL exceedances outside the eastern and western Survey Area B mesa sidewall were not surveyed. This is identified as a potential data gap. However, the IL exceedances occur in areas of thin soil and exposed bedrock with no observed mining-related disturbance, and therefore appear to be representative of naturally occurring conditions.

One background reference area (BG-1) was selected to represent the Mancos Shale and the Quaternary deposits on the valley bottom. BG-1 was located within the Mancos Shale along the border with the Quaternary deposits. Outside of known mining-impacted areas (e.g., the western mine waste burial pit), surface gamma measurements are less than two times the BG-1 IL (refer to Figure 4-1b). However, the BG-1 IL (i.e., the BG-1 IL of 20,677) is elevated when compared to IL values for Quaternary deposits at other AUMs. Due to the potential extent of mining-related impacts into Quaternary deposits southwest of the claim areas (identified by IL exceedances), a separate background reference area is warranted to represent the Quaternary deposits. This is identified as a data gap. Of note, the addition of a separate background reference area to represent the Quaternary deposits will alter the estimate of the lateral and vertical extent of mining-related impacts developed from this evaluation.

A surface gamma survey was also conducted in the exploration area located on the mesa bench/mesa top (refer to Section 3.3.1.2). The spatial patterns of surface gamma measurements in the exploration area are shown in Figure 4-1d. Surface gamma measurements within the exploration area ranged from 7,942 cpm to 20,428 cpm. In general, higher surface gamma survey measurements occurred in the northern portion of the exploration area; however, no distinct spatial pattern was observed. All measurements were less than two times the BG-2 (i.e., Toreva Formation) IL.

Five potential data gaps were identified for the surface gamma survey, as listed below:

1. Field personnel were unable to perform the surface gamma survey in some areas along the mesa sidewall because of access and safety issues. Approximately 1.4 acres could not be surveyed due to unsafe terrain (refer to Figure 3-4).

2. The survey was not extended laterally along the Survey Area B mesa sidewall where gamma measurements were greater than the IL because of professional judgement that the mining-impacted material did not extend across the drainages on the west and east sides of the Site and that the material at the extent of the survey was NORM. This data gap is considered minor because the areas are not disturbed by mining and the IL exceedances appear to be representative of naturally occurring conditions.

3. Only the approximate centerline of the western and eastern extents of the northern potential haul road were surveyed. The road shoulders were not surveyed due to a miscommunication with the field team.

4. The gamma survey was not extended laterally from portions of the western and eastern extent of the potential haul roads where gamma measurements were greater than the IL, due to miscommunication with the field personnel. However, gamma measurements on the potential haul roads were less than two times the IL (refer to Figure 4-1c).

5. A background reference area is warranted to better evaluate potential mining-related impacts in the Quaternary deposits on the valley bottom.

4.2.1.2 Subsurface Gamma Survey

Surface and subsurface static gamma measurements were collected at all but one of the 62 borehole locations. A surface static gamma measurement was not collected at S078-SCX-058; refer to Appendix C.2. Surface and subsurface static gamma measurement locations are shown in Figure 3-6b. Measurements and corresponding measurement depths are provided in Table 4-2 and are shown on the borehole logs in Appendix C.2. Surface and subsurface static gamma measurements from the boreholes are presented below by Survey Area:

- Survey Area A – The subsurface static gamma IL (29,180 cpm) was exceeded in soil/sediment in 35 of the 40 boreholes in Survey Area A. Locations where subsurface static gamma measurements did not exceed the IL were generally located in the valley bottom and foothill areas along the periphery of Survey Area A, outside of mining-disturbed or impacted areas. The maximum subsurface static measurement (499,890 cpm) was measured in soil at 7.0 ft bgs in borehole S078-SCX-041, which was in the center of the western mine waste burial pit. In general, surface and subsurface static gamma measurements were less than two times the IL and increased slightly or remained approximately constant with depth. There are two exceptions to the above: (1) at a number of locations collected within the identified mine waste burial pits static gamma measurements were five to ten times the IL, measurements increased with depth where coincident with potential buried material, and then decreased with depth after that; and (2)at location S078-SCX-037 gamma measurements were collected from the potential haul road in the foothills and static gamma measurements increased with depth to approximately ten times the IL in soil samples collected above bedrock. Nineteen of the 40 borehole locations had measurements collected from bedrock in addition to soil and/or sediment. Subsurface static gamma measurements in bedrock typically were similar to, or slightly higher than, measurements in the overlying soil/sediment.

- Survey Area B – A subsurface static gamma IL was not established for Survey Area B. The maximum subsurface static gamma measurement in soil (127,896 cpm) was collected at 1.0 ft bgs in borehole S078-SCX-024, which was in a berm that was used to divert water from draining into the mining/reclaimed disturbed area on the east side of the mesa bench in Survey Area B. Subsurface soil/sediment static gamma measurements generally increased or remained constant with depth with the highest measurement at each location generally measured at the soil/bedrock interface. The exceptions to this are S078-SCX-024 (maximum detection location described above) and -SCX-026 described below. In borehole S078-SCX-026, static gamma measurements initially increased with depth to 62,658 cpm at

4.0 ft bgs, and then decreased further down-hole; S078-SCX-026 is located in the area of the potential haul road and downgradient from the seep. Subsurface static gamma measurements were collected in bedrock in 12 of the 21 locations in Survey Area B. The maximum subsurface static gamma measurement in bedrock (578,306 cpm) was collected at 8.0 ft bgs in borehole S078-SCX-012 in the western portion of the mining/reclaimed disturbed area. Subsurface static gamma measurements in bedrock typically were similar to, or up to two times the measurements in the overlying soil/sediment in the eastern and northern areas of the mining/reclaimed disturbed area. In the western portion of the mining/reclaimed disturbed area, gamma measurements were significantly higher in bedrock than those measured in overlying soil, this is also the primary zone that was targeted for mining, per discussions on-site with NAML representatives.

4.2.2 Gamma Correlation Results

The high-density surface gamma measurements and concentrations of Ra-226 in surface soils obtained from the Gamma Correlation Study (refer to Section 3.3.1.3) were used to develop a correlation equation, using regression analysis, between the mean gamma measurements and Ra-226 concentrations measured in the co-located composite surface soil samples. This correlation is meant to be used as a general screening tool and provides approximate predicted Ra-226 concentrations.

The correlation was developed as a potential field screening tool for future Removal or Remedial Action evaluations. The Trust has provided all correlation data to the Agencies. Analytical results of the correlation samples, which were used to develop the correlation equation, are presented in Table 4-3. The mean value of the gamma survey results from the correlation plots, with their corresponding Ra-226 concentrations and a graph showing the linear regression line and adjusted Pearson's Correlation Coefficient (R^2) value for the correlation, are shown in Figure 4-2a. The regression produced an adjusted R^2 value of 0.71, which is not within the acceptance criterion of 0.8 to 1.0 described in the *RSE Work Plan*. The adjusted R^2 value is likely lower because correlation locations S078-C03-001 and S078-C04-001 have similar Ra-226 concentrations (19.1 and 19.9 pCi/g, respectively) but the mean gamma count rates for the two locations are not similar (33,222 cpm and 52,335 cpm, respectively). These results were possibly due to the presence of gamma radiation heterogeneity at correlation location S078-C04-001 (in comparison to more homogenous measurements at correlation location S078-C03-001), that was not captured in the five-point composite soil sample (refer to Appendix A for correlation location statistics). The correlation model may have been influenced by additional environmental conditions and the limited number of correlation sample locations. Users of the regression equation should be aware of the limitations of the dataset and be cautious when estimating radium-226 concentrations. The inability to construct a statistically defensible correlation model is identified as a data gap.

The correlation equation to convert gamma measurements in cpm to predicted surface soil Ra-226 concentrations in pCi/g for the Site is:

$$\text{Gamma (cpm)} = 1{,}380 \times \text{Surface Soil Ra-226 (pCi/g)} + 16{,}142$$

The predicted Ra-226 concentrations in soil, as calculated from the gamma measurements using the developed correlation equation, are shown in Figure 4-2a. Ra-226 concentrations predicted using gamma measurements lower than the minimum (16,151 cpm) and greater than the maximum (52,335 cpm) mean gamma measurements from the Gamma Correlation Study are extrapolated from the regression model and are therefore uncertain. Using the correlation equation, the predicted Ra-226 concentration associated with the minimum mean gamma measurement is 0.007 pCi/g and the concentration associated with the maximum mean gamma measurement is 26.2 pCi/g. Therefore, predicted Ra-226 concentrations less than 0.007 pCi/g and greater than 26.2 pCi/g should be limited to qualitative use only. The correlation locations were intentionally selected to be focused on the lower range of gamma measurements observed at the Site. Mean gamma measurements for correlation locations ranged from 16,151 to 52,335 cpm. The correlation was focused on the lower range because future Removal or Remedial Action decisions become more critical at lower Ra-226 concentrations where the limits of remediation may be defined.

The correlation equation predicted Ra-226 concentrations that were less than zero for gamma survey measurements below 16,143 cpm. The predicted concentrations are shown in Figure 4-2a and the values less than zero are generally located in undisturbed areas of the Site. The elevated predicted Ra-226 concentrations shown in Figure 4-2a occur in the same areas where the elevated surface gamma measurements occur (refer to Section 4.2.1). This is because the predicted Ra-226 concentrations are based on a correlation with the gamma measurements. Predicted Ra-226 concentrations in the Survey Area range from -7.8 to 206.4 pCi/g, with a mean of 2.6 pCi/g, and a standard deviation, of 5.5 pCi/g. Bin ranges in Figure 4-2a are based on these mean and standard deviation values.

The gamma correlation was not used for the Site Characterization, which instead relied on actual gamma radiation measurements and soil analytical results. However, predicted Ra-226 concentrations were compared to the Ra-226 laboratory concentrations measured in surface soil samples collected at surface and borehole locations, as shown in Figure 4-2b. The correlation results were also compared to investigation levels, as shown in Figure 4-2c. Per the Agencies, these comparisons can be used for site characterization and are one of many analyses that can be used to interpret the data (NNEPA, 2018).

When comparing the predicted Ra-226 concentrations to the Ra-226 laboratory concentrations, soil/sediment sample locations are generally not co-located with specific gamma measurement locations (refer to Figure 4-2b). Therefore, the measured Ra-226 laboratory concentrations can only be qualitatively compared to the nearby predicted Ra-226 concentrations. A majority of the measured Ra-226 laboratory concentrations were within the applicable predicted Ra-226 bin ranges (44 out of 76 locations), laboratory Ra-226 concentrations were lower than the predicted bin range at 15 locations and were higher than the predicted bin range at 16 locations. Notable locations where the laboratory Ra-226 concentrations were not within the predicted range included: (1) most of the samples in the western portion of the mining/reclaimed disturbed area on the mesa bench (S078-SCX-001, -SCX-002, -SCX-012, -SCX-015, -SCX-016, and -SCX-017) where surface soil/sediment samples have laboratory Ra-226 concentrations that were lower than the predicted Ra-226 concentrations; (2) sample S078-SCX-024 collected from the berm near the upstream segment of the eastern drainage, which had a laboratory Ra-226 concentration that was higher than the predicted Ra-226 concentration in the vicinity of the sample; (3) samples S078-SCX-004, -SCX-005, and -SCX-037 collected on the mesa sidewall had laboratory concentrations lower than the predicted Ra-226 concentrations; and (4) sample S078-CX-002 collected from the valley bottom west of the claim #79 boundary, which has a laboratory Ra-226 concentration that was higher than the predicted Ra-226 concentration in the vicinity of the sample.

These results indicated that the correlation equation may predict higher or lower Ra-226 concentrations than the actual concentrations at specific locations. This is a function of the natural heterogeneity in Ra-226 concentrations and gamma radiation measurements, which affects the correlation based on the five Gamma Correlation Study areas, and the predicted values, based on the subsequent gamma measurements.

The predicted Ra-226 concentrations were also compared to the Ra-226 ILs from each Survey Area, as shown in Figure 4-2c. The symbols for surface sample locations and boreholes where Ra-226 concentrations in surface soil/sediment samples exceeded the IL are highlighted with yellow halos. Laboratory results for Ra-226 exceeded ILs for the vast majority of the site. While these locations generally fell in areas where predicted Ra-226 concentrations were also above ILs, a number of laboratory results exceeded ILs in the southern portion of Survey Area A and northern portion of Survey Area B where predicted Ra-226 concentrations were below ILs. The area of the Site where predicted Ra-226 values exceeded the ILs is compared to surface gamma IL exceedances in the surface gamma survey in Section 4.5.

The correlation soil samples were also analyzed for thorium isotopes Th-232 and Th-228. The objectives of the thorium analyses were to assess the potential effects of Th-232 series radioisotopes on the correlation of gamma measurements to concentrations of Ra-226 in surface soils (i.e., to evaluate whether gamma-emitting radioisotopes in the Th-232 series are impacting gamma measurements at the Site). The justification for the analysis is provided in Section 3.3.1.3. A multivariate linear regression (MLR) regression model was performed by ERG to relate the gamma count rate to multiple soil radionuclides simultaneously. The MLR and results are described extensively in Appendix A. ERG identified that the thorium series radionuclides do not affect the prediction of concentrations of Ra-226 from gamma survey measurements at the Site.

4.2.2.1 Secular Equilibrium Results

The activities of Th-230 and Ra-226 were compared to consider whether the uranium series is in secular equilibrium at the Site (refer to Section 3.3.1.4 and Appendix A). A linear regression was performed on the dataset (refer to Appendix A Figure 9). The p-value for the regression slope is significant (i.e., $p < 0.05$) and the adjusted R^2 meets the study DQO (adjusted $R^2 > 0.8$), indicating that Ra-226 and Th-230 exist in equilibrium. However, when compared to a y=x line (this line represents a perfect 1:1 ratio between Th-230 and Ra-226, indicating secular equilibrium), the y=x line falls partially outside of the 95% UCL bands of the Th-230/Ra-226 regression, indicating

Ra-226 and Th-230 are not in secular equilibrium at the Site (refer to figures in Appendix A). This may be an important consideration in the future if a human health and/or ecological risk assessment is performed.

4.3 SOIL METALS AND RADIUM-226 ANALYTICAL RESULTS

A total of 73 surface soil/sediment grab samples (57 soil and 16 sediment) from 73 locations, 90 subsurface soil/sediment grab samples (77 soil and 13 sediment) from 46 borehole locations, and 18 samples that contained bedrock or boulder material from 15 borehole locations were collected at the Site (refer to Table 3-2). The metals and Ra-226 analytical results for each Survey Area are compared to their respective ILs and presented in Tables 4-4a and 4-4b. Figures 4-3a through 4-3e present the spatial patterns, both laterally and vertically, of metals and Ra-226 detections and IL exceedances in the soil/sediment and bedrock samples.

Ra-226 and/or metals concentrations exceeded their respective ILs in all but one surface soil sample (S078-SCX-038 in Survey Area A) and in all but one subsurface sample (S078-SCX-053 in Survey Area A). The maximum Ra-226 and metals concentrations were detected in the western and eastern mine waste burial pits in Survey Area A, in the berm near the upstream segment of the eastern drainage in Survey Area B, and in the mesa sidewall in both Survey Areas A and B. The maximum concentrations for Ra-226 were detected along the potential haul road (S078-SCX-037) and in the western mine waste burial pit (S078-SCX-041). The maximum concentrations for uranium and vanadium were detected in subsurface soil in the western mine waste burial pit (S078-SCX-041). The maximum concentration for arsenic was detected in subsurface soil in the eastern mine waste burial pit (S078-SCX-036). The maximum concentration for molybdenum was detected in surface soil sample near the eastern boundary of claim #78 (S078-SCX-005), and the maximum concentration for selenium was detected in a soil sample along the potential haul road on the mesa sidewall (S078-SCX-026). Presented sample counts include normal samples and do not include duplicate samples. Surface and subsurface soil/sediment IL exceedances for each analyte, with respect to each of the two survey areas, are described below:

- Ra-226
    - Survey Area A – The Ra-226 IL (3.59 pCi/g) was exceeded in 31 of 47 surface soil/sediment samples and 42 of 75 subsurface soil/sediment samples. Survey Area A Ra-226 concentrations ranged from 1.17 to 134 pCi/g. The highest concentrations occurred in subsurface soil along the potential haul road at the base of the mesa sidewall (134 pCi/g at S078-SCX-037), and subsurface soil in the center of the western mine waste burial pit (90 pCi/g at S078-SCX-041). In both cases the highest concentrations occurred at intermediate depths within the boreholes with concentrations decreasing in shallower and deeper soil/sediment. All other Ra-226 concentrations were less than ten times the IL. Additionally, Ra-226 was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 1.68 to 47.7 pCi/g.
    - Survey Area B – The Ra-226 IL (2.02 pCi/g) was exceeded in 20 of 26 surface soil/sediment samples and all 15 subsurface soil/sediment samples. Survey Area B Ra-226

concentrations ranged from 1.48 to 24.8 pCi/g. The highest concentration (24.8 pCi/g) occurred in surface sediment in the berm near the upstream segment of the eastern drainage (S078-SCX-024). All other Ra-226 concentrations were less than ten times the IL and displayed no apparent spatial patterns or concentrations gradients. Additionally, Ra-226 was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 0.94 to 136 pCi/g.

- Uranium
    - Survey Area A – The uranium IL (3.21 mg/kg) was exceeded in 31 of 47 surface soil/sediment samples and 54 of 75 subsurface soil/sediment samples. Survey Area A uranium concentrations ranged from 0.73 to 140 mg/kg. The highest concentrations (up to 140 mg/kg) occurred in subsurface soil in the center of the western mine waste burial pit (S078-SCX-041). Uranium was also detected at concentrations ranging from 39 to 55 mg/kg in subsurface soil/sediment within the eastern mine waste burial pit (S078-SCX-031, -SCX-034, and -SCX-035). The detected high concentrations all occurred at intermediate depths within each borehole, likely coincident with buried waste material. All other uranium concentrations were less than ten times the IL. Additionally, uranium was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 2.0 to 140 mg/kg.
    - Survey Area B – The uranium IL (1.46 mg/kg) was exceeded in all 26 surface soil/sediment samples and all 15 subsurface soil/sediment samples. Survey Area B uranium concentrations ranged from 1.7 to 92 mg/kg. The highest concentration (92 mg/kg) occurred in surface sediment in the berm near the upstream segment of the eastern drainage (S078-SCX-024). Uranium was also detected at concentrations ranging from 28 to 65 mg/kg in surface and subsurface soil along the potential haul road in the southern portion of the mining/reclaimed disturbance area (S078-SCX-026). All other uranium concentrations were less than 23 mg/kg. Additionally, uranium was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 0.74 to 400 mg/kg.

As a broader point of reference, a regional study of the Western US documented uranium concentrations in soil that ranged from 0.68 to 7.9 mg/kg, with a mean value of 2.5 mg/kg (USGS, 1984). Uranium concentrations exceeded the maximum regional value in 42 out of 122 Survey Area A soil/sediment samples, and ten out of 42 Survey Area B soil/sediment samples.

- Arsenic
    - Survey Area A – The arsenic IL (3.35 mg/kg) was exceeded in 38 of 47 surface soil/sediment samples and 65 of 75 subsurface soil/sediment samples. Survey Area A arsenic concentrations ranged from 1.7 to 20 mg/kg. The highest concentrations occurred in subsurface soil in the eastern portion of the eastern mine waste burial pit (20 and 12 mg/kg at S078-SCX-036 and -SCX-035, respectively). The detected high concentrations occurred at an intermediate depth (3.0 ft bgs) in borehole S078-SCX-035 and at the bottom depth (16.0 ft bgs) in borehole S078-SCX-036. All other arsenic concentrations were less than three times the IL. Additionally, arsenic was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 2.3 to 4.7 mg/kg.

  - Survey Area B – The arsenic IL (18.6 mg/kg) was not exceeded in any of the 26 surface soil/sediment samples or any of the15 subsurface soil/sediment samples in Survey Area B. Arsenic concentrations ranged from 1.8 to 18 mg/kg. The highest concentration in Survey Area B occurred in a subsurface soil sample collected on the mesa sidewall. Arsenic was detected in eight of the nine samples that contained bedrock or boulder material at concentrations ranging from 2.6 to 6.3 mg/kg.

As a broader point of reference, a regional study of the Western US documented arsenic concentrations in soil that ranged from less than 0.10 to 97 mg/kg, with a mean value of 5.5 mg/kg (USGS, 1984). All arsenic concentrations were within the typical range of regional values in the soil/sediment samples from Survey Areas A and B.

- Molybdenum

  - Survey Area A – The molybdenum IL (0.568 mg/kg) was exceeded in 14 of 47 surface soil/sediment samples and 34 of 75 subsurface soil/sediment samples. Detected Survey Area A molybdenum concentrations ranged from 0.2 to 2.8 mg/kg and molybdenum was not detected in one surface soil sample (S078-CX-004). The highest concentration (2.8 mg/kg) occurred in subsurface soil in the center of the western mine waste burial pit (S078-SCX-041). Molybdenum was also detected in subsurface soil/sediment in the center of the eastern mine waste burial pit (S078-SCX-032) and the central drainage at the base of the mesa sidewall (S078-SCX-037) at 2.0 and 1.9 mg/kg, respectively. The detected high concentrations all occurred at the bottom depth within each borehole. All other molybdenum concentrations were less than three times the IL. Additionally, molybdenum was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 0.27 to 2.5 mg/kg.

  - Survey Area B – The molybdenum IL (0.371 mg/kg) was exceeded in 19 of 26 surface soil/sediment samples and all 15 subsurface soil/sediment samples. Detected Survey Area B molybdenum concentrations ranged from 0.27 to 5.0 mg/kg. The highest concentration (5.0 mg/kg) occurred in surface soil in the mesa sidewall in the eastern portion of the claim #78 boundary (S078-SCX-005). Molybdenum was also detected at concentrations ranging from 2.9 to 3.3 mg/kg in surface and subsurface soil in the mesa sidewall (S078-SCX-003 and –SCX-004) and northeast of the claim #78 boundary (S078-SCX-062). All other molybdenum concentrations were less than, or approximately equal to, five times the IL. Additionally, molybdenum was detected in seven of the nine samples that contained bedrock or boulder material at concentrations ranging from 0.49 to 2.6 mg/kg; molybdenum was not detected in one bedrock sample (S078-SCX-020).

As a broader point of reference, a regional study of the Western US documented molybdenum concentrations in soil that ranged from less than 3 to 7 mg/kg, with a mean value of 0.85 mg/kg (USGS, 1984). All molybdenum concentrations were within the typical range of regional values in soil/sediment samples from Survey Areas A and B.

- Selenium – A selenium IL for Survey Area B was not identified because in BG-2 only two detections of selenium exist, and the detections both have the same concentration of 1 mg/kg. One distinct detection value is insufficient for ProUCL to calculate an IL.

  - Survey Area A – The selenium IL (1.10 mg/kg) was exceeded in 43 of 47 surface soil/sediment samples and 71 of 75 subsurface soil/sediment samples. Detected Survey Area A selenium concentrations ranged from 1.1 to 6.3 mg/kg; selenium was not detected in five surface and subsurface soil/sediment samples. The highest concentration (6.3 mg/kg) occurred in subsurface soil in the eastern portion of the eastern mine waste burial pit (S078-SCX-035). This detection occurred at an intermediate depth (7.0 ft bgs) with lower concentrations in shallower and deeper samples. The highest selenium concentrations occurred in subsurface soil within the eastern mine waste burial pit (S078-SCX-031 and -SCX-035). Additionally, selenium was detected in eight of the nine samples that contained bedrock or boulder material at concentrations ranging from 1.1 to 8.3 mg/kg.

  - Survey Area B – Selenium was detected in 21 of 26 surface soil/sediment samples and 13 of 15 subsurface soil/sediment samples at concentrations ranging from 1.3 to 13 mg/kg. The highest concentration (13 mg/kg) occurred in subsurface soil along the haul road in the southern portion of the mining/reclaimed disturbance area (S078-SCX-026). Selenium was also detected at a concentration of 7.8 mg/kg in subsurface soil in the northeast of the claim #78 boundary (S078-SCX-062). All other selenium concentrations were less than 3.7 mg/kg. As noted above, a selenium IL was not identified for Survey Area B. Additionally, selenium was detected in six of the nine samples that contained bedrock or boulder material at concentrations ranging from 1.1 to 7.3 mg/kg.

As a broader point of reference, a regional study of the Western US documented selenium concentrations in soil that typically ranged from less than 0.10 to 4.3 mg/kg, with a mean value of 0.23 mg/kg (USGS, 1984). Selenium concentrations were within the typical range of regional values in both survey areas, with the exception of locations S313-SCX-035 in Survey Area A, and S313-SCX-026 and -SCX-062 in Survey Area B.

- Vanadium

  - Survey Area A – The vanadium IL (12.2 mg/kg) was exceeded in 43 of 47 surface soil/sediment samples and 70 of 75 subsurface soil/sediment samples. Survey Area A vanadium concentrations ranged from 7.1 to 140 mg/kg. The highest concentration (140 mg/kg) occurred in subsurface soil in the center of the western mine waste burial pit (S078-SCX-041). Vanadium was also detected at concentrations ranging from 100 to 120 mg/kg in surface and subsurface soil/sediment within the eastern mine waste burial pit (S078-SCX-031, -SCX-032, and -SCX-035). The detected high concentrations occurred at an intermediate depth in the western mine waste burial pit, and at surface, intermediate, and bottom depths in boreholes at the eastern mine waste burial pit. All other vanadium concentrations were less than six times the IL. Additionally, vanadium was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 10 to 95 mg/kg.

  - Survey Area B – The vanadium IL (22.3 mg/kg) was exceeded in seven of 26 surface soil/sediment samples and four of 15 subsurface soil/sediment samples. Survey Area B vanadium concentrations ranged from 9.4 to 74 mg/kg. The highest concentration (74 mg/kg) occurred in surface sediment in the berm near the upstream segment of the eastern drainage (S078-SCX-024). Vanadium was also detected at concentrations ranging from 56 to 60 mg/kg in surface and subsurface soil along the potential haul road in the southern portion of the mining/reclaimed disturbance area (S078-SCX-026). All other vanadium concentrations were less than two times the IL. Additionally, vanadium was detected in all nine samples that contained bedrock or boulder material at concentrations ranging from 10 to 410 mg/kg.

As a broader point of reference, a regional study of the Western US documented vanadium concentrations in soil that ranged from 7 to 500 mg/kg, with a mean value of 70 mg/kg (USGS, 1984). All vanadium concentrations were within the typical range of regional values in soil/sediment samples from Survey Areas A and B.

4.4 CONSTITUENTS OF POTENTIAL CONCERN

Based on the results presented in Sections 4.2 and 4.3, gamma radiation and concentrations of Ra-226, arsenic, molybdenum, selenium, uranium, and vanadium in soil/sediment exceeded their respective ILs in Survey Areas A and B. Therefore, these constituents were confirmed as COPCs for the Site.

4.5 AREAS THAT EXCEED THE INVESTIGATION LEVELS

The approximate lateral extent of surface gamma IL exceedances in soil/sediment is 35.3 acres, as shown in Figure 4-4a. To estimate this area, polygons were contoured around portions of the Site that had multiple, contiguous surface gamma IL exceedances and then the total area within the polygons was calculated. Figures 4-4b and 4-4c show larger scale views of each of the two Survey Areas to better display those areas with multiple, contiguous surface gamma IL exceedances. Twelve sample locations were located in areas that were not included in the 35.3 acres, as follows:

- Three locations within the eastern mine waste burial pit footprint (S078-SCX-031, -SCX-035, and -SCX-036) had uranium concentrations greater than 10 times the uranium IL, and arsenic, selenium, vanadium, and Ra-226 concentrations up to greater than five times their respective ILs, but static gamma measurements below the IL. The areas around these samples are included in the TENORM volume estimate in Section 4.7.

- Three locations in the valley bottom, located cross-gradient from the potential mine waste on the mesa sidewall (S078-SCX-060), near Baird Route 29 (S078-CX-006), and in the down-stream portion of the eastern drainage (S078-SCX-010), had Ra-226 or metals concentrations less than, or approximately equal to, two times their respective ILs, but static gamma measurements below the IL. These areas within the valley bottom, were outside of the areas that were estimated to be impacted by mining, and were not included in the TENORM volume estimate in Section 4.7.

- Four locations in the northern portion of the mining/reclaimed disturbed area, located in the upstream section of the western drainage (S078-CX-008), along the potential haul road (S078-SCX-022 and –SCX-025), and in the northern berm up-slope from the central and eastern drainages (S078-CX-014), had molybdenum, uranium, and Ra-226 concentrations typically less than two times their respective ILs. The molybdenum concentration in S078-SCX-025 was less than three times the molybdenum IL. These areas within the mining/reclaimed disturbed area were included in the TENORM volume estimate in Section 4.7 because of the amount of visible ground disturbance in the areas of these samples.

- Two locations northeast of the claim #78 boundary, located cross-gradient from the eastern drainage (S078-CX-013) and near a potential haul road (S078-SCX-062), had vanadium and Ra-226 less than three times their respective ILs and molybdenum and uranium concentrations less than ten times their respective ILs for location S078-SCX-062. There was no visual evidence of mining disturbance of the ground surface at both sample locations. Therefore, these areas were not included in the TENORM volume estimate in Section 4.7.

Figures 4-5a, 4-5b, and 4-5c show the vertical extent of IL exceedances in each borehole by incorporating information from each location, including: (1) depth to bedrock; (2) total borehole depth; and (3) depth range of IL exceedances. Table 4-5 lists the IL exceedances identified at each borehole location and Figures 4-5a, 4-5b, and 4-5c show the surface gamma IL exceedances for reference.

IL exceedances in metals and Ra-226 concentrations at surface and subsurface sample locations are generally co-located with surface gamma survey measurements that exceeded the IL. Variations are typically the result of natural variability and the different field methods. For example, a small piece of mineralized rock or petrified wood may have been collected in a soil sample but may not have been detected by the gamma meter in the gamma survey due to distance from the meter, the depth below ground surface, or because the gamma meter measures radiation over a larger area than the discrete soil sample location, which tends to average the gamma levels.

The lateral extent of the IL exceedances (for surface gamma data) shown in Figure 4-4a were compared to the predicted Ra-226 concentrations that exceeded ILs in Figure 4-2c. Predicted Ra-226 concentrations exceeded the Ra-226 IL in a smaller area of the Site than the surface gamma IL exceedances. Surface gamma IL exceedances covered approximately three quarters of Survey Area B while predicted Ra-226 exceedances covered approximately half of the Survey Area. The most noticeable differences were in the central (including the central portion of claim #79) and northern portions of Survey Area B where much of the predicted Ra-226 concentrations fell below the Ra-226 IL. Surface gamma and predicted Ra-226 exceedances covered approximately the same areas within Survey Area A.

4.6 AREAS OF TENORM AND NORM

A multiple lines of evidence approach was used to evaluate the Site and distinguish areas of TENORM from areas of NORM within the Survey Area, as described in Section 3.3.3. Based on this evaluation, 44.7 acres, out of the 73.1 acres of the Survey Area, were estimated to contain TENORM at the Site. This estimate is inclusive of three areas: the mining/reclaimed disturbed area and surrounding areas (primarily the mesa bench and upper mesa sidewall), the lower mesa sidewall and foothills, and the valley bottom. The area containing TENORM is shown in relation to the lateral extent of IL exceedances in Figure 4-6 and in relation to the gamma measurements in Figure 4-7.

The RSE data that supports the delineation of TENORM at the Site includes:

- Historical Data Review Conclusions
    - Historical document review indicated that a mine waste burial pit was present on-site. Also, documentation noted that two rim strips and three pits were reclaimed, and an adit, an additional pit and waste pile were present on-site; however, Stantec personnel did not observe these features.
    - Between 1957 and 1968, 4,181.08 tons of ore that contained 17,327 pounds of 0.21 percent U_3O_8 and 13,400 pounds of 0.27 percent V_2O_5 were produced from the Site.
    - Historical document review suggested that reclamation activities had taken place for two rim strips, three pits, and along the potential haul road on the mesa sidewall. This resulted in the creation of one mine waste burial pit, a large disturbance area and partial revegetation of the mesa bench, emplacement of berms and check dams along the eastern drainage, and removal of the potential haul road along the mesa sidewall.
- Geology/geomorphology
    - Bedrock at the Site consisted of two geologic formations: (1) the Toreva Formation; and (2) the Mancos Shale. On-site uranium was located in carnotite within the Toreva sandstone, beneath a carbonaceous siltstone. Additionally, portions of the Site consisted of shallow or outcropping bedrock. Therefore, the geology and geomorphology of the Site was conducive to the presence of NORM at or near the ground surface.
    - Several ephemeral drainages are present on-site that drain to the southwest until they are diverted to culverts along Baird Route 29 and then drain southeast (see Figures 2-1 and 2-9a). A diversion drainage and culverts were placed along Baird Route 29 to channel water from the Site toward an engineered drainage channel located south of Baird Route 29. One of the drainages (north of claim #79) previously crossed the road near the home-site and terminated in the pond. It is now diverted southeast along Baird Route 29 to a culvert, placed under Baird Route 29, and into the engineered drainage. One drainage terminates in a pond, and the other two drainages drain through the culverts, placed under Baird Route 29, and into the engineered drainage channel. The drainages could have transported NORM/TENORM to the southwest.
    - An active seep was identified on the mesa sidewall in the southern portion of the claim #78 boundary and within the mining/reclaimed disturbed area. Because the seep was located in the mining/reclaimed disturbed area, flow from the seep could have transported NORM/TENORM downgradient.

- Disturbance Mapping – Stantec field personnel observed the following features:
    - Mine waste material from accessible areas of the slopes and benches of the mesa sidewall was removed and placed in the eastern mine waste burial pit.
    - The location of the western and eastern mine waste burial pits.
    - Two potential haul roads ran from Baird Route 29 to claim#79 and the eastern mine waste burial pit, and then converged into one road on the foothills. The area of the potential haul road that ran along the mesa sidewall from the portion of the mining disturbed area south of the seep to the mesa bench was removed during reclamation. The portion of the potential haul road that crossed the mesa bench toward the exploration area was removed during reclamation activities. The potential haul road continues through the exploration area and then toward the northwest to where it eventually meets Baird Route 29 again. Another spur of the potential haul road continues to the southeast along the mesa sidewall.
    - The west side of the mesa bench was reclaimed and revegetated. During an on-site visit, NAML personnel stated that a pit or pits were present in the western portion of the mining/reclaimed disturbed area. The pit was less than 10 ft deep. It was backfilled with waste material and clean cover material was placed followed by revegetation of the area.
    - The east side of the mesa bench, with weathered bedrock at the surface, was scraped and furrowed. The area was not re-vegetated and there was little to no vegetative growth in that area. A series of check dams/berms were placed in the eastern drainage to deter erosion of the mesa edge, but a large erosional incision was present along the mesa edge and runnels were present on the mesa sidewall.
- Site Characterization
    - Mining-related disturbances were present in the mining/reclaimed disturbed area and surrounding areas located on the mesa bench and upper mesa sidewall; these areas comprise the majority of Survey Areas B and the northeastern portion of Survey Area A, are inclusive of portions of the potential haul roads, and the upper sections of the ephemeral drainages. Surface gamma IL exceedances were generally observed in the southern/southwestern portions of the mesa bench and along the mesa sidewall, coincident with the mining/reclaimed disturbed area, and in surrounding areas. The highest surface gamma measurements were observed in the western portion of the mining/reclaimed disturbed area coincident with bedrock outcrops exposed at the junction of the potential haul road and the revegetated area. A mix of coal-like and sandstone bedrock outcrops were present where the highest gamma measurements were collected on the Site (western mining/reclaimed area and east of the claim #78 boundary), this is likely the carnotite ore material that was targeted during mining operations. The highest Ra-226, uranium, and vanadium concentrations in soil/sediment within the mining/reclaimed disturbed area were measured in surface sediment at the berm near the upstream section of the eastern drainage, while the highest arsenic, molybdenum, and selenium concentrations were measured in surface and subsurface soil on the mesa sidewall in the southern portion and just south from the mining/reclaimed disturbed area. The lateral extent of TENORM is defined based on IL

exceedances in the southern sections of this area and by observed disturbance areas and haul roads in the northern portion.

- Historical documentation as well as NAML personnel identified the general area of a historical pit within the mining/reclaimed disturbed area on the western side of the mesa bench. A number of boreholes and a geophysical survey were completed as part of the RSE, on the mesa top in an attempt to identify the location of the pit(s). Boreholes were placed based on information from NAML personnel and the 1966 historical aerial photograph. Bedrock (including weathered sandstone, shale, and coal) was encountered at or shallower than 2.0 ft bgs in boreholes throughout the remediated/revegetated area (S078-SCX-012, -SCX-013, -SCX-015, -SCX-016, and –SCX-017). A backfilled pit was not identified, because buried waste material was not observed, and bedrock was encountered at shallow depths (2.0 ft or less). However, a large outcrop which forms a topographic high point was present at the top of the haul road adjacent to the area reported as a historical pit, as shown in Appendix B-2 photograph number 20.

- It is assumed that the historical "pit" may have consisted of the surface excavation of this outcrop down to the surrounding ground surface.

- Some of the highest surface gamma survey measurements for the Site were collected near a coal/sandstone bedrock outcrop, on the mesa bench, east of the claim #78 boundary. Ground disturbance is limited in the area of the outcrop and a large amount of the colluvium down-slope from the area of the outcrop exceeded the IL. This area was included as TENORM due to the disturbance in the area of the outcrop and because it is adjacent to visible mining related disturbance. It is important to note that gamma survey measurements in undisturbed areas on the mesa sidewall east of this area also exceeded the IL. These areas were assumed to be NORM. Runoff from both the TENORM and NORM areas drain into the eastern drainage at the Site.

- The lower mesa sidewall and foothills comprise the eastern and northeastern portions of Survey Area A and are inclusive of a section of the mesa sidewall potential haul road, the eastern mine waste burial pit, potential mine waste material on the mesa sidewall, and segments of the eastern and central drainages. Surface gamma IL exceedances were generally observed throughout this area with the higher measurements along the mesa sidewall (coincident with the potential haul road and central drainage) and along the eastern drainage. The potential mine waste material on the western portion of the mesa sidewall included dark colored colluvium/waste material that was likely dozed/pushed off the mesa bench during mining operations. The highest Ra-226 concentration was measured in subsurface soil along the potential haul road near the base of the mesa sidewall, while the highest metals concentrations were measured in subsurface soil within the eastern mine waste burial pit footprint. The lateral extent of TENORM is defined based on IL exceedances along the mesa sidewall, the eastern and central ephemeral drainages, and potential haul road. Limited areas within the foothills west of the eastern drainage were not included in the TENORM area due to having only sporadic surface gamma exceedances (typically less than two times the IL) associated with exposed bedrock, and the lack of observed mining activity disturbance. Surface gamma survey measurements exceeded the IL in limited areas east of the eastern drainage. These areas are upgradient and across from the Site drainage and are assumed to contain NORM.

- The valley bottom, located in the south and southwestern portions of the Site, comprises the majority of Survey Area A, and is inclusive of the western mine waste burial pit, the claim #79 boundary, areas down-slope from potential mine waste and mining/reclaimed disturbed areas, and the downstream segments of the ephemeral drainages. Surface gamma IL exceedances were generally observed in the northern portion of the valley bottom with the higher measurements collected within the western mine waste burial pit. The highest Ra-226 and metals concentrations were measured in subsurface soil within the western mine waste burial pit footprint, with the exception of molybdenum for which the highest concentration was measured immediately down-slope from the potential mine waste observed on the mesa sidewall. The lateral extent of TENORM is defined based on IL exceedances along the valley bottom coincident with the claim #79 boundary, western mine waste burial pit, and potential haul road, and down-slope from observed potential mine waste material on the mesa sidewall. Limited areas south of the claim #79 boundary were not included in the TENORM area due to having only sporadic surface gamma exceedances (typically less than two times the IL) likely associated with exposed bedrock, and the lack of observed mining activity disturbance. It is important to consider that the addition of a separate background reference area to represent the Quaternary deposits within the valley bottom will alter the estimate of the lateral and vertical extent of mining-related impacts developed from this evaluation.

- Boreholes and geophysics were completed to characterize the volume of TENORM buried in the eastern mine waste burial pit. Buried waste material included silt, sand, gravels, and boulders. The static gamma survey measurements shown on the borehole logs in Appendix C.2 are indicative of the depth of waste material in the mine waste burial pit. The mine waste burial pit was placed in an existing drainage area that was excavated prior to placing waste. The waste material was placed on top of the colluvial/alluvial material that was present in the drainage. Waste material appears to extend to approximately 17.0, 20.0, 17.5, and 14.5 ft bgs in the S078-SCX-031, -SCX-032, -SCX-035, and -SCX-036 boreholes, respectively (refer to borehole logs). It is important to note that the depth of waste material was estimated based on analytical results and when static gamma measurements stabilized downhole. It is also assumed that the natural material below the waste material contains NORM. Information from NAML personnel during the on-site visit generally corroborate these findings, NAML personnel recalled that waste material extended to approximately 15 ft bgs. Results of the geophysical surveys also support these findings and correlate well with the borehole logs, as a consistent resistive break is present at approximately 15 to 20 ft bgs along the length of the mine waste burial pit.

- Boreholes were completed in the western mine waste burial pit in an attempt to identify if buried mine waste was present, and to identify the location of the waste. Historical documents that detailed reclamation activities did not include information about the western mine waste burial pit and NAML personnel that visited the Site could not provide information about the western mine waste burial pit. The area consisted of a revegetated disturbed area surrounded by a barbed wire fence and an earthen berm along the eastern edge. Conclusive information about buried waste material was only identified in one borehole (S078-SCX-041) where mine waste material appeared to be present from approximately 6.0 to 9.0 ft bgs, but the material above 6.0 ft may include TENORM as well. TENORM may also be present in the area of the S078-SCX-046 borehole (e.g., variable subsurface static gamma measurements), but information was not conclusive. While subsurface static gamma measurements and metals/Ra-226 concentrations exceeded the ILs in other nearby boreholes (S078-SCX-042, -SCX-043, -SCX-047, -SCX-048, and -SCX-050), there was no direct evidence that TENORM was present (i.e., fluctuating subsurface static gamma measurements or Ra-226/metals concentrations over an interval that contained waste material, or material properties that were visibly indicative of fill). Subsurface materials in the nearby boreholes generally appeared to be natural/undisturbed and were representative of geologic materials that would be expected to be present downslope from a steep sidewall that contained NORM (prior to mining activities). A volume estimate is provided for the western mine waste burial pit in Section 4.7.

- Metals concentrations in samples collected outside of the area of TENORM were within the regional concentration values except for S078-SCX-62 on the mesa top where the selenium and uranium concentrations exceeded the regional values.
- It is important to consider that the subsurface static gamma IL for Survey Area A (there is no subsurface static gamma IL for Survey Area B) was not used as a standalone measurement to delineate the vertical extent of TENORM that exceeded the IL at the Site. The static gamma IL was used as one line of evidence as described in Section 4.1. For example, the downhole increasing/decreasing trends of static gamma measurements in boreholes within the eastern mine waste burial pit provide more useful information regarding the location of buried mine waste than the presence of an IL exceedance.

The area of the Site considered to contain TENORM (i.e., multiple lines of evidence pointed to the presence of mining-related impacts) was 44.7 acres, as shown on Figure 4-8a. Portions of the TENORM exceeded one or more IL; where approximately 31.6 acres contained TENORM that exceeded the surface gamma IL and the majority of the sample locations where Ra-226 and/or metals ILs were exceeded. TENORM exceeding the ILs was observed at six sample locations that were not coincident with areas of the Site that exceeded the surface gamma IL. TENORM that exceeded the ILs in Survey Area A and Survey Area B is shown on Figures 4-8b and 4-8c, respectively, and is compared to mining-related features in Figure 4-8d.

4.7 TENORM VOLUME ESTIMATE

The volume estimate of TENORM that exceeded one or more IL is approximately 91,012 yd^3, as shown in Figure 4-9a. This estimate was calculated using ESRI ArcGIS Desktop 10.3.1 Spatial Analyst Extension cut/fill tool (ESRI, 2017). The volume analysis also utilized the ground surface elevation contours developed from the orthophotographs coupled with hand-derived contours based on field personnel observations, depth to bedrock in boreholes, gamma measurements, sample analytical data, and historical mining documentation. Field observations included observations of disturbance, changes in vegetation, estimating/projecting the slope of underlying bedrock, and estimating the shape and topography of waste material and/or soil deposits.

TENORM exceeding the ILs at the Site was split into groups based on the depth or type of material to aid in analysis and describing the basis of the volumes. The locations, volume, and areas of these groups are shown in Figure 4-9a. Assumptions used to calculate the volume were as follows:

General Assumptions

- It was assumed that subsurface bedrock encountered in boreholes was not previously modified by human activity and is therefore NORM.
- Portions of the areas delineated as exposed bedrock on Figure 4-9a contain small amounts of colluvium that is mining-disturbed within the areas of TENORM.
- For areas of TENORM at the Site containing large cobble- or boulder-sized rocks at the surface whose heights exceeded the assumed depth of TENORM in that area (e.g., a 3-ft-tall boulder in an area where TENORM was assumed to extend 1 ft bgs), the additional volume of the boulders was assumed to be accounted for by the TENORM depth estimates.
- The subsurface static gamma IL for Survey Area A (there is no subsurface static gamma IL for Survey Area B) was not used as a standalone measurement to delineate the vertical extent of TENORM that exceeded the IL at the Site. The static gamma IL was used as one line of evidence as described in Section 4.1.

Group Assumptions

- Group 1 (18,841 yd^3) – Contours of the thickness of the eastern mine waste burial pit were generated to support these volume calculations (refer to Figure 4-9b). The thickness contours were based on: (1) the depth of waste material (bottom surface) observed in boreholes; and (2) elevation profiles of the top of the mine waste burial pit area (top surface) based on topographic contours from the orthophotographs (Cooper, 2017). These data were used to generate cross-section A – A' shown in Figure 2-9. The mine waste burial pit thickness contours ranged from 2 ft bgs near the edges of the mine waste burial pit, to 25 ft bgs near the center (refer to Figure 4-9b). Waste material appeared to extend to approximately 17.0, 20.0, 17.5, and 14.5 ft bgs in the S078-SCX-031, -SCX-032, -SCX-035, and -SCX-036 boreholes, respectively (refer to borehole logs). Additional information about the eastern mine waste burial pit is described in Section 4.6 above. Note that the waste material in the mine waste burial pit is covered with fill material that does not exceed the ILs at the surface in some locations. Also note that the mine waste burial pit was created during reclamation activities by filling in an existing minor drainage.
- Group 2 (1,318 yd^3) – The volume of the western mine waste burial pit was estimated based on the data collected from several boreholes in and around the mine waste burial pit. The thickness of the material exceeding ILs varied widely between boreholes from 4.5 to 20 ft bgs, and a thickness of 10 ft was used for the volume estimate over the Group 2 area. Waste material was observed between 6 to 9 ft bgs in borehole S078-SCX-041, but many other boreholes in the area did not show direct evidence of buried waste material. Additional information about the western mine waste burial pit is described in Section 4.6 above.
- Group 3 (2,878 yd^3) – The volume of TENORM exceeding ILs in Group 3 was based on field observations and borehole data. The TENORM material was assumed to be 0.5 ft thick over the area of the polygon. Much of the Group 3 area consists of highly weathered bedrock at

the surface. Soil was removed from much of the Group 3 area during previous reclamation activities and disturbance from the scraping of the surface was observed.

- Group 3a (1,068 yd^3) – The volume of TENORM exceeding ILs in Group 3a was based on Ra-226 and/or metals IL exceedances in sample locations (S078-CX-008, -CX-014, -SCX-022, and –SCX-025) in an area of the mesa bench that was disturbed by mining-related activities, but where surface gamma measurements were less than the IL. TENORM was assumed to extend to 0.5 ft over the area of the Group 3a polygon.

- Group 4 (11,384 yd^3) – The volume of TENORM exceeding ILs in Group 4 was based on field observations and borehole data and was assumed to be 1.0 ft thick over the area of the polygon. The portions of Group 4 on top of the mesa include some of the primary mining areas (refer to Section 2.0), and several boreholes were completed in this portion of the Group to support the volume estimates. Some areas along the mesa sidewall in the lower portions of Group 4 that are within the potential mine waste area shown in Figure 2-9a were not able to be accessed safely. Mine-impacted materials derived from the mesa top were visible on the cliffs and slopes in the lower portions of Group 4, though subsurface soil sampling and gamma surveying was limited in these areas.

- Group 5 (17,452 yd^3) – Group 5 consists of the mesa sidewall adjacent to the primary mining areas. The area was partially covered by mine waste rock situated on the steep slope. The volume of TENORM exceeding ILs was assumed to be 3.0 ft thick over that area based on field observations, historical aerial photography and mine drawings, and limited soil sampling and gamma radiation surveys. Portions of Group 5 could not be accessed safely, and drill rig access was not possible. Consequently, those portions of the area were not evaluated. Based on field mapping, the thickest waste material (estimated at 5 ft thick) was present in the upper (northern) portion of Group 5. The lower and western portions of the group contained some bedrock outcrops and thinner (estimated at 1 to 2 ft thick) deposits of waste rock that was transported downslope due to mass wasting.

- Group 6 (2,562 yd^3) – Group 6 consists of the mesa sidewalls in the eastern portions of the Site. This area was cross-gradient from the primary mining areas, across a drainage, and did not contain visible waste rock or surface disturbance other than limited ground disturbance near the coal/sandstone outcrop on the mesa bench. The volume of TENORM exceeding ILs was estimated to be 0.5 ft thick based on field mapping and gamma measurements.

- Group 7 (665 yd^3) – TENORM exceeding ILs in the area of the eastern drainage was estimated to be 0.5 ft thick based on field mapping and gamma measurements. The entire drainage was assumed to contain TENORM above the ILs though surface gamma measurements indicated that some portions of the drainage did not contain TENORM above the ILs. Elevated gamma survey measurements may also be attributed to bedrock outcrops in the drainage and runoff from NORM material east of the Site.

- Group 8 (7,541 yd^3) – Group 8 consists of a disturbed area and waste rock downslope of the southeast corner of Group 5. This area appeared to be a staging area for mining and/or reclamation operations. The volume of TENORM exceeding ILs in this area was assumed to be 5.0 ft thick based on four boreholes (S078-SCX-027 through -SCX-030). Downhole static gamma survey and soil sampling data exceeded ILs in these boreholes, though results are variable and some elevated static gamma measurements and Ra-226/metals concentrations are likely due to the presence of NORM. The down-hole data are relatively stable (e.g., subsurface static gamma measurements did not fluctuate with changes in subsurface lithology). The depth of TENORM (5.0 ft) was estimated based on the likely amount of disturbance that occurred in the area, including the use of heavy machinery and potential stockpiling activities.

- Group 9 (18,704 yd^3) – Group 9 consists of the valley floor area and the lowest elevations at the Site. The volume of TENORM exceeding ILs in this area was assumed to be 1.0 ft thick based on results of surface and subsurface soil samples, gamma survey results, and field mapping. Depth to bedrock is highly variable in Group 9 with bedrock outcrops at the surface in some locations and soil thicknesses of over 20 ft in others. Downhole gamma survey measurements and metals concentrations exceeded ILs in some boreholes, though results were variable, and it was not clear whether subsurface material was NORM or TENORM. Based on historical data and aerial photographs, excavation and/or burial of waste rock was not conducted in this area. It is important to consider that the addition of a separate background reference area to represent the Quaternary deposits will alter the estimate of the lateral and vertical extent of mining-related impacts developed for Group 9.

- Group 10 (5,530 yd^3) – Based on field observations, the volume of TENORM exceeding ILs in the areas of the potential haul roads was assumed to extend to an average of 2.0 ft bgs. Portions of the road contain cut surfaces where bedrock is exposed at the surface (TENORM will be limited), while other portions on the road contain unconsolidated fill material that was used to create a level road base surface (i.e., thicker amounts of TENORM, including the area where the potential haul road runs parallel to the drainage below the mesa sidewall).

- Group 11 (3,069 yd^3) – The volume of TENORM exceeding ILs in the area of the main site drainage was estimated based on a critical review of aerial imagery (Cooper, 2017 and Google Earth, 2018), field mapping of sediment thicknesses within the drainage (ranging from an estimated 0.1 to 4 ft bgs), and gamma measurements. The entire drainage was assumed to contain 3 ft of TENORM above the ILs. Many parts of the drainage are deeply incised and safe access for sampling or scanning was not possible.

Historical reclamation planning documents stated that approximately 8,000 bcy of waste material was to be placed in the eastern mine waste burial pit, and the total work quantity was not to exceed 13,600 bcy, with the additional 5,600 bcy being stockpiled material and cover material. Based on RSE Site Characterization activities, including drilling and geophysics, approximately 18,841 yd^3 of TENORM (including cover material) was estimated to be present in the eastern mine waste burial pit. The calculated volume of the eastern mine waste burial pit was less than 1.5 times the amount of waste material and cover material listed in the reclamation documents, which is a reasonable comparison. However, it is important to consider that the reclamation documents were planning documents and a final volume from reclamation activities was not provided.

A NAML memorandum stated that approximately 5,000 yd^3 of waste material was placed in pits on the mesa top. The areas of the backfilled pits were not identified using data collected during RSE Site Characterization activities that included drilling and geophysical surveys. However, areas of reclamation and revegetation were identified on the mesa top. It was assumed that the pits were shallow surface excavations in the revegetated area (this area is included in Group

4 above). Because the pits could not be identified a direct comparison of the approximate portion of the volume of Group 4 coincident with the revegetated area was not applicable.

4.8 SURFACE WATER AND WELL WATER ANALYTICAL RESULTS

The surface water and well water samples collected as part of the Site Characterization activities were analyzed for the constituents listed in Section 3.3.2.4 to evaluate potential mining-related impacts. All three water features observed in the field (refer to Section 3.3.2.4) were sampled. The locations of these water features are shown in Figure 2-1 and included the following:

- Pond/Well/1050475 (sample S078-WS-001) located 0.25 miles southwest of the claim #79 boundary
- S078-Seep-1 seep (sample S078-WS-002) located along a geologic contact in the mesa sidewall in the southeast portion of the claim #78 boundary
- 04T-386/Tank 4T-386/CH981123BGW002 water well (sample S078-WL-001) located approximately 1.0 mile south of the claim #79

The analytical results from the samples were compared to the water ILs, which are defined as the lowest value from the following regulations/standards: the National Secondary Drinking Water Regulations (NSDWR), the Navajo Nation Surface Water Quality Standards, the Navajo Drinking Water maximum contaminant levels (MCLs), and/or the National Primary Drinking Water Regulations. The water ILs are shown in Table 4-6a and the analytical results compared to the water ILs are shown in Table 4-6b.

Analytical results indicated that the sample from the S078-Seep-1 seep (S078-WS-002) had radionuclides as well as total and dissolved metals concentrations greater than ILs. Radiological constituents Ra-226, Ra-228, and adjusted gross alpha concentrations ranged from approximately five to 30 times their respective ILs; the highest elevated concentration, adjusted gross alpha, measured at 421 pCi/L compared to the IL of 15 pCi/L. Metals including beryllium, cadmium, thallium, uranium, and zinc concentrations ranged from less than two to approximately 16 times greater than ILs. Beryllium and uranium concentrations were 65 and 190 micrograms per liter (µg/L), respectively, compared to ILs of 4 and 30 µg/L. Cadmium, thallium, and zinc concentrations were less than two times their respective ILs. The pH of the seep sample was 3.67, which was indicative of acidic conditions. All other metals and radionuclides were below their respective ILs in the three samples. Based on these results, the above radionuclides and metals are confirmed COPCs for Seep S078-Seep-1 water.

Results of general chemistry parameters indicated that TDS and sulfate were above their respective ILs in the samples collected from all three features (S078-WL-001, S078-WS-001, and S078-WS-002). Based on these results, TDS and sulfate are confirmed COPCs for all three features. All other general chemistry parameters were below their respective ILs in the three samples.

Because radionuclides and metals exceeded their respective ILs for S078-Seep-1, and TDS and sulfate exceeded their respective ILs in the samples collected at all three water features, further characterization may be considered at these locations to evaluate potential mining-related impacts. It should be noted that elevated constituent concentrations and the low pH measured in water from S078-Seep-1 may be attributable to the geochemical composition of coal seams within the Toreva Formation rather than historical mining operations at the Site; however, further investigation is needed to determine the source(s) of potential seep water impacts at the Site. The laboratory analytical data and Data Usability Report are provided in Appendix F.

4.9 GEOPHYSICAL SURVEY RESULTS

The results of the geophysical survey are provided in Appendix A.2. A summary of the interpretation of the geophysical survey results is presented below.

- Area 1 – Survey results indicated approximately 7 to12 ft bgs of resistive material near the surface, underlain by lower resistivity material. This generally correlated with the depth to bedrock observed in the drilling data.
- Area 2 – Survey results indicated approximately 10 to15 ft bgs of resistive material near the surface. This correlated with the drilling data in the area of the eastern mine waste burial pit: depths of native unconsolidated material (sand and gravel) and depths of reclamation material.
- Area 3 – Survey results indicated resistive material ranging in thickness from 10 to 35 ft bgs. This resistivity signature was typically associated with unconsolidated deposits at the Site. However, bedrock is at or near the surface across much of the mesa top, where Area 3 was located, based on field mapping and the results of the drilling investigation. Thus, discontinuous resistivity in the subsurface of Area 3 was likely a result of varying bedrock compositions. The mesa top bedrock contained beds of coal, sandstone, siltstone, and other types of sedimentary rock (refer to Appendix C.2).

An important consideration is that the interpretations of geophysical survey data are based on a number of assumptions and minor physical variations in subsurface properties. Therefore, interpretation results should be considered “suggestive” of subsurface conditions. Interpretation of geophysical survey data requires the consideration of multiple lines of evidence, including a comparison to subsurface data collected during drilling activities. An assessment of the geophysical data on its own, without additional supporting investigation techniques, can lead to false conclusions. In instances where the results of geophysical surveys contradict with direct observations collected during drilling and sampling, the drilling data should be considered more reliable.

Results of the geophysical survey were used to inform the TENORM volume estimate, specifically supporting the depth to bedrock and thicknesses of potential mine-impacted fill. These results are presented in Sections 4.6 and 4.7.

4.10 POTENTIAL DATA GAPS AND SUPPLEMENTAL STUDIES

4.10.1 Data Gaps

Nine potential data gaps were identified based on the Site Clearance and RSE data collection and analyses for the Site as described in Sections 3.3 and 4.2. These data gaps can be considered for subsequent evaluations in support of future Removal or Remedial Action evaluations at the Site.

1. Only the approximate center of the western and eastern extents of the northern potential haul road were surveyed. The road shoulders were not surveyed due to a miscommunication with the field team.

2. The surface gamma survey does not cover the areal extent of samples collected in BG-1.

3. Subsurface static gamma measurements were not collected in BG-2 due to the shallow depth of soil on bedrock.

4. Field personnel were unable to perform the surface gamma survey in some areas along the mesa sidewall because of access and safety issues. Approximately 1.4 acres could not be surveyed due to unsafe terrain. These areas were included in the TENORM area and volume estimates.

5. The survey was not extended laterally along the Survey Area B mesa sidewall where gamma measurements were greater than the IL because of professional judgement that the mining-impacted material did not extend across the drainages on the west and east sides of the Site and that the material at the extent of the survey was NORM. This data gap is considered minor because the areas are not disturbed by mining and the IL exceedances appear to be representative of naturally occurring conditions.

6. The gamma survey was not extended laterally from portions of the western and eastern extent of the potential haul roads where gamma measurements were greater than the IL due to miscommunication with the field personnel. However, gamma measurements on the potential haul roads were less than two times the IL.

7. The correlation to compare Ra-226 concentrations to surface gamma survey data did not meet the DQO.

8. Field personnel terminated two boreholes because of decreasing static gamma measurements, using this criterion was a field error.

9. A background reference area is warranted to better evaluate potential mining-related impacts in the Quaternary deposits on the valley bottom.

4.10.2 Supplemental Studies

Following review of the RSE report data and discussions with the Agencies, a limited number of items were identified for supplemental work to be considered for subsequent evaluations in support of future Removal or Remedial Action evaluations at the Site, as follows:

1. It was identified that Ra-226 and Th-230 concentrations were in equilibrium at the Site. However, sample results did not indicate that they were in secular equilibrium. This may be an important consideration in the future if a human health and/or ecological risk assessment is performed.

2. Additional correlation studies may be needed to identify the relationship between gamma and Ra-226.

3. The USEPA identified that there were potential discrepancies between the NNDWR database used for this study (received from NNDWR in 2016) and a 2018 version of the database that the USEPA reviewed. It is recommended that the two databases are compared (with additional field work, if necessary) to confirm the locations of water features.

4. Additional sampling may be required downgradient of the eastern mine waste burial pit to evaluate infiltration and potential subsurface transport from the area of the burial pit.

5. Large boulders located along or at the base of the mesa sidewall were included in the area of the surface gamma survey but were not otherwise evaluated. Additional characterization of the boulders may be required prior to future Removal or Remedial Actions.

5.0 SUMMARY AND CONCLUSIONS

This report details the purpose and objectives, field investigation activities, findings, and conclusions of the Site Clearance and RSE activities conducted for the Site between August 2015 and October 2017. The Site is known as the Claim 28 site and is also identified by the USEPA as AUM claim with two mine site identifications of #78 and #79in the *2007 AUM Atlas*.

The purpose of the RSE was to review relevant information and collect data related to historical mining activities to support future Removal or Remedial Action evaluations at the Site. It is not intended to establish cleanup levels or determine cleanup options or potential remedies. The primary objective of the RSE process is to determine the location and volume of TENORM that may be present at the Site in excess of ILs, because of historical mining activities. To meet these objectives, the RSE included historical data review, visual observations, surface gamma surveys, surface and subsurface static gamma measurements, and soil/sediment sampling and analyses. An estimate of areas containing TENORM was made based on an evaluation of the RSE information/data and multiple lines of evidence. Surface water and well water samples were also collected as part of the RSE to evaluate potential mining-related impacts. The correlation between gamma measurements (in cpm) and concentrations of Ra-226 in surface soils (pCi/g) was developed as a potential field screening tool for future Removal or Remedial Action evaluations. The gamma correlation was not used for the Site Characterization, which relied on the actual gamma radiation measurements and soil/sediment analytical results. However, predicted Ra-226 concentrations were compared to the actual Ra-226 laboratory results and ILs from the surface soil/sediment samples.

The Site was located within the Black Mesa Mining District on Black Mesa. The Site was in operation between 1957 and 1968. Mine workings at the Site consisted of an open pit. The USAEC reported total ore production from the Site was 4,181.08 tons (approximately 8,362,160 pounds) of ore that contained 17,327.367 pounds of 0.21 percent U_3O_8 and 13,400.06 pounds of 0.27 percent V_2O_5.

Two potential background reference areas (BG-1 and BG-2) were considered and the same two potential background reference areas were selected to develop surface gamma, subsurface gamma, Ra-226, and metals ILs for the for the two Survey Areas (Survey Area A and B) at the Site.

Arsenic, molybdenum, selenium, uranium, vanadium, and Ra-226 concentrations and gamma radiation measurements in soil/sediment exceeded their respective ILs and are confirmed COPCs for the Site.

Surface gamma measurements and Ra-226 and metals concentrations were generally highest in areas that were coincident with the western portion of the mining/reclaimed disturbed area and the western and eastern Mine Waste Burial Pits. The maximum gamma survey measurement was 301,035 cpm, which was greater than 14 times the maximum surface gamma IL (i.e., BG-1 IL of

20,677 cpm), and occurred in the western portion of the mining/reclaimed disturbed area. The highest Ra-226 and metals concentrations, and subsurface static gamma measurements were also detected in the western and eastern Mine Waste Burial Pits and western portion of the mining/reclaimed disturbed area, as well as in the berm near the upstream segment of the eastern drainage and in the mesa sidewall.

Results of the Gamma Correlation Study indicated that surface gamma survey results do not correlate sufficiently well with Ra-226 concentrations in soil (the DQO was not met). Therefore, users of the regression equation should be aware of the limitations of the dataset and be cautious when estimating radium-226 concentrations. Additional correlation studies may be needed to identify the relationship between gamma and Ra-226.

Based on the data analysis performed for this report along with the multiple lines of evidence, approximately 44.7, out of the 73.10 acres of the Survey Area, were estimated to contain TENORM. This estimate is inclusive of three areas: the mining/reclaimed disturbed area and surrounding areas (primarily the mesa bench and upper mesa sidewall), the lower mesa sidewall and foothills, and the valley bottom. The areas outside of the TENORM boundary have sporadic surface gamma IL exceedances, and show no signs of mining-related disturbance. Therefore, they are considered NORM (i.e., naturally occurring). Of the 44.7 acres that contain TENORM, 31.6 acres contain TENORM that exceeds the ILs. The volume of TENORM in excess of ILs is estimated to be 91,012 yd^3 (69,584 cubic meters). It should be noted that the COPC measurements and concentrations in the area that contains TENORM that exceeds the ILs are generally higher than the COPC measurements and concentrations in the area of NORM located outside the TENORM boundary.

Water samples were collected from one surface water pond (Pond/Well/1050475), one seep (S078-Seep-1), and one windmill well (04T-386/Tank 4T-386/CH981123BGW002). Sample analyses indicated that seep water sample S078-WS-002 (S078-Seep-1) had radionuclides (Ra-226, Ra-228, and adjusted gross alpha) and total and dissolved metals (beryllium, cadmium, thallium, uranium, and zinc) concentrations greater than respective ILs. These results included an adjusted gross alpha concentration of 421 pCi/L, which was approximately 30 times the IL (15 pCi/L), a beryllium concentration of 65 µg/L, which was approximately 16 times the IL (4 µg/L); and a uranium concentration of 190 µg/L, which was approximately six times the IL (30 µg/L). The pH of the seep water was 3.67. Based on these results, the above radionuclides and metals were confirmed as COPCs for the seep water. All other metals and radionuclides were below their respective ILs in the three water samples. Results of general chemistry parameters indicated that TDS and sulfate were also above their respective ILs for all three water features (S078-WL-001, S078-WS-001, and S078-WS-002). All other general chemistry parameters were below their respective ILs in the three samples. Based on these results, TDS and sulfate are confirmed COPCs for all three features. Because radionuclides and metals exceeded their respective ILs for S078-Seep-1, and TDS and sulfate exceeded their respective ILs in the samples collected at all three water features, further characterization may be necessary at these locations to evaluate potential mining-related impacts. It should be noted that elevated constituent concentrations and the low pH measured in water from S078-Seep-1 may be attributable to the geochemical composition of coal seems within the Toreva Formation rather than historical mining operations at the Site; however, further investigation is needed to determine the source(s) of potential seep water impacts at the site.

Nine potential data gaps were identified based on the Site Clearance and RSE data collection and analyses for the Site, as listed in Section 4.10. These data gaps can be taken into consideration for subsequent evaluations in support of future Removal or Remedial Action evaluations at the Site.

6.0 ESTIMATE OF REMOVAL SITE EVALUATION COSTS

The Claim 28 RSE was performed in accordance with the requirements of the *Trust Agreement* to characterize existing site conditions. Project costs related to the RSE include the planning and implementation of the scope of work stipulated in the *Site Clearance Work Plan* and *RSE Work Plan* and community outreach. Stantec's costs associated with the Claim 28 RSE were $741,600. Stantec's costs associated with interim actions (access road improvements and sign installation) were $70,500. In addition, Administrative costs provided by the Trust were estimated currently at $191,500[4,5]. Administrative costs will change due to continued community outreach and close out activities.

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[4] This cost is based on an approved budget of May 8, 2018; Administrative work, including community communications, are not yet complete.

[5] Administrative costs were averaged across all Sites.

7.0 REFERENCES

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TABLES

Table 3-1a
Identified Water Features
Claim 28
Removal Site Evaluation Report - Final
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Identified Water Feature	Source of Identified Water Feature	Water Feature Identification	Field Sample Identification	Field Personnel Observations
Pond	2007 AUM Atlas[1]	Pond/Well/1050475	S078-WS-001	This location was a pond that varies in size seasonally with runoff (i.e., the pond can be up to 150 feet across). On October 19, 2016 field personnel collected surface water sample ID S078-WS-001 from the pond. Field personnel did not observe a water well at this location.
Windmill Well	2007 AUM Atlas[1], NNDWR	04T-386/Tank 4T-386/CH981123BGW002	S078-WL-001	This location was a windmill well, two water tanks, and water trough. On October 19, 2016 field personnel collected water well sample ID S078-WL-001 from the valve at the trough.
Seep	Stantec/Trust	S078-Seep-1	S078-WS-002	This location was a water seep. The seep daylighted on the mesa side wall along a geologic contact. The area where water daylighted was approximately 50 feet wide. On November 5, 2016 field personnel collected surface water sample ID S078-WS-002 from an area where the seep was pooling. The pooled area was approximately one foot by one foot.

Notes
ID - identification
NNDWR - Navajo Nation Department of Water Resources
[1] USEPA, 2007a

Table 3-1b
Water Well Specifications for 04T-386
Claim 28
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Description	Water Well Information
Tribal Well Number	04T-386
Easting[1]	599579.00
Northing[1]	4009827.00
Operator	Tribe Operations and Maintenance
Well Completed Date	9/15/1954
Elevation (ft amsl)	6,662
Well Depth (ft bgs)	902
Well Type	Water Well
Well Status	Active
Well Use	Domestic
Well Borehole Diameter (inches)	unknown
Well Casing Diameter (inches)	10.75 inches from ground surface to 130 ft bgs, 5.0 inches from 544 to902 ft bgs
Top of Well Casing (ft ags)	unknown
Bottom of Well Casing (ft bgs)	902
Well Build Material	Steel
Top of Well Screen Perforation (ft bgs)	802
Bottom of Well Screen Perforation (ft bgs)	902

Notes
ft - feet
ft ags - feet above ground surface
ft amsl - feet above mean sea level
ft bgs - feet below ground surface
[1] Coordinate System: NAD 1983 UTM Zone 12N

Table 3-2
Soil and Sediment Sampling Summary
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									Sample Types		
Sample Location	Sample Depth (ft bgs)	Sample Media	Sample Category	Sample Collection Method	Survey Area	Sample Date	Easting ¹	Northing ¹	Metals, Total	Ra-226	Thorium
Background Reference Area Study - Background Area 1											
S078-BG1-001	0 - 0.5	soil	SF	grab	NA	10/19/2016	599034.66	4011791.07	N;FD	N;FD	--
S078-BG1-002	0 - 0.5	soil	SF	grab	NA	10/19/2016	599034.71	4011794.95	N;MS;MSD	N	--
S078-BG1-003	0 - 0.5	soil	SF	grab	NA	10/19/2016	599031.70	4011795.77	N	N	--
S078-BG1-004	0 - 0.5	soil	SF	grab	NA	10/19/2016	599028.38	4011794.49	N	N	--
S078-BG1-005	0 - 0.5	soil	SF	grab	NA	10/19/2016	599028.79	4011791.63	N	N	--
S078-BG1-006	0 - 0.5	soil	SF	grab	NA	10/19/2016	599025.85	4011789.85	N	N	--
S078-BG1-007	0 - 0.5	soil	SF	grab	NA	10/19/2016	599031.04	4011790.11	N	N	--
S078-BG1-008	0 - 0.5	soil	SF	grab	NA	10/19/2016	599030.87	4011786.66	N	N	--
S078-BG1-009	0 - 0.5	soil	SF	grab	NA	10/19/2016	599028.99	4011784.40	N	N	--
S078-BG1-010	0 - 0.5	soil	SF	grab	NA	10/19/2016	599025.75	4011786.64	N	N	--
S078-BG1-011	0 - 0.5	soil	SF	grab	NA	11/10/2016	599020.44	4011777.85	N;FD	N;FD	--
S078-BG1-013	0 - 0.5	soil	SF	grab	NA	11/10/2016	599020.36	4011779.04	N	N	--
S078-BG1-013	0.5 - 1.0	soil	SB	grab	NA	11/10/2016	599020.36	4011779.04	N	N	--
S078-BG1-013	2 - 2.6	soil	SB	grab	NA	11/10/2016	599020.36	4011779.04	N	N	--
Background Reference Area Study - Background Area 2											
S078-BG2-001	0 - 0.5	soil	SF	grab	NA	10/19/2016	599111.91	4011952.68	N;FD	N;FD	--
S078-BG2-002	0 - 0.5	soil	SF	grab	NA	10/19/2016	599109.17	4011952.12	N	N	--
S078-BG2-003	0 - 0.5	soil	SF	grab	NA	10/19/2016	599114.87	4011954.42	N	N	--
S078-BG2-004	0 - 0.5	soil	SF	grab	NA	10/19/2016	599113.00	4011957.09	N	N	--
S078-BG2-005	0 - 0.5	soil	SF	grab	NA	10/19/2016	599108.40	4011956.05	N	N	--
S078-BG2-006	0 - 0.5	soil	SF	grab	NA	10/19/2016	599110.55	4011957.41	N	N	--
S078-BG2-007	0 - 0.5	soil	SF	grab	NA	10/19/2016	599115.57	4011959.23	N	N	--
S078-BG2-008	0 - 0.5	soil	SF	grab	NA	10/19/2016	599109.48	4011960.71	N	N	--
S078-BG2-009	0 - 0.5	soil	SF	grab	NA	10/19/2016	599111.67	4011962.87	N;MS;MSD	N	--
S078-BG2-010	0 - 0.5	soil	SF	grab	NA	10/19/2016	599114.35	4011962.06	N	N	--
Correlation				5-point composite	NA						
S078-C01-001	0 - 0.5	soil	SF	5-point composite	NA	11/11/2016	599470.76	4011392.84	--	N;FD	N;FD
S078-C02-001	0 - 0.5	soil	SF	5-point composite	NA	11/11/2016	599285.16	4011574.96	--	N	N
S078-C03-001	0 - 0.5	soil	SF	5-point composite	NA	11/11/2016	599324.79	4011616.18	--	N	N
S078-C04-001	0 - 0.5	soil	SF	5-point composite	NA	11/11/2016	599641.10	4011600.03	--	N	N
S078-C05-001	0 - 0.5	soil	SF	5-point composite	NA	11/11/2016	599014.40	4011770.94	--	N	N
Characterization											
S078-CX-001	0 - 0.5	sediment	SF	grab	A	4/18/2017	599260.41	4011442.09	N	N	--
S078-CX-002	0 - 0.5	soil	SF	grab	A	4/18/2017	599260.90	4011503.65	N	N	--
S078-CX-003	0 - 0.5	soil	SF	grab	A	4/18/2017	599340.89	4011687.84	N	N	--
S078-CX-004	0 - 0.5	soil	SF	grab	A	4/18/2017	599385.00	4011717.54	N	N	--
S078-CX-005	0 - 0.5	soil	SF	grab	A	4/18/2017	599407.97	4011376.22	N	N	--
S078-CX-006	0 - 0.5	soil	SF	grab	A	4/18/2017	599218.96	4011341.11	N	N	--
S078-CX-007	0 - 0.5	soil	SF	grab	B	4/19/2017	599674.06	4011846.08	N;FD	N;FD	--
S078-CX-008	0 - 0.5	sediment	SF	grab	B	4/19/2017	599595.00	4011806.56	N;MS;MSD	N	--
S078-CX-009	0 - 0.5	sediment	SF	grab	B	4/19/2017	599473.79	4011794.56	N	N	--
S078-CX-010	0 - 0.5	soil	SF	grab	B	4/19/2017	599645.61	4011700.58	N	N	--
S078-CX-011	0 - 0.5	soil	SF	grab	A	4/19/2017	599504.71	4011616.44	N;FD	N;FD	--
S078-CX-012	0 - 0.5	sediment	SF	grab	B	4/19/2017	599681.80	4011519.23	N	N	--
S078-CX-013	0 - 0.5	soil	SF	grab	B	10/21/2017	599709.16	4011757.26	N	N	--
S078-CX-014	0 - 0.5	soil	SF	grab	B	10/21/2017	599693.66	4011808.07	N	N	--
S078-SCX-001	0 - 0.5	sediment	SF	grab	B	4/19/2017	599471.70	4011745.36	N;FD	N;FD	--
S078-SCX-001	1.0 - 1.5	sediment	SB	grab	B	4/19/2017	599471.70	4011745.36	N	N	--
S078-SCX-001	1.5 - 2.0	sediment	SB	grab	B	4/19/2017	599471.70	4011745.36	N	N	--

Notes

--	Not Sampled
N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
NA	Not Applicable
SB	Subsurface Sample
SF	Surface Sample
ft bgs	feet below ground surface
¹ Coordinate System:	NAD 1983 UTM Zone 12N

Table 3-2
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									Sample Types		
Sample Location	Sample Depth (ft bgs)	Sample Media	Sample Category	Sample Collection Method	Survey Area	Sample Date	Easting ¹	Northing ¹	Metals, Total	Ra-226	Thorium
Characterization continued											
S078-SCX-002	0 - 0.5	soil	SF	grab	B	4/19/2017	599507.56	4011704.56	N	N	--
S078-SCX-002	0.5 - 1.0	soil	SB	grab	B	4/19/2017	599507.56	4011704.56	N	N	--
S078-SCX-002	1.0 - 2.0	soil	SB	grab	B	4/19/2017	599507.56	4011704.56	N	N	--
S078-SCX-002	2.0 - 2.75	soil	SB	grab	B	4/19/2017	599507.56	4011704.56	N	N	--
S078-SCX-003	0 - 0.5	soil	SF	grab	B	4/19/2017	599573.30	4011675.45	N	N	--
S078-SCX-003	0.5 - 1.0	soil	SB	grab	B	4/19/2017	599573.30	4011675.45	N	N	--
S078-SCX-004	0 - 0.5	sediment	SF	grab	B	4/19/2017	599629.40	4011662.09	N	N	--
S078-SCX-005	0 - 0.5	soil	SF	grab	B	4/19/2017	599687.74	4011615.16	N	N	--
S078-SCX-006	0 - 0.5	soil	SF	grab	A	4/20/2017	599336.37	4011657.30	N	N	--
S078-SCX-006	0.5 - 1.5	soil	SB	grab	A	4/20/2017	599336.37	4011657.30	N	N	--
S078-SCX-006	1.5 - 2.5	soil	SB	grab	A	4/20/2017	599336.37	4011657.30	N	N	--
S078-SCX-007	0 - 0.5	sediment	SF	grab	A	4/20/2017	599329.07	4011534.77	N;MS;MSD	N	--
S078-SCX-007	0.5 - 2.0	sediment	SB	composite	A	4/20/2017	599329.07	4011534.77	N	N	--
S078-SCX-007	2.0 - 2.5	sediment	SB	grab	A	4/20/2017	599329.07	4011534.77	N	N	--
S078-SCX-008	0 - 0.5	soil	SF	grab	A	4/20/2017	599457.65	4011525.24	N	N	--
S078-SCX-009	0 - 0.25	soil	SF	grab	A	4/20/2017	599516.60	4011472.83	N	N	--
S078-SCX-010	0 - 0.5	sediment	SF	grab	A	4/20/2017	599436.40	4011275.95	N	N	--
S078-SCX-010	0.5 - 2.5	sediment	SB	composite	A	4/20/2017	599436.40	4011275.95	N	N	--
S078-SCX-010	2.5 - 3.0	sediment	SB	grab	A	4/20/2017	599436.40	4011275.95	N	N	--
S078-SCX-011	0 - 0.5	soil	SF	grab	A	4/20/2017	599301.95	4011350.34	N	N	--
S078-SCX-011	0.5 - 1.5	soil	SB	grab	A	4/20/2017	599301.95	4011350.34	N	N	--
S078-SCX-011	1.5 - 2.0	soil	SB	grab	A	4/20/2017	599301.95	4011350.34	N	N	--
S078-SCX-012	0 - 0.5	sediment	SF	grab	B	10/11/2017	599536.93	4011763.61	N	N	--
S078-SCX-012	7.5 - 8.5	bedrock	SB	grab	B	10/11/2017	599536.93	4011763.61	N	N	--
S078-SCX-012	10.0 - 11.0	bedrock	SB	grab	B	10/11/2017	599536.93	4011763.61	N	N	--
S078-SCX-012	11.5 - 12.0	bedrock	SB	grab	B	10/11/2017	599536.93	4011763.61	N	N	--
S078-SCX-012	12.0 - 13.0	bedrock	SB	grab	B	10/11/2017	599536.93	4011763.61	N	N	--
S078-SCX-013	0 - 0.5	sediment	SF	grab	B	10/11/2017	599547.77	4011758.60	N	N	--
S078-SCX-013	1.0 - 1.5	sediment	SB	grab	B	10/11/2017	599547.77	4011758.60	N	N	--
S078-SCX-013	2.5 - 3.0	bedrock	SB	grab	B	10/11/2017	599547.77	4011758.60	N	N	--
S078-SCX-014	0 - 0.5	soil	SF	grab	B	10/11/2017	599539.54	4011780.47	N	N	--
S078-SCX-015	0 - 0.5	sediment	SF	grab	B	10/11/2017	599513.14	4011758.28	N	N	--
S078-SCX-015	3.0 - 4.0	bedrock	SB	grab	B	10/11/2017	599513.14	4011758.28	N;FD	N;FD	--
S078-SCX-016	0 - 0.5	sediment	SF	grab	B	10/11/2017	599490.49	4011758.99	N	N	--
S078-SCX-017	0 - 0.5	soil	SF	grab	B	10/11/2017	599494.43	4011722.86	N	N	--
S078-SCX-017	0.5 - 2.0	soil	SB	composite	B	10/11/2017	599494.43	4011722.86	N	N	--
S078-SCX-018	0 - 0.5	soil	SF	grab	B	10/12/2017	599566.25	4011793.96	N	N	--
S078-SCX-018	0.5 - 1.0	soil	SB	grab	B	10/12/2017	599566.25	4011793.96	N	N	--
S078-SCX-019	0 - 0.5	bedrock	SF	grab	B	10/12/2017	599581.53	4011746.78	N	N	--
S078-SCX-020	0 - 0.5	bedrock	SF	grab	B	10/12/2017	599610.00	4011715.10	N	N	--
S078-SCX-021	0 - 0.5	soil	SF	grab	B	10/12/2017	599633.31	4011711.36	N;MS;MSD	N	--
S078-SCX-022	0 - 0.5	soil	SF	grab	B	10/12/2017	599688.73	4011860.16	N	N	--
S078-SCX-023	0 - 0.5	bedrock	SF	grab	B	10/12/2017	599687.75	4011860.78	N	N	--
S078-SCX-024	0 - 0.5	sediment	SF	grab	B	10/12/2017	599705.91	4011779.18	N;FD	N;FD	--
S078-SCX-025	0 - 0.5	soil	SF	grab	B	10/12/2017	599627.27	4011796.32	N	N	--
S078-SCX-026	0 - 0.5	soil	SF	grab	B	10/13/2017	599638.17	4011635.60	N;MS;MSD	N	--
S078-SCX-026	4.0 - 5.0	soil	SB	grab	B	10/13/2017	599638.17	4011635.60	N	N	--
S078-SCX-026	8.0 - 9.0	soil	SB	grab	B	10/13/2017	599638.17	4011635.60	N	N	--
S078-SCX-027	0 - 0.5	soil	SF	grab	B	10/13/2017	599622.11	4011607.35	N	N	--
S078-SCX-027	5.0 - 6.0	soil	SB	grab	B	10/13/2017	599622.11	4011607.35	N	N	--
S078-SCX-027	6.0 - 7.0	soil	SB	grab	B	10/13/2017	599622.11	4011607.35	N	N	--
S078-SCX-027	11.0 - 12.0	soil	SB	grab	B	10/13/2017	599622.11	4011607.35	N	N	--
S078-SCX-027	12.0 - 13.0	soil	SB	grab	B	10/13/2017	599622.11	4011607.35	N	N	--

Notes

--	Not Sampled
N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
NA	Not Applicable
SB	Subsurface Sample
SF	Surface Sample
ft bgs	feet below ground surface
¹ Coordinate System:	NAD 1983 UTM Zone 12N

Table 3-2
Soil and Sediment Sampling Summary
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									Sample Types		
Sample Location	Sample Depth (ft bgs)	Sample Media	Sample Category	Sample Collection Method	Survey Area	Sample Date	Easting ¹	Northing ¹	Metals, Total	Ra-226	Thorium
Characterization continued											
S078-SCX-028	0 - 0.5	soil	SF	grab	A	10/14/2017	599622.54	4011588.49	N;FD	N;FD	--
S078-SCX-028	4.0 - 5.0	soil	SB	grab	A	10/14/2017	599622.54	4011588.49	N	N	--
S078-SCX-028	12.0 - 13.0	soil	SB	grab	A	10/14/2017	599622.54	4011588.49	N	N	--
S078-SCX-028	28.0 - 29.0	soil	SB	grab	A	10/14/2017	599622.54	4011588.49	N	N	--
S078-SCX-028	32.0 - 33.0	bedrock	SB	grab	A	10/14/2017	599622.54	4011588.49	N	N	--
S078-SCX-029	0 - 0.5	soil	SF	grab	A	10/14/2017	599618.36	4011572.48	N	N	--
S078-SCX-029	4.0 - 5.0	soil	SB	grab	A	10/14/2017	599618.36	4011572.48	N	N	--
S078-SCX-029	8.0 - 9.0	soil	SB	grab	A	10/14/2017	599618.36	4011572.48	N	N	--
S078-SCX-029	15.5 - 16.5	soil	SB	grab	A	10/14/2017	599618.36	4011572.48	N	N	--
S078-SCX-030	0 - 0.5	soil	SF	grab	A	10/14/2017	599597.44	4011602.30	N;FD	N;FD	--
S078-SCX-030	5.0 - 6.0	soil	SB	grab	A	10/14/2017	599597.44	4011602.30	N	N	--
S078-SCX-030	11.0 - 13.0	soil	SB	composite	A	10/14/2017	599597.44	4011602.30	N	N	--
S078-SCX-031	0 - 0.5	soil	SF	grab	A	10/16/2017	599586.26	4011545.64	N;MS;MSD	N	--
S078-SCX-031	3.0 - 4.0	soil	SB	grab	A	10/16/2017	599586.26	4011545.64	N	N	--
S078-SCX-031	9.0 - 10.0	soil	SB	grab	A	10/16/2017	599586.26	4011545.64	N	N	--
S078-SCX-031	17.0 - 18.0	soil	SB	grab	A	10/16/2017	599586.26	4011545.64	N	N	--
S078-SCX-031	21.0 - 22.0	soil	SB	grab	A	10/16/2017	599586.26	4011545.64	N	N	--
S078-SCX-032	0 - 0.5	soil	SF	grab	A	10/16/2017	599603.88	4011534.55	N	N	--
S078-SCX-032	3.0 - 4.0	boulder	SB	grab	A	10/16/2017	599603.88	4011534.55	N	N	--
S078-SCX-032	14.0 - 15.0	soil	SB	grab	A	10/16/2017	599603.88	4011534.55	N	N	--
S078-SCX-032	18.0 - 19.0	soil	SB	grab	A	10/16/2017	599603.88	4011534.55	N	N	--
S078-SCX-032	20.0 - 21.0	soil	SB	grab	A	10/16/2017	599603.88	4011534.55	N	N	--
S078-SCX-033	0 - 0.5	soil	SF	grab	A	10/16/2017	599602.89	4011524.26	N	N	--
S078-SCX-033	3.0 - 4.0	soil/bedrock	SB	grab	A	10/16/2017	599602.89	4011524.26	N;FD	N;FD	--
S078-SCX-034	0 - 0.5	soil	SF	grab	A	10/16/2017	599610.08	4011542.99	N	N	--
S078-SCX-034	4.0 - 5.0	soil	SB	grab	A	10/16/2017	599610.08	4011542.99	N	N	--
S078-SCX-034	10.0 - 11.0	boulder	SB	grab	A	10/16/2017	599610.08	4011542.99	N	N	--
S078-SCX-034	17.0 - 18.0	soil	SB	grab	A	10/16/2017	599610.08	4011542.99	N	N	--
S078-SCX-034	22.0 - 23.0	soil	SB	grab	A	10/16/2017	599610.08	4011542.99	N	N	--
S078-SCX-035	0 - 0.5	soil	SF	grab	A	10/17/2017	599645.47	4011514.95	N	N	--
S078-SCX-035	2.0 - 3.0	soil	SB	grab	A	10/17/2017	599645.47	4011514.95	N	N	--
S078-SCX-035	6.0 - 7.0	soil	SB	grab	A	10/17/2017	599645.47	4011514.95	N	N	--
S078-SCX-035	18.0 - 19.0	boulder	SB	grab	A	10/17/2017	599645.47	4011514.95	N	N	--
S078-SCX-035	27.0 - 28.0	soil	SB	grab	A	10/17/2017	599645.47	4011514.95	N	N	--
S078-SCX-036	0 - 0.5	soil	SF	grab	A	10/17/2017	599644.49	4011515.57	N	N	--
S078-SCX-036	1.0 - 2.0	soil	SB	grab	A	10/17/2017	599644.49	4011515.57	N;FD	N;FD	--
S078-SCX-036	11.0 - 12.0	soil	SB	grab	A	10/17/2017	599644.49	4011515.57	N	N	--
S078-SCX-036	15.0 - 16.0	soil	SB	grab	A	10/17/2017	599644.49	4011515.57	N	N	--
S078-SCX-037	0 - 0.5	sediment	SF	grab	A	10/17/2017	599560.83	4011622.29	N	N	--
S078-SCX-037	5.0 - 6.0	sediment	SB	grab	A	10/17/2017	599560.83	4011622.29	N	N	--
S078-SCX-037	7.0 - 8.0	sediment	SB	grab	A	10/17/2017	599560.83	4011622.29	N	N	--
S078-SCX-038	0 - 0.5	soil	SF	grab	A	10/17/2017	599509.62	4011558.06	N;FD	N;FD	--
S078-SCX-038	10.0 - 11.0	soil	SB	grab	A	10/17/2017	599509.62	4011558.06	N;MS;MSD	N	--
S078-SCX-038	12.0 - 13.0	soil	SB	grab	A	10/17/2017	599509.62	4011558.06	N	N	--
S078-SCX-039	0 - 0.5	soil	SF	grab	A	10/17/2017	599446.43	4011549.72	N	N	--
S078-SCX-039	12.0 - 13.0	soil	SB	grab	A	10/17/2017	599446.43	4011549.72	N	N	--
S078-SCX-039	16.0 - 17.0	soil	SB	grab	A	10/17/2017	599446.43	4011549.72	N	N	--
S078-SCX-040	0 - 0.5	sediment	SF	grab	A	10/18/2017	599381.03	4011565.07	N	N	--
S078-SCX-040	4.0 - 5.0	sediment	SB	grab	A	10/18/2017	599381.03	4011565.07	N	N	--
S078-SCX-040	11.0 - 12.0	sediment	SB	grab	A	10/18/2017	599381.03	4011565.07	N	N	--

Notes

--	Not Sampled
N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
NA	Not Applicable
SB	Subsurface Sample
SF	Surface Sample
ft bgs	feet below ground surface
¹ Coordinate System:	NAD 1983 UTM Zone 12N

Table 3-2
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									Sample Types		
Sample Location	Sample Depth (ft bgs)	Sample Media	Sample Category	Sample Collection Method	Survey Area	Sample Date	Easting ¹	Northing ¹	Metals, Total	Ra-226	Thorium
Characterization continued											
S078-SCX-041	0 - 0.5	soil	SF	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	3.0 - 4.0	soil	SB	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	5.0 - 6.0	soil	SB	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	7.0 - 9.0	soil	SB	composite	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	10.0 - 11.0	soil	SB	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	14.0 - 15.0	soil	SB	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-041	17.0 - 18.0	soil	SB	grab	A	10/18/2017	599373.42	4011530.84	N	N	--
S078-SCX-042	0 - 0.5	soil	SF	grab	A	10/18/2017	599356.35	4011530.21	N	N	--
S078-SCX-042	6.0 - 7.0	soil	SB	grab	A	10/18/2017	599356.35	4011530.21	N	N	--
S078-SCX-042	12.0 - 13.0	soil	SB	grab	A	10/18/2017	599356.35	4011530.21	N	N	--
S078-SCX-043	0 - 0.5	soil	SF	grab	A	10/18/2017	599370.16	4011515.30	N;FD	N;FD	--
S078-SCX-043	7.0 - 8.0	soil	SB	grab	A	10/18/2017	599370.16	4011515.30	N	N	--
S078-SCX-044	0 - 0.5	sediment	SF	grab	A	10/18/2017	599331.53	4011525.39	N	N	--
S078-SCX-044	4.0 - 5.0	sediment	SB	grab	A	10/18/2017	599331.53	4011525.39	N	N	--
S078-SCX-044	9.0 - 10.0	sediment	SB	grab	A	10/18/2017	599331.53	4011525.39	N	N	--
S078-SCX-045	0 - 0.5	soil	SF	grab	A	10/18/2017	599360.48	4011586.89	N;MS;MSD	N	--
S078-SCX-045	6.0 - 7.0	soil	SB	grab	A	10/18/2017	599360.48	4011586.89	N	N	--
S078-SCX-046	0 - 0.5	soil	SF	grab	A	10/19/2017	599373.37	4011540.48	N	N	--
S078-SCX-046	3.0 - 4.0	soil	SB	grab	A	10/19/2017	599373.37	4011540.48	N	N	--
S078-SCX-046	6.0 - 7.0	soil	SB	grab	A	10/19/2017	599373.37	4011540.48	N	N	--
S078-SCX-047	0 - 0.5	soil	SF	grab	A	10/19/2017	599375.20	4011532.48	N	N	--
S078-SCX-047	3.0 - 4.0	soil	SB	grab	A	10/19/2017	599375.20	4011532.48	N	N	--
S078-SCX-047	8.0 - 9.0	soil	SB	grab	A	10/19/2017	599375.20	4011532.48	N	N	--
S078-SCX-047	11.0 - 12.0	soil/bedrock	SB	grab	A	10/19/2017	599375.20	4011532.48	N	N	--
S078-SCX-048	0 - 0.5	soil	SF	grab	A	10/19/2017	599370.99	4011522.09	N	N	--
S078-SCX-048	3.0 - 4.0	soil	SB	grab	A	10/19/2017	599370.99	4011522.09	N	N	--
S078-SCX-048	8.0 - 9.0	soil	SB	grab	A	10/19/2017	599370.99	4011522.09	N	N	--
S078-SCX-048	12.0 - 13.0	soil/bedrock	SB	grab	A	10/19/2017	599370.99	4011522.09	N	N	--
S078-SCX-049	0 - 0.5	soil	SF	grab	A	10/19/2017	599367.23	4011530.72	N;FD	N;FD	--
S078-SCX-049	2.0 - 3.0	soil	SB	grab	A	10/19/2017	599367.23	4011530.72	N	N	--
S078-SCX-050	0 - 0.5	soil	SF	grab	A	10/19/2017	599360.78	4011538.65	N;MS;MSD	N	--
S078-SCX-050	7.0 - 8.0	soil	SB	grab	A	10/19/2017	599360.78	4011538.65	N	N	--
S078-SCX-051	0 - 0.5	soil	SF	grab	A	10/19/2017	599362.05	4011619.09	N	N	--
S078-SCX-051	16.0 - 17.0	soil	SB	grab	A	10/19/2017	599362.05	4011619.09	N	N	--
S078-SCX-052	0 - 0.5	soil	SF	grab	A	10/19/2017	599361.08	4011619.70	N	N	--
S078-SCX-052	9.0 - 10.0	soil	SB	grab	A	10/19/2017	599361.08	4011619.70	N	N	--
S078-SCX-053	0 - 0.5	soil	SF	grab	A	10/19/2017	599360.14	4011652.57	N	N	--
S078-SCX-053	9.0 - 10.0	soil	SB	grab	A	10/19/2017	599360.14	4011652.57	N	N	--
S078-SCX-054	0 - 0.5	soil	SF	grab	A	10/20/2017	599328.52	4011644.68	N;FD;MS;MSD	N;FD	--
S078-SCX-054	8.0 - 9.0	soil	SB	grab	A	10/20/2017	599328.52	4011644.68	N;FD	N;FD	--
S078-SCX-054	16.0 - 17.0	soil	SB	grab	A	10/20/2017	599328.52	4011644.68	N	N	--

Notes

--	Not Sampled
N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
NA	Not Applicable
SB	Subsurface Sample
SF	Surface Sample
ft bgs	feet below ground surface
¹ Coordinate System:	NAD 1983 UTM Zone 12N

Table 3-2
Soil and Sediment Sampling Summary
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Sample Location	Sample Depth (ft bgs)	Sample Media	Sample Category	Sample Collection Method	Survey Area	Sample Date	Easting [1]	Northing [1]	Sample Types Metals, Total	Ra-226	Thorium
Characterization continued											
S078-SCX-055	0 - 0.5	soil	SF	grab	A	10/20/2017	599272.03	4011523.88	N;FD	N;FD	--
S078-SCX-055	14.0 - 15.0	soil	SB	grab	A	10/20/2017	599272.03	4011523.88	N	N	--
S078-SCX-055	18.0 - 19.0	bedrock	SB	grab	A	10/20/2017	599272.03	4011523.88	N	N	--
S078-SCX-056	0 - 0.5	soil	SF	grab	A	10/20/2017	599245.86	4011477.20	N	N	--
S078-SCX-056	2.0 - 3.0	soil	SB	grab	A	10/20/2017	599245.86	4011477.20	N	N	--
S078-SCX-056	9.0 - 10.0	soil	SB	grab	A	10/20/2017	599245.86	4011477.20	N	N	--
S078-SCX-057	0 - 0.5	soil	SF	grab	A	10/20/2017	599232.36	4011447.67	N	N	--
S078-SCX-057	6.0 - 7.0	soil	SB	grab	A	10/20/2017	599232.36	4011447.67	N	N	--
S078-SCX-057	22.0 - 23.0	soil	SB	grab	A	10/20/2017	599232.36	4011447.67	N	N	--
S078-SCX-058	0 - 0.5	soil	SF	grab	A	10/20/2017	599318.90	4011484.62	N	N	--
S078-SCX-058	7.0 - 8.0	soil	SB	grab	A	10/20/2017	599318.90	4011484.62	N	N	--
S078-SCX-058	14.0 - 15.0	bedrock	SB	grab	A	10/20/2017	599318.90	4011484.62	N;FD	N;FD	--
S078-SCX-059	0 - 0.5	soil	SF	grab	A	10/20/2017	599361.85	4011489.69	N	N	--
S078-SCX-059	3.0 - 4.0	soil	SB	grab	A	10/20/2017	599361.85	4011489.69	N	N	--
S078-SCX-059	6.0 - 7.0	soil	SB	grab	A	10/20/2017	599361.85	4011489.69	N	N	--
S078-SCX-060	0 - 0.5	soil	SF	grab	A	10/21/2017	599282.44	4011645.66	N	N	--
S078-SCX-060	0.5 - 2.1	soil	SB	composite	A	10/21/2017	599282.44	4011645.66	N;MS;MSD	N	--
S078-SCX-061	0 - 0.5	soil	SF	grab	A	10/21/2017	599231.91	4011488.14	N	N	--
S078-SCX-061	0.5 - 1.5	soil	SB	grab	A	10/21/2017	599231.91	4011488.14	N;FD	N;FD	--
S078-SCX-062	0 - 0.5	soil	SF	grab	B	10/13/2017	599731.39	4011844.87	N	N	--

Notes

--	Not Sampled
N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
NA	Not Applicable
SB	Subsurface Sample
SF	Surface Sample
ft bgs	feet below ground surface
[1] Coordinate System:	NAD 1983 UTM Zone 12N

Table 3-3
Mine Feature Samples and Area
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Mine Feature	Surface Samples	Subsurface Samples	Area (sq. ft)	Volume of TENORM exceeding ILs (yd^3)
Eastern Mine Waste Burial Pit	6	19	36,036	18,841
Western Mine Waste Burial Pit	6	16	3,567	1,318
Mining/Reclaimed Disturbed Area	23*	27*	363,678	--
Berm	2	0	3,211	--
Potential Haul Roads	9	8	**	5,530
Drainages	6	8	***	--

Notes

sq.ft - square feet

yd^3 - cubic yards

ILs - investigation levels

TENORM - technologically enhanced naturally occurring radioactive material

-- Discrete volume was not identified for feature

* Sample counts include samples collected within the potential haul roads and drainages mapped within the mining/reclaimed disturbed area

** Area not determined because the width of the potential haul roads vary throughout the Site

*** Area not determined because the width of the drainages vary throughout the Site

Table 3-4
Water Sampling Summary
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					Sample Types							
Field Sample Identification	Water Feature Identification	Sample Date	Easting [1]	Northing [1]	Ra-226	Ra-228	Gross Alpha	Metals, Dissolved	Metals, Total	TDS	Anions	Cations
Surface Water												
S078-WS-001	Pond/Well/1050475	10/19/2016	599119.87	4011161.50	N	N	N	N	N;MS;MSD	N	N	N
S078-WS-002[2]	S078-Seep-1	11/5/2016	599650.44	4011662.72	N	N	N	N;MS;MSD	N;MS;MSD	N	N	N
Well Water												
S078-WL-001[3]	04T-386/Tank 4T-386/CH981123BGW002	10/19/2016	599543.94	4010021.93	N;FD	N;FD	N;FD	N;FD	N;FD;MS;MSD	N;FD	N;FD	N;FD

Notes

N	Normal
FD	Field Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
Ra-226	Radium 226
Ra-228	Radium 228
TDS	Total Dissolved Solids

[1] Coordinate System: NAD 1983 UTM Zone 12N

[2] Metals mercury analysis also included laboratory MS/MSD, all other metals analyses did not include laboratory MS/MDS

[3] Metals total mercury analysis also included laboratory MS/MSD, all other total metals analyses did not include laboratory MS/MDS

Table 4-1
Background Reference Area Soil Sample Analytical Results
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Location Identification	S078-BG1-001 Dup	S078-BG1-001	S078-BG1-002	S078-BG1-003	S078-BG1-004	S078-BG1-005	S078-BG1-006	S078-BG1-007	S078-BG1-008	S078-BG1-009	S078-BG1-010	S078-BG1-011
Date Collected	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	11/10/2016
Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte (Units)												
Metals[1] (mg/kg)												
Arsenic	1.3	1.4	1.3	2	2.4	1.4	2.4	2	1.4	1.4	1.9	3
Molybdenum	0.18	<0.18	0.2	0.26	0.35	<0.2	0.35	<0.2	<0.19	0.3	0.25	0.34
Selenium	<0.86	<0.91	<0.99	<0.93	0.93	<0.99	0.94	<1	<0.96	<1	<0.93	<1
Uranium	1.1	0.7	0.59	0.69	2.4	2.4	2	0.93	0.64	0.51	1.5	1.7
Vanadium	6.4	6.3	5.8	7.7	9.9	6.3	9.9	9.6	6.6	6.3	7.3	9.9
Radionuclides (pCi/g)												
Radium-226	1.73 ± 0.35	2.11 ± 0.38	1.45 ± 0.28	1.54 ± 0.3	3.14 ± 0.49	1.39 ± 0.3	2.83 ± 0.5 J+	1.8 ± 0.32	1.78 ± 0.34	1.78 ± 0.35	2.48 ± 0.4	2.45 ± 0.39

Notes

Bold	Bolded result indicates positively identified compound
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-dilute value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-1
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Location Identification	S078-BG1-011 Dup	S078-BG1-013	S078-BG1-013	S078-BG1-013	S078-BG2-001	S078-BG2-001 Dup	S078-BG2-002	S078-BG2-003	S078-BG2-004	S078-BG2-005	S078-BG2-006
Date Collected	11/10/2016	11/10/2016	11/10/2016	11/10/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016
Depth (feet)	0 - 0.5	0 - 0.5	0.5 - 1.0	2.0 - 2.6	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte (Units)											
Metals[1] (mg/kg)											
Arsenic	4.9	2.1	2	2.3	4.9	4.1	3.6	3.2	3.4	4.5	3.7
Molybdenum	0.33	0.34	0.33	0.29	0.35	0.28	0.22	0.28	0.23	0.23	0.27
Selenium	<1	<1	<0.99	<0.99	<0.96	<0.93	<0.97	<0.95	<0.89	1	<0.98
Uranium	2.3	1.2	1.3	1	1.1	1	1.2	0.74	0.94	0.95	1
Vanadium	17	7.6	8.2	10	18	13	10	12	9.8	11	12
Radionuclides (pCi/g)											
Radium-226	2.89 ± 0.45	2.03 ± 0.35	2.13 ± 0.39	2.96 ± 0.48	1.4 ± 0.32	1.76 ± 0.37	1.63 ± 0.32	1.64 ± 0.34	1.41 ± 0.34	1.51 ± 0.31	1.58 ± 0.39

Notes

Bold	Bolded result indicates positively identified compound
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-dilute value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

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Location Identification	S078-BG2-007	S078-BG2-008	S078-BG2-009	S078-BG2-010
Date Collected	10/19/2016	10/19/2016	10/19/2016	10/19/2016
Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte (Units)				
Metals[1] (mg/kg)				
Arsenic	14	3.6	6.1	10
Molybdenum	0.26	0.28	0.25 J-	0.26
Selenium	<0.92	<0.9	<0.96	1
Uranium	0.75	0.7	0.57	0.68
Vanadium	14	11	13 J+	19
Radionuclides (pCi/g)				
Radium-226	1.42 ± 0.28	1.79 ± 0.34	1.7 ± 0.34	1.23 ± 0.28

Notes

Bold	Bolded result indicates positively identified compound
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
[1]	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-dilute value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-2
Static Gamma Measurement Summary
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Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-BG1-013	Background Area 1	*	0.0	soil	17,864
S078-BG1-013	Background Area 1	*	0.5	soil	22,744
S078-BG1-013	Background Area 1	*	1.0	soil	29,180
S078-BG1-013	Background Area 1	*	1.5	soil	31,995
S078-BG1-013	Background Area 1	*	2.0	soil	32,404
S078-BG1-013	Background Area 1	*	2.6	soil	32,569
S078-SCX-006	A	--	0.0	soil	26,316
S078-SCX-006	A	29,180	0.5	soil	35,765
S078-SCX-006	A	29,180	1.0	soil	31,821
S078-SCX-006	A	29,180	1.5	soil	27,354
S078-SCX-006	A	29,180	2.0	soil	24,223
S078-SCX-006	A	29,180	2.5	soil	23,218
S078-SCX-007	A	--	0.0	sediment	22,617
S078-SCX-007	A	29,180	0.5	sediment	29,563
S078-SCX-007	A	29,180	1.0	sediment	32,252
S078-SCX-007	A	29,180	1.5	sediment	33,977
S078-SCX-007	A	29,180	2.0	sediment	35,605
S078-SCX-007	A	29,180	2.5	sediment	36,602**
S078-SCX-008	A	--	0.0	soil	28,044
S078-SCX-008	A	29,180	0.5	soil	45,480**
S078-SCX-009	A	--	0.0	soil	27,449
S078-SCX-009	A	29,180	0.25	soil	28,365**
S078-SCX-010	A	--	0.0	sediment	17,713
S078-SCX-010	A	29,180	0.5	sediment	23,342
S078-SCX-010	A	29,180	1.0	sediment	25,363
S078-SCX-010	A	29,180	1.5	sediment	26,693
S078-SCX-010	A	29,180	2.0	sediment	27,266
S078-SCX-010	A	29,180	2.5	sediment	27,241
S078-SCX-010	A	29,180	3.0	sediment	26,967
S078-SCX-011	A	--	0.0	soil	23,093
S078-SCX-011	A	29,180	0.5	soil	29,557
S078-SCX-011	A	29,180	1.0	soil	28,377
S078-SCX-011	A	29,180	1.5	soil	24,778
S078-SCX-011	A	29,180	2.0	soil	22,733
S078-SCX-028	A	--	0.0	soil	24,424
S078-SCX-028	A	29,180	1.0	soil	29,730
S078-SCX-028	A	29,180	2.0	soil	28,018
S078-SCX-028	A	29,180	3.0	soil	30,372
S078-SCX-028	A	29,180	4.0	soil	31,988
S078-SCX-028	A	29,180	5.0	soil	30,100
S078-SCX-028	A	29,180	6.0	soil	28,718
S078-SCX-028	A	29,180	7.0	soil	27,170
S078-SCX-028	A	29,180	8.0	soil	27,010
S078-SCX-028	A	29,180	9.0	soil	25,586
S078-SCX-028	A	29,180	10.0	soil	24,378
S078-SCX-028	A	29,180	11.0	soil	23,552
S078-SCX-028	A	29,180	12.0	soil	23,870
S078-SCX-028	A	29,180	13.0	soil	23,434
S078-SCX-028	A	29,180	14.0	soil	23,290
S078-SCX-028	A	29,180	15.0	soil	23,162
S078-SCX-028	A	29,180	16.0	soil	23,470
S078-SCX-028	A	29,180	17.0	soil	23,918
S078-SCX-028	A	29,180	18.0	soil	23,344
S078-SCX-028	A	29,180	19.0	soil	23,132
S078-SCX-028	A	29,180	20.0	soil	23,196
S078-SCX-028	A	29,180	21.0	soil	24,080
S078-SCX-028	A	29,180	22.0	soil	22,914
S078-SCX-028	A	29,180	23.0	soil	23,672
S078-SCX-028	A	29,180	24.0	soil	23,332
S078-SCX-028	A	29,180	25.0	soil	23,814
S078-SCX-028	A	29,180	26.0	soil	24,042

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

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Static Gamma Measurement Summary
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Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-028 Continued					
S078-SCX-028	A	29,180	27.0	soil	23,986
S078-SCX-028	A	29,180	28.0	soil	24,792
S078-SCX-028	A	29,180	29.0	soil	25,036
S078-SCX-028	A	29,180	30.0	bedrock	25,600
S078-SCX-028	A	29,180	31.0	bedrock	27,526
S078-SCX-028	A	29,180	32.0	bedrock	26,754
S078-SCX-028	A	29,180	33.0	bedrock	26,992
S078-SCX-028	A	29,180	34.0	bedrock	29,838
S078-SCX-028	A	29,180	35.0	bedrock	39,094
S078-SCX-028	A	29,180	36.0	bedrock	44,008
S078-SCX-028	A	29,180	37.0	bedrock	34,292
S078-SCX-029	A	--	0.0	soil	19,164
S078-SCX-029	A	29,180	1.0	soil	26,914
S078-SCX-029	A	29,180	2.0	soil	30,164
S078-SCX-029	A	29,180	3.0	soil	35,088
S078-SCX-029	A	29,180	4.0	soil	36,600
S078-SCX-029	A	29,180	5.0	soil	33,626
S078-SCX-029	A	29,180	6.0	soil	31,324
S078-SCX-029	A	29,180	7.0	soil	29,222
S078-SCX-029	A	29,180	8.0	soil	26,654
S078-SCX-029	A	29,180	9.0	soil	23,752
S078-SCX-029	A	29,180	10.0	soil	23,416
S078-SCX-029	A	29,180	11.0	soil	24,462
S078-SCX-029	A	29,180	12.0	soil	22,864
S078-SCX-029	A	29,180	13.0	soil	23,552
S078-SCX-029	A	29,180	14.0	soil	22,496
S078-SCX-029	A	29,180	15.0	soil	23,340
S078-SCX-029	A	29,180	16.0	soil	22,814
S078-SCX-029	A	29,180	17.0	bedrock	19,150
S078-SCX-029	A	29,180	18.0	bedrock	23,654
S078-SCX-029	A	29,180	19.0	bedrock	34,976
S078-SCX-029	A	29,180	20.0	bedrock	47,522
S078-SCX-030	A	--	0.0	soil	24,268
S078-SCX-030	A	29,180	1.0	soil	30,822
S078-SCX-030	A	29,180	2.0	soil	33,094
S078-SCX-030	A	29,180	3.0	soil	34,274
S078-SCX-030	A	29,180	4.0	soil	35,616
S078-SCX-030	A	29,180	5.0	soil	34,106
S078-SCX-030	A	29,180	6.0	soil	36,328
S078-SCX-030	A	29,180	7.0	soil	35,578
S078-SCX-030	A	29,180	8.0	soil	34,890
S078-SCX-030	A	29,180	9.0	soil	32,720
S078-SCX-030	A	29,180	10.0	soil	28,976
S078-SCX-030	A	29,180	11.0	soil	26,002
S078-SCX-030	A	29,180	12.0	soil	25,488
S078-SCX-030	A	29,180	13.0	soil	24,952
S078-SCX-030	A	29,180	14.0	soil	25,588
S078-SCX-030	A	29,180	15.0	soil	26,148
S078-SCX-030	A	29,180	16.0	soil	26,734
S078-SCX-030	A	29,180	17.0	soil	27,804
S078-SCX-030	A	29,180	18.0	soil	26,812
S078-SCX-030	A	29,180	19.0	soil	26,626
S078-SCX-030	A	29,180	20.0	soil	26,092
S078-SCX-030	A	29,180	21.0	bedrock	23,300
S078-SCX-030	A	29,180	22.0	bedrock	23,288
S078-SCX-030	A	29,180	23.0	bedrock	22,302
S078-SCX-030	A	29,180	24.5	bedrock	21,664
S078-SCX-031	A	--	0.0	soil	18,836
S078-SCX-031	A	29,180	1.0	soil	29,342
S078-SCX-031	A	29,180	2.0	soil	36,770
S078-SCX-031	A	29,180	3.0	soil	61,322
S078-SCX-031	A	29,180	4.0	soil	123,360
S078-SCX-031	A	29,180	5.0	soil	81,326
S078-SCX-031	A	29,180	6.0	soil	97,320
S078-SCX-031	A	29,180	7.0	soil	100,900
S078-SCX-031	A	29,180	8.0	soil	98,740
S078-SCX-031	A	29,180	9.0	soil	105,132
S078-SCX-031	A	29,180	10.0	soil	99,566
S078-SCX-031	A	29,180	11.0	soil	130,920
S078-SCX-031	A	29,180	12.0	soil	113,300
S078-SCX-031	A	29,180	13.0	soil	103,842
S078-SCX-031	A	29,180	14.0	soil	104,690
S078-SCX-031	A	29,180	15.0	soil	99,584
S078-SCX-031	A	29,180	16.0	soil	88,758
S078-SCX-031	A	29,180	17.0	soil	61,412
S078-SCX-031	A	29,180	18.0	soil	46,008
S078-SCX-031	A	29,180	19.0	soil	41,120
S078-SCX-031	A	29,180	20.0	soil	42,996
S078-SCX-031	A	29,180	21.0	soil	36,218
S078-SCX-031	A	29,180	22.0	soil	32,002

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
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Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-031 Continued					
S078-SCX-031	A	29,180	23.0	soil	29,802
S078-SCX-031	A	29,180	24.0	soil	30,352
S078-SCX-031	A	29,180	25.0	soil	29,530
S078-SCX-031	A	29,180	26.0	soil	28,852
S078-SCX-031	A	29,180	27.0	soil	30,604
S078-SCX-031	A	29,180	28.0	soil	31,050
S078-SCX-031	A	29,180	29.0	soil	37,110
S078-SCX-031	A	29,180	29.5	soil	42,702
S078-SCX-032	A	--	0.0	soil	24,058
S078-SCX-032	A	29,180	1.0	soil	55,198
S078-SCX-032	A	29,180	2.0	soil	124,690
S078-SCX-032	A	29,180	3.0	soil	202,260
S078-SCX-032	A	29,180	4.0	soil	95,026
S078-SCX-032	A	29,180	5.0	soil	78,380
S078-SCX-032	A	29,180	6.0	soil	75,504
S078-SCX-032	A	29,180	7.0	soil	73,664
S078-SCX-032	A	29,180	8.0	soil	68,992
S078-SCX-032	A	29,180	9.0	soil	84,742
S078-SCX-032	A	29,180	10.0	soil	66,200
S078-SCX-032	A	29,180	11.0	soil	60,164
S078-SCX-032	A	29,180	12.0	soil	99,262
S078-SCX-032	A	29,180	13.0	soil	123,142
S078-SCX-032	A	29,180	14.0	soil	102,406
S078-SCX-032	A	29,180	15.0	soil	102,022
S078-SCX-032	A	29,180	16.0	soil	92,190
S078-SCX-032	A	29,180	17.0	soil	71,762
S078-SCX-032	A	29,180	18.0	soil	43,940
S078-SCX-032	A	29,180	19.0	soil	37,460
S078-SCX-032	A	29,180	20.0	soil	39,894
S078-SCX-032	A	29,180	21.0	soil	42,598
S078-SCX-032	A	29,180	22.0	soil	39,534
S078-SCX-032	A	29,180	23.0	soil	33,072
S078-SCX-032	A	29,180	24.0	soil	33,746
S078-SCX-032	A	29,180	24.5	soil	38,924
S078-SCX-033	A	--	0.0	soil	20,234
S078-SCX-033	A	29,180	1.0	soil	35,854
S078-SCX-033	A	29,180	2.0	soil	44,136
S078-SCX-033	A	29,180	3.0	soil	36,140
S078-SCX-033	A	29,180	4.0	bedrock	30,048
S078-SCX-033	A	29,180	5.0	bedrock	27,948
S078-SCX-034	A	--	0.0	soil	21,342
S078-SCX-034	A	29,180	1.0	soil	37,094
S078-SCX-034	A	29,180	2.0	soil	73,328
S078-SCX-034	A	29,180	3.0	soil	77,370
S078-SCX-034	A	29,180	4.0	soil	77,078
S078-SCX-034	A	29,180	5.0	soil	93,252
S078-SCX-034	A	29,180	6.0	soil	98,970
S078-SCX-034	A	29,180	7.0	soil	105,602
S078-SCX-034	A	29,180	8.0	soil	110,386
S078-SCX-034	A	29,180	9.0	boulder	112,824
S078-SCX-034	A	29,180	10.0	boulder	114,628
S078-SCX-034	A	29,180	11.0	boulder	120,780
S078-SCX-034	A	29,180	12.0	boulder	121,358
S078-SCX-034	A	29,180	13.0	boulder	126,580
S078-SCX-034	A	29,180	14.0	soil	108,270
S078-SCX-034	A	29,180	15.0	soil	83,576
S078-SCX-034	A	29,180	16.0	soil	45,466
S078-SCX-034	A	29,180	17.0	soil	32,474
S078-SCX-034	A	29,180	18.0	soil	29,946
S078-SCX-034	A	29,180	19.0	soil	28,244
S078-SCX-034	A	29,180	20.0	soil	27,352
S078-SCX-034	A	29,180	21.0	soil	26,842
S078-SCX-034	A	29,180	22.0	soil	25,152
S078-SCX-034	A	29,180	23.0	soil	24,906
S078-SCX-034	A	29,180	24.0	soil	25,252
S078-SCX-034	A	29,180	25.0	soil	29,872
S078-SCX-034	A	29,180	26.0	soil	28,066
S078-SCX-034	A	29,180	27.0	soil	25,626
S078-SCX-034	A	29,180	28.0	soil	23,434
S078-SCX-034	A	29,180	29.0	soil	24,128
S078-SCX-034	A	29,180	30.0	soil	25,156
S078-SCX-034	A	29,180	31.0	soil	25,560
S078-SCX-034	A	29,180	32.0	soil	24,634
S078-SCX-034	A	29,180	33.0	soil	23,576
S078-SCX-034	A	29,180	34.0	soil	23,308
S078-SCX-034	A	29,180	34.5	soil	25,554

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-035	A	--	0.0	soil	18,368
S078-SCX-035	A	29,180	1.0	soil	29,314
S078-SCX-035	A	29,180	2.0	soil	39,426
S078-SCX-035	A	29,180	3.0	soil	80,288
S078-SCX-035	A	29,180	4.0	soil	89,048
S078-SCX-035	A	29,180	5.0	soil	91,338
S078-SCX-035	A	29,180	6.0	soil	91,404
S078-SCX-035	A	29,180	7.0	soil	94,082
S078-SCX-035	A	29,180	8.0	soil	87,146
S078-SCX-035	A	29,180	9.0	soil	88,702
S078-SCX-035	A	29,180	10.0	soil	90,672
S078-SCX-035	A	29,180	11.0	soil	108,048
S078-SCX-035	A	29,180	12.0	soil	101,880
S078-SCX-035	A	29,180	13.0	soil	91,524
S078-SCX-035	A	29,180	14.0	soil	91,078
S078-SCX-035	A	29,180	15.0	soil	95,660
S078-SCX-035	A	29,180	16.0	soil	91,418
S078-SCX-035	A	29,180	17.0	soil	90,254
S078-SCX-035	A	29,180	18.0	boulder	72,348
S078-SCX-035	A	29,180	19.0	boulder	62,806
S078-SCX-035	A	29,180	20.0	boulder	45,914
S078-SCX-035	A	29,180	21.0	boulder	37,700
S078-SCX-035	A	29,180	22.0	boulder	33,542
S078-SCX-035	A	29,180	23.0	boulder	30,850
S078-SCX-035	A	29,180	24.0	boulder	30,558
S078-SCX-035	A	29,180	25.0	boulder	32,564
S078-SCX-035	A	29,180	26.0	soil	25,126
S078-SCX-035	A	29,180	27.0	soil	21,058
S078-SCX-035	A	29,180	28.0	soil	26,956
S078-SCX-035	A	29,180	29.0	soil	42,356
S078-SCX-036	A	--	0.0	soil	17,864
S078-SCX-036	A	29,180	1.0	soil	30,042
S078-SCX-036	A	29,180	2.0	soil	36,920
S078-SCX-036	A	29,180	3.0	soil	88,376
S078-SCX-036	A	29,180	4.0	soil	118,526
S078-SCX-036	A	29,180	5.0	soil	114,962
S078-SCX-036	A	29,180	6.0	soil	112,500
S078-SCX-036	A	29,180	7.0	soil	95,596
S078-SCX-036	A	29,180	8.0	soil	97,030
S078-SCX-036	A	29,180	9.0	soil	92,356
S078-SCX-036	A	29,180	10.0	soil	90,986
S078-SCX-036	A	29,180	11.0	soil	93,092
S078-SCX-036	A	29,180	12.0	soil	93,438
S078-SCX-036	A	29,180	13.0	soil	88,194
S078-SCX-036	A	29,180	14.0	soil	71,804
S078-SCX-036	A	29,180	15.0	soil	39,022
S078-SCX-036	A	29,180	16.0	soil	31,790
S078-SCX-036	A	29,180	17.0	soil	29,590
S078-SCX-036	A	29,180	18.0	soil	28,476
S078-SCX-036	A	29,180	19.0	soil	35,992
S078-SCX-037	A	--	0.0	soil	25,698
S078-SCX-037	A	29,180	1.0	soil	35,774
S078-SCX-037	A	29,180	2.0	soil	41,724
S078-SCX-037	A	29,180	3.0	soil	45,976
S078-SCX-037	A	29,180	4.0	soil	62,758
S078-SCX-037	A	29,180	5.0	soil	60,812
S078-SCX-037	A	29,180	6.0	soil	103,820
S078-SCX-037	A	29,180	7.0	soil	241,116
S078-SCX-037	A	29,180	8.0	soil	146,270
S078-SCX-037	A	29,180	9.0	bedrock	202,244
S078-SCX-037	A	29,180	10.0	bedrock	158,312
S078-SCX-038	A	--	0.0	soil	19,558
S078-SCX-038	A	29,180	1.0	soil	26,574
S078-SCX-038	A	29,180	2.0	soil	28,386
S078-SCX-038	A	29,180	3.0	soil	30,670
S078-SCX-038	A	29,180	4.0	soil	36,230
S078-SCX-038	A	29,180	5.0	soil	42,512
S078-SCX-038	A	29,180	6.0	soil	44,278
S078-SCX-038	A	29,180	7.0	soil	44,484
S078-SCX-038	A	29,180	8.0	soil	46,404
S078-SCX-038	A	29,180	9.0	soil	44,636
S078-SCX-038	A	29,180	10.0	soil	69,372
S078-SCX-038	A	29,180	11.0	soil	40,376
S078-SCX-038	A	29,180	11.5	soil	39,714

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-039	A	--	0.0	soil	21,382
S078-SCX-039	A	29,180	1.0	soil	30,966
S078-SCX-039	A	29,180	2.0	soil	32,130
S078-SCX-039	A	29,180	3.0	soil	32,878
S078-SCX-039	A	29,180	4.0	soil	33,476
S078-SCX-039	A	29,180	5.0	soil	34,042
S078-SCX-039	A	29,180	6.0	soil	33,422
S078-SCX-039	A	29,180	7.0	soil	33,386
S078-SCX-039	A	29,180	8.0	soil	33,984
S078-SCX-039	A	29,180	9.0	soil	39,146
S078-SCX-039	A	29,180	10.0	soil	35,812
S078-SCX-039	A	29,180	11.0	soil	36,988
S078-SCX-039	A	29,180	12.0	soil	36,440
S078-SCX-039	A	29,180	13.0	soil	33,846
S078-SCX-039	A	29,180	14.0	soil	38,592
S078-SCX-039	A	29,180	15.0	soil	36,098
S078-SCX-039	A	29,180	16.0	soil	49,718
S078-SCX-039	A	29,180	17.0	soil	127,112**
S078-SCX-040	A	--	0.0	sediment	21,032
S078-SCX-040	A	29,180	1.0	sediment	30,596
S078-SCX-040	A	29,180	2.0	sediment	35,344
S078-SCX-040	A	29,180	3.0	sediment	36,936
S078-SCX-040	A	29,180	4.0	sediment	37,392
S078-SCX-040	A	29,180	5.0	sediment	37,934
S078-SCX-040	A	29,180	6.0	sediment	35,970
S078-SCX-040	A	29,180	7.0	sediment	35,466
S078-SCX-040	A	29,180	8.0	sediment	39,478
S078-SCX-040	A	29,180	9.0	sediment	38,824
S078-SCX-040	A	29,180	10.0	sediment	38,994
S078-SCX-040	A	29,180	11.0	sediment	34,546
S078-SCX-040	A	29,180	12.0	sediment	23,102
S078-SCX-040	A	29,180	13.0	boulder	18,558
S078-SCX-040	A	29,180	14.0	boulder	25,318
S078-SCX-040	A	29,180	15.0	sediment	35,520
S078-SCX-041	A	--	0.0	soil	33,594
S078-SCX-041	A	29,180	1.0	soil	40,912
S078-SCX-041	A	29,180	2.0	soil	53,108
S078-SCX-041	A	29,180	3.0	soil	93,608
S078-SCX-041	A	29,180	4.0	soil	144,332
S078-SCX-041	A	29,180	5.0	soil	227,790
S078-SCX-041	A	29,180	6.0	soil	464,024
S078-SCX-041	A	29,180	7.0	soil	499,890
S078-SCX-041	A	29,180	8.0	soil	464,900
S078-SCX-041	A	29,180	9.0	soil	337,070
S078-SCX-041	A	29,180	10.0	soil	108,614
S078-SCX-041	A	29,180	11.0	soil	70,432
S078-SCX-041	A	29,180	12.0	soil	62,574
S078-SCX-041	A	29,180	13.0	soil	63,832
S078-SCX-041	A	29,180	14.0	soil	65,914
S078-SCX-041	A	29,180	15.0	soil	64,104
S078-SCX-041	A	29,180	16.0	soil	69,610
S078-SCX-041	A	29,180	17.0	soil	64,344
S078-SCX-041	A	29,180	18.0	soil	64,082
S078-SCX-041	A	29,180	19.0	bedrock	47,178
S078-SCX-041	A	29,180	20.0	bedrock	27,262
S078-SCX-041	A	29,180	20.5	bedrock	29,012
S078-SCX-042	A	--	0.0	soil	24,512
S078-SCX-042	A	29,180	1.0	soil	33,666
S078-SCX-042	A	29,180	2.0	soil	34,172
S078-SCX-042	A	29,180	3.0	soil	36,012
S078-SCX-042	A	29,180	4.0	soil	35,332
S078-SCX-042	A	29,180	5.0	soil	33,038
S078-SCX-042	A	29,180	6.0	soil	36,592
S078-SCX-042	A	29,180	7.0	soil	38,402
S078-SCX-042	A	29,180	8.0	soil	37,564
S078-SCX-042	A	29,180	9.0	soil	37,778
S078-SCX-042	A	29,180	10.0	soil	38,450
S078-SCX-042	A	29,180	11.0	soil	38,120
S078-SCX-042	A	29,180	12.0	soil	37,596
S078-SCX-042	A	29,180	13.0	soil	36,764
S078-SCX-042	A	29,180	14.0	soil	34,652**
S078-SCX-043	A	--	0.0	soil	21,300
S078-SCX-043	A	29,180	1.0	soil	33,038
S078-SCX-043	A	29,180	2.0	soil	36,956
S078-SCX-043	A	29,180	3.0	soil	36,720
S078-SCX-043	A	29,180	4.0	soil	37,100
S078-SCX-043	A	29,180	5.0	soil	36,444
S078-SCX-043	A	29,180	6.0	soil	36,526
S078-SCX-043	A	29,180	7.0	soil	37,762
S078-SCX-043	A	29,180	8.0	soil	35,708**

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

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Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-044	A	--	0.0	sediment	22,554
S078-SCX-044	A	29,180	1.0	sediment	30,738
S078-SCX-044	A	29,180	2.0	sediment	32,568
S078-SCX-044	A	29,180	3.0	sediment	34,070
S078-SCX-044	A	29,180	4.0	sediment	33,758
S078-SCX-044	A	29,180	5.0	sediment	39,700
S078-SCX-044	A	29,180	6.0	sediment	43,808
S078-SCX-044	A	29,180	7.0	sediment	44,334
S078-SCX-044	A	29,180	8.0	sediment	42,966
S078-SCX-044	A	29,180	9.0	sediment	42,740
S078-SCX-044	A	29,180	10.0	sediment	43,744
S078-SCX-044	A	29,180	11.0	sediment	43,284
S078-SCX-044	A	29,180	12.0	sediment	44,634
S078-SCX-044	A	29,180	13.0	sediment	48,130
S078-SCX-044	A	29,180	14.0	sediment	49,472
S078-SCX-044	A	29,180	15.0	sediment	49,812
S078-SCX-044	A	29,180	16.0	sediment	51,282
S078-SCX-044	A	29,180	17.0	sediment	53,730
S078-SCX-044	A	29,180	18.0	sediment	52,882
S078-SCX-044	A	29,180	19.0	sediment	51,818
S078-SCX-044	A	29,180	20.0	sediment	50,042
S078-SCX-044	A	29,180	21.0	sediment	50,718
S078-SCX-044	A	29,180	22.0	sediment	51,644
S078-SCX-044	A	29,180	23.0	bedrock	57,130
S078-SCX-044	A	29,180	24.0	bedrock	56,410
S078-SCX-044	A	29,180	24.5	bedrock	57,438
S078-SCX-045	A	--	0.0	soil	21,518
S078-SCX-045	A	29,180	1.0	soil	33,940
S078-SCX-045	A	29,180	2.0	soil	34,380
S078-SCX-045	A	29,180	3.0	soil	33,810
S078-SCX-045	A	29,180	4.0	soil	35,094
S078-SCX-045	A	29,180	5.0	soil	35,788
S078-SCX-045	A	29,180	6.0	soil	36,438
S078-SCX-045	A	29,180	7.0	soil	36,508
S078-SCX-045	A	29,180	8.0	soil	38,344
S078-SCX-045	A	29,180	9.0	soil	39,342
S078-SCX-045	A	29,180	10.0	soil	39,718
S078-SCX-045	A	29,180	11.0	soil	39,118
S078-SCX-045	A	29,180	12.0	soil	36,702
S078-SCX-045	A	29,180	13.0	soil	28,312
S078-SCX-045	A	29,180	14.0	soil	29,578
S078-SCX-045	A	29,180	15.0	soil	31,960
S078-SCX-045	A	29,180	16.0	soil	32,822
S078-SCX-045	A	29,180	17.0	soil	31,536
S078-SCX-045	A	29,180	18.0	bedrock	30,272
S078-SCX-045	A	29,180	19.0	bedrock	27,464
S078-SCX-046	A	--	0.0	soil	26,998
S078-SCX-046	A	29,180	1.0	soil	38,542
S078-SCX-046	A	29,180	2.0	soil	41,626
S078-SCX-046	A	29,180	3.0	soil	57,256
S078-SCX-046	A	29,180	4.0	soil	57,980
S078-SCX-046	A	29,180	5.0	soil	45,554
S078-SCX-046	A	29,180	6.0	soil	42,230
S078-SCX-046	A	29,180	7.0	soil	43,012
S078-SCX-046	A	29,180	8.0	soil	43,490
S078-SCX-046	A	29,180	9.0	soil	44,356
S078-SCX-046	A	29,180	10.0	soil	45,980
S078-SCX-046	A	29,180	11.0	soil	40,888
S078-SCX-046	A	29,180	12.0	soil	33,746
S078-SCX-046	A	29,180	13.0	soil	34,914
S078-SCX-046	A	29,180	14.0	soil	34,234
S078-SCX-046	A	29,180	14.5	soil	35,934
S078-SCX-047	A	--	0.0	soil	23,754
S078-SCX-047	A	29,180	1.0	soil	37,106
S078-SCX-047	A	29,180	2.0	soil	44,804
S078-SCX-047	A	29,180	3.0	soil	61,152
S078-SCX-047	A	29,180	4.0	soil	63,636
S078-SCX-047	A	29,180	5.0	soil	57,420
S078-SCX-047	A	29,180	6.0	soil	53,866
S078-SCX-047	A	29,180	7.0	soil	52,178
S078-SCX-047	A	29,180	8.0	soil	51,092
S078-SCX-047	A	29,180	9.0	soil	48,996
S078-SCX-047	A	29,180	10.0	soil	49,356
S078-SCX-047	A	29,180	11.0	soil	43,736
S078-SCX-047	A	29,180	12.0	bedrock	37,046
S078-SCX-047	A	29,180	13.0	bedrock	32,898
S078-SCX-047	A	29,180	13.5	bedrock	28,710

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-048	A	--	0.0	soil	22,424
S078-SCX-048	A	29,180	1.0	soil	34,858
S078-SCX-048	A	29,180	2.0	soil	37,122
S078-SCX-048	A	29,180	3.0	soil	41,524
S078-SCX-048	A	29,180	4.0	soil	39,738
S078-SCX-048	A	29,180	5.0	soil	40,060
S078-SCX-048	A	29,180	6.0	soil	38,388
S078-SCX-048	A	29,180	7.0	soil	37,502
S078-SCX-048	A	29,180	8.0	soil	38,942
S078-SCX-048	A	29,180	9.0	soil	39,292
S078-SCX-048	A	29,180	10.0	soil	40,622
S078-SCX-048	A	29,180	11.0	soil	39,524
S078-SCX-048	A	29,180	12.0	soil	39,204
S078-SCX-048	A	29,180	13.0	soil	38,946
S078-SCX-048	A	29,180	14.0	bedrock	33,752
S078-SCX-049	A	--	0.0	soil	30,472
S078-SCX-049	A	29,180	1.0	soil	47,324
S078-SCX-049	A	29,180	2.0	soil	44,912
S078-SCX-049	A	29,180	3.0	soil	34,692
S078-SCX-049	A	29,180	4.0	soil	35,580
S078-SCX-049	A	29,180	5.0	soil	23,872**
S078-SCX-050	A	--	0.0	soil	24,718
S078-SCX-050	A	29,180	1.0	soil	31,272
S078-SCX-050	A	29,180	2.0	soil	35,008
S078-SCX-050	A	29,180	3.0	soil	37,412
S078-SCX-050	A	29,180	4.0	soil	35,334
S078-SCX-050	A	29,180	5.0	soil	33,170
S078-SCX-050	A	29,180	6.0	soil	36,272
S078-SCX-050	A	29,180	7.0	soil	40,208
S078-SCX-050	A	29,180	8.0	soil	38,220
S078-SCX-050	A	29,180	9.0	soil	36,188
S078-SCX-050	A	29,180	10.0	soil	36,040
S078-SCX-050	A	29,180	11.0	soil	36,592
S078-SCX-050	A	29,180	12.0	soil	39,332
S078-SCX-050	A	29,180	13.0	soil	38,700
S078-SCX-050	A	29,180	14.0	soil	44,230
S078-SCX-050	A	29,180	15.0	soil	45,436
S078-SCX-051	A	--	0.0	soil	32,068
S078-SCX-051	A	29,180	1.0	soil	38,422
S078-SCX-051	A	29,180	2.0	soil	36,676
S078-SCX-051	A	29,180	3.0	soil	25,516
S078-SCX-051	A	29,180	4.0	soil	25,126
S078-SCX-051	A	29,180	5.0	soil	30,652
S078-SCX-051	A	29,180	6.0	soil	37,248
S078-SCX-051	A	29,180	7.0	soil	34,178
S078-SCX-051	A	29,180	8.0	soil	30,254
S078-SCX-051	A	29,180	9.0	soil	25,482
S078-SCX-051	A	29,180	10.0	soil	25,502
S078-SCX-051	A	29,180	11.0	soil	27,438
S078-SCX-051	A	29,180	12.0	soil	29,524
S078-SCX-051	A	29,180	13.0	soil	36,852
S078-SCX-051	A	29,180	14.0	soil	41,772
S078-SCX-051	A	29,180	15.0	soil	45,420
S078-SCX-051	A	29,180	16.0	soil	45,526
S078-SCX-051	A	29,180	17.0	soil	42,860
S078-SCX-051	A	29,180	18.0	soil	36,532
S078-SCX-051	A	29,180	19.0	bedrock	28,850
S078-SCX-052	A	--	0.0	soil	33,702
S078-SCX-052	A	29,180	1.0	soil	48,192
S078-SCX-052	A	29,180	2.0	soil	35,568
S078-SCX-052	A	29,180	3.0	soil	34,210
S078-SCX-052	A	29,180	4.0	soil	35,256
S078-SCX-052	A	29,180	5.0	soil	35,804
S078-SCX-052	A	29,180	6.0	soil	36,716
S078-SCX-052	A	29,180	7.0	soil	35,954
S078-SCX-052	A	29,180	8.0	soil	36,762
S078-SCX-052	A	29,180	9.0	soil	40,042
S078-SCX-052	A	29,180	10.0	soil	37,740
S078-SCX-052	A	29,180	11.0	soil	38,912
S078-SCX-052	A	29,180	12.0	soil	43,082
S078-SCX-052	A	29,180	13.0	soil	42,110
S078-SCX-052	A	29,180	14.0	soil	39,802
S078-SCX-052	A	29,180	15.0	soil	39,542
S078-SCX-052	A	29,180	16.0	soil	40,246
S078-SCX-052	A	29,180	17.0	soil	35,864
S078-SCX-052	A	29,180	18.0	soil	34,108
S078-SCX-052	A	29,180	19.0	soil	35,962
S078-SCX-052	A	29,180	20.0	soil	38,920

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-053	A	--	0.0	soil	21,038
S078-SCX-053	A	29,180	1.0	soil	27,030
S078-SCX-053	A	29,180	2.0	soil	27,066
S078-SCX-053	A	29,180	3.0	soil	26,202
S078-SCX-053	A	29,180	4.0	soil	27,536
S078-SCX-053	A	29,180	5.0	soil	27,700
S078-SCX-053	A	29,180	6.0	soil	28,338
S078-SCX-053	A	29,180	7.0	soil	27,746
S078-SCX-053	A	29,180	8.0	soil	26,180
S078-SCX-053	A	29,180	9.0	soil	24,352
S078-SCX-053	A	29,180	10.0	soil	24,438
S078-SCX-053	A	29,180	11.0	bedrock	24,862
S078-SCX-053	A	29,180	12.0	bedrock	27,616
S078-SCX-053	A	29,180	13.0	bedrock	28,374
S078-SCX-053	A	29,180	14.0	bedrock	30,770
S078-SCX-053	A	29,180	15.0	bedrock	29,286
S078-SCX-053	A	29,180	16.0	bedrock	30,136
S078-SCX-053	A	29,180	17.0	bedrock	33,274
S078-SCX-054	A	--	0.0	soil	25,872
S078-SCX-054	A	29,180	1.0	soil	26,522
S078-SCX-054	A	29,180	2.0	soil	23,240
S078-SCX-054	A	29,180	3.0	soil	21,566
S078-SCX-054	A	29,180	4.0	soil	20,318
S078-SCX-054	A	29,180	5.0	soil	20,894
S078-SCX-054	A	29,180	6.0	soil	22,240
S078-SCX-054	A	29,180	7.0	soil	21,646
S078-SCX-054	A	29,180	8.0	soil	24,996
S078-SCX-054	A	29,180	9.0	soil	28,474
S078-SCX-054	A	29,180	10.0	soil	26,030
S078-SCX-054	A	29,180	11.0	soil	23,304
S078-SCX-054	A	29,180	12.0	soil	23,106
S078-SCX-054	A	29,180	13.0	soil	24,810
S078-SCX-054	A	29,180	14.0	soil	29,474
S078-SCX-054	A	29,180	15.0	soil	35,108
S078-SCX-054	A	29,180	16.0	soil	38,794
S078-SCX-054	A	29,180	17.0	soil	35,016
S078-SCX-054	A	29,180	18.0	soil	30,572
S078-SCX-055	A	--	0.0	soil	32,988
S078-SCX-055	A	29,180	1.0	soil	25,936
S078-SCX-055	A	29,180	2.0	soil	22,572
S078-SCX-055	A	29,180	3.0	soil	22,808
S078-SCX-055	A	29,180	4.0	soil	22,818
S078-SCX-055	A	29,180	5.0	soil	22,626
S078-SCX-055	A	29,180	6.0	soil	22,214
S078-SCX-055	A	29,180	7.0	soil	22,432
S078-SCX-055	A	29,180	8.0	soil	25,518
S078-SCX-055	A	29,180	9.0	soil	30,212
S078-SCX-055	A	29,180	10.0	soil	30,814
S078-SCX-055	A	29,180	11.0	soil	33,928
S078-SCX-055	A	29,180	12.0	soil	33,524
S078-SCX-055	A	29,180	13.0	soil	32,200
S078-SCX-055	A	29,180	14.0	soil	27,942
S078-SCX-055	A	29,180	15.0	soil	26,018
S078-SCX-055	A	29,180	16.0	soil	27,734
S078-SCX-055	A	29,180	17.0	soil	40,740
S078-SCX-055	A	29,180	18.0	bedrock	48,528
S078-SCX-055	A	29,180	19.0	bedrock	51,010
S078-SCX-055	A	29,180	20.0	bedrock	39,146
S078-SCX-055	A	29,180	21.0	bedrock	31,894
S078-SCX-056	A	--	0.0	soil	26,962
S078-SCX-056	A	29,180	1.0	soil	23,920
S078-SCX-056	A	29,180	2.0	soil	21,700
S078-SCX-056	A	29,180	3.0	soil	20,842
S078-SCX-056	A	29,180	4.0	soil	23,380
S078-SCX-056	A	29,180	5.0	soil	24,188
S078-SCX-056	A	29,180	6.0	soil	22,886
S078-SCX-056	A	29,180	7.0	soil	20,910
S078-SCX-056	A	29,180	8.0	soil	21,138
S078-SCX-056	A	29,180	9.0	soil	21,872
S078-SCX-056	A	29,180	10.0	soil	23,206
S078-SCX-056	A	29,180	11.0	soil	24,226
S078-SCX-056	A	29,180	12.0	soil	25,966
S078-SCX-056	A	29,180	13.0	soil	23,530
S078-SCX-056	A	29,180	14.0	soil	24,500
S078-SCX-056	A	29,180	15.0	soil	24,566

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-057	A	--	0.0	soil	19,654
S078-SCX-057	A	29,180	1.0	soil	20,956
S078-SCX-057	A	29,180	2.0	soil	21,744
S078-SCX-057	A	29,180	3.0	soil	21,038
S078-SCX-057	A	29,180	4.0	soil	19,680
S078-SCX-057	A	29,180	5.0	soil	22,758
S078-SCX-057	A	29,180	6.0	soil	21,914
S078-SCX-057	A	29,180	7.0	soil	21,186
S078-SCX-057	A	29,180	8.0	soil	20,706
S078-SCX-057	A	29,180	9.0	soil	20,772
S078-SCX-057	A	29,180	10.0	soil	22,580
S078-SCX-057	A	29,180	11.0	soil	24,526
S078-SCX-057	A	29,180	12.0	soil	24,294
S078-SCX-057	A	29,180	13.0	soil	29,344
S078-SCX-057	A	29,180	14.0	soil	24,104
S078-SCX-057	A	29,180	15.0	soil	22,094
S078-SCX-057	A	29,180	16.0	soil	24,842
S078-SCX-057	A	29,180	17.0	soil	28,062
S078-SCX-057	A	29,180	18.0	soil	27,706
S078-SCX-057	A	29,180	19.0	soil	27,056
S078-SCX-057	A	29,180	20.0	soil	32,996
S078-SCX-057	A	29,180	21.0	soil	32,786
S078-SCX-057	A	29,180	22.0	soil	32,914
S078-SCX-057	A	29,180	23.0	soil	36,650
S078-SCX-057	A	29,180	24.0	bedrock	36,900
S078-SCX-057	A	29,180	24.5	bedrock	39,174
S078-SCX-058	A	29,180	1.0	soil	32,592
S078-SCX-058	A	29,180	2.0	soil	36,394
S078-SCX-058	A	29,180	3.0	soil	36,400
S078-SCX-058	A	29,180	4.0	soil	33,602
S078-SCX-058	A	29,180	5.0	soil	32,290
S078-SCX-058	A	29,180	6.0	soil	33,056
S078-SCX-058	A	29,180	7.0	soil	35,864
S078-SCX-058	A	29,180	8.0	soil	42,910
S078-SCX-058	A	29,180	9.0	soil	42,828
S078-SCX-058	A	29,180	10.0	bedrock	44,734
S078-SCX-058	A	29,180	11.0	bedrock	39,464
S078-SCX-058	A	29,180	12.0	bedrock	46,074
S078-SCX-058	A	29,180	13.0	bedrock	48,540
S078-SCX-058	A	29,180	14.0	bedrock	43,804
S078-SCX-058	A	29,180	15.0	bedrock	64,572
S078-SCX-059	A	--	0.0	soil	19,694
S078-SCX-059	A	29,180	1.0	soil	34,426
S078-SCX-059	A	29,180	2.0	soil	42,936
S078-SCX-059	A	29,180	3.0	soil	46,788
S078-SCX-059	A	29,180	4.0	soil	47,172
S078-SCX-059	A	29,180	5.0	soil	48,822
S078-SCX-059	A	29,180	6.0	soil	47,732
S078-SCX-059	A	29,180	7.0	soil	55,206
S078-SCX-059	A	29,180	8.0	bedrock	44,844
S078-SCX-059	A	29,180	9.0	bedrock	39,854
S078-SCX-059	A	29,180	9.5	bedrock	38,068
S078-SCX-060	A	--	0.0	soil	14,707
S078-SCX-060	A	29,180	0.5	soil	18,576
S078-SCX-060	A	29,180	1.0	soil	20,686
S078-SCX-060	A	29,180	1.5	soil	21,159
S078-SCX-060	A	29,180	2.0	soil	21,659
S078-SCX-061	A	--	0.0	soil	15,994
S078-SCX-061	A	29,180	0.5	soil	21,883
S078-SCX-061	A	29,180	1.0	soil	23,522
S078-SCX-061	A	29,180	1.5	soil	24,144
S078-SCX-001	B	--	0.0	sediment	28,943
S078-SCX-001	B	NA	0.5	sediment	29,148
S078-SCX-001	B	NA	1.0	sediment	34,423
S078-SCX-001	B	NA	1.5	sediment	38,437
S078-SCX-001	B	NA	2.0	sediment	55,800**
S078-SCX-002	B	--	0.0	soil	23,546
S078-SCX-002	B	NA	0.5	soil	29,130
S078-SCX-002	B	NA	1.0	soil	29,609
S078-SCX-002	B	NA	1.5	soil	31,255
S078-SCX-002	B	NA	2.0	soil	36,169
S078-SCX-002	B	NA	2.75	soil	81,681**
S078-SCX-003	B	--	0.0	soil	20,994
S078-SCX-003	B	NA	0.5	soil	27,330
S078-SCX-003	B	NA	1.0	soil	28,368**
S078-SCX-004	B	--	0.0	sediment	65,316
S078-SCX-004	B	NA	0.5	sediment	78,423
S078-SCX-005	B	--	0.0	soil	29,781
S078-SCX-005	B	NA	0.5	soil	32,837**

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-012	B	--	0.0	sediment	22,208
S078-SCX-012	B	NA	1.0	sediment	107,530
S078-SCX-012	B	NA	2.0	bedrock	113,130
S078-SCX-012	B	NA	3.0	bedrock	64,402
S078-SCX-012	B	NA	4.0	bedrock	100,162
S078-SCX-012	B	NA	5.0	bedrock	132,386
S078-SCX-012	B	NA	6.0	bedrock	293,338
S078-SCX-012	B	NA	7.0	bedrock	548,808
S078-SCX-012	B	NA	8.0	bedrock	578,306
S078-SCX-012	B	NA	9.0	bedrock	352,848
S078-SCX-012	B	NA	10.0	bedrock	367,136
S078-SCX-012	B	NA	11.0	bedrock	423,278
S078-SCX-013	B	--	0.0	sediment	17,964
S078-SCX-013	B	NA	1.0	sediment	48,790
S078-SCX-013	B	NA	2.0	bedrock	146,872
S078-SCX-013	B	NA	3.0	bedrock	193,960
S078-SCX-013	B	NA	4.0	bedrock	135,520
S078-SCX-013	B	NA	5.0	bedrock	46,982
S078-SCX-013	B	NA	6.0	bedrock	40,278
S078-SCX-013	B	NA	7.0	bedrock	37,464
S078-SCX-013	B	NA	8.0	bedrock	37,468
S078-SCX-013	B	NA	9.0	bedrock	41,254
S078-SCX-013	B	NA	9.5	bedrock	44,646
S078-SCX-014	B	--	0.0	soil	16,962
S078-SCX-014	B	NA	1.0	soil	15,252
S078-SCX-014	B	NA	2.0	bedrock	14,908
S078-SCX-014	B	NA	2.5	bedrock	14,832
S078-SCX-015	B	--	0.0	sediment	21,422
S078-SCX-015	B	NA	1.0	sediment	101,696
S078-SCX-015	B	NA	2.0	bedrock	208,354
S078-SCX-015	B	NA	3.0	bedrock	73,044
S078-SCX-015	B	NA	4.0	bedrock	65,478
S078-SCX-015	B	NA	5.0	bedrock	48,148
S078-SCX-015	B	NA	6.0	bedrock	56,036
S078-SCX-015	B	NA	7.0	bedrock	76,224
S078-SCX-015	B	NA	8.0	bedrock	90,888
S078-SCX-016	B	--	0.0	sediment	27,540
S078-SCX-016	B	NA	1.0	sediment	80,854
S078-SCX-016	B	NA	2.0	bedrock	209,058
S078-SCX-016	B	NA	3.0	bedrock	280,246
S078-SCX-016	B	NA	4.0	bedrock	473,736
S078-SCX-016	B	NA	5.0	bedrock	483,466
S078-SCX-016	B	NA	6.0	bedrock	518,208
S078-SCX-016	B	NA	7.0	bedrock	403,728
S078-SCX-016	B	NA	8.0	bedrock	286,844
S078-SCX-017	B	--	0.0	soil	18,082
S078-SCX-017	B	NA	1.0	soil	29,370
S078-SCX-017	B	NA	2.0	soil	52,480
S078-SCX-017	B	NA	3.0	bedrock	201,318
S078-SCX-017	B	NA	3.5	bedrock	169,406
S078-SCX-018	B	--	0.0	soil	15,140
S078-SCX-018	B	NA	1.0	soil	26,988
S078-SCX-018	B	NA	2.0	bedrock	20,924
S078-SCX-018	B	NA	3.0	bedrock	24,126
S078-SCX-018	B	NA	4.0	bedrock	22,100
S078-SCX-018	B	NA	4.5	bedrock	18,982
S078-SCX-019	B	--	0.0	bedrock	16,756
S078-SCX-019	B	NA	1.0	bedrock	27,218
S078-SCX-019	B	NA	2.0	bedrock	27,138
S078-SCX-019	B	NA	3.0	bedrock	24,760
S078-SCX-019	B	NA	4.0	bedrock	23,600
S078-SCX-020	B	--	0.0	bedrock	16,644
S078-SCX-020	B	NA	1.0	bedrock	19,828
S078-SCX-020	B	NA	2.0	bedrock	23,826
S078-SCX-020	B	NA	3.0	bedrock	24,734
S078-SCX-021	B	--	0.0	soil	17,860
S078-SCX-021	B	NA	1.0	bedrock	23,408
S078-SCX-021	B	NA	2.0	bedrock	23,032
S078-SCX-021	B	NA	3.0	bedrock	20,892
S078-SCX-021	B	NA	4.0	bedrock	23,588
S078-SCX-021	B	NA	5.0	bedrock	17,646
S078-SCX-021	B	NA	6.0	bedrock	14,086
S078-SCX-022	B	--	0.0	soil	12,436
S078-SCX-022	B	NA	1.0	soil	18,724
S078-SCX-022	B	NA	2.0	soil	22,992
S078-SCX-022	B	NA	3.0	bedrock	23,610

Notes

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**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-2
Static Gamma Measurement Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Subsurface Static Gamma Investigation Level (cpm)	Sample Depth (ft bgs)	Media	Static Gamma Measurement (cpm)
S078-SCX-023	B	--	0.0	bedrock	16,006
S078-SCX-023	B	NA	1.0	bedrock	27,074
S078-SCX-023	B	NA	2.0	bedrock	30,488
S078-SCX-023	B	NA	3.0	bedrock	31,470
S078-SCX-023	B	NA	4.0	bedrock	29,984
S078-SCX-024	B	--	0.0	sediment	24,876
S078-SCX-024	B	NA	1.0	sediment	127,896
S078-SCX-024	B	NA	2.0	bedrock	44,562
S078-SCX-024	B	NA	3.0	bedrock	30,354
S078-SCX-025	B	--	0.0	soil	12,920
S078-SCX-025	B	NA	1.0	soil	18,308
S078-SCX-025	B	NA	2.0	bedrock	21,844
S078-SCX-025	B	NA	3.0	bedrock	29,002
S078-SCX-025	B	NA	4.0	bedrock	28,968
S078-SCX-025	B	NA	5.0	bedrock	27,678
S078-SCX-026	B	--	0.0	soil	25,720
S078-SCX-026	B	NA	1.0	soil	34,826
S078-SCX-026	B	NA	2.0	soil	40,422
S078-SCX-026	B	NA	3.0	soil	56,608
S078-SCX-026	B	NA	4.0	soil	62,658
S078-SCX-026	B	NA	5.0	soil	54,660
S078-SCX-026	B	NA	6.0	soil	40,164
S078-SCX-026	B	NA	7.0	soil	35,100
S078-SCX-026	B	NA	8.0	soil	28,302
S078-SCX-026	B	NA	9.0	soil	27,398
S078-SCX-026	B	NA	10.0	soil	27,412
S078-SCX-026	B	NA	11.0	soil	22,980
S078-SCX-026	B	NA	12.0	soil	21,298
S078-SCX-026	B	NA	13.0	soil	21,290
S078-SCX-026	B	NA	14.0	bedrock	23,658
S078-SCX-026	B	NA	15.0	bedrock	25,082
S078-SCX-027	B	--	0.0	soil	21,614
S078-SCX-027	B	NA	1.0	soil	28,294
S078-SCX-027	B	NA	2.0	soil	27,264
S078-SCX-027	B	NA	3.0	soil	28,790
S078-SCX-027	B	NA	4.0	soil	30,596
S078-SCX-027	B	NA	5.0	soil	33,140
S078-SCX-027	B	NA	6.0	soil	30,692
S078-SCX-027	B	NA	7.0	soil	27,544
S078-SCX-027	B	NA	8.0	soil	22,802
S078-SCX-027	B	NA	9.0	soil	23,176
S078-SCX-027	B	NA	10.0	soil	25,272
S078-SCX-027	B	NA	11.0	soil	26,640
S078-SCX-027	B	NA	12.0	soil	37,884
S078-SCX-027	B	NA	13.0	soil	41,380
S078-SCX-027	B	NA	14.0	bedrock	25,380
S078-SCX-027	B	NA	15.0	bedrock	28,442
S078-SCX-027	B	NA	16.0	bedrock	50,962
S078-SCX-027	B	NA	17.0	bedrock	52,736
S078-SCX-062	B	--	0.0	soil	14,039
S078-SCX-062	B	NA	0.5	soil	20,157
S078-SCX-062	B	NA	0.83	soil	20,869**

Notes

Bold	Bolded result indicates measurement exceeds subsurface gamma investigation level
*	The subsurface gamma investigation levels are derived from the background area
**	Measurement collected at interface of unconsolidated material and refusal material (e.g., bedrock)
NA	A borehole in Survey Area B was not completed, therefore a subsurface static gamma investigation level was not established for Survey Area B
--	The subsurface gamma investigation level does not apply to surface static gamma measurements
IL	Investigation Level
RSE	Removal Site Investigation
cpm	counts per minute
ft bgs	feet below ground surface

Table 4-3
Gamma Correlation Study Soil Sample Analytical Results
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Location Identification Date Collected Depth (feet) Analyte (Units)	S078-C01-001 Dup 11/11/2016 0 - 0.5	S078-C01-001 11/11/2016 0 - 0.5	S078-C02-001 11/11/2016 0 - 0.5	S078-C03-001 11/11/2016 0 - 0.5	S078-C04-001 11/11/2016 0 - 0.5	S078-C05-001 11/11/2016 0 - 0.5
Radionuclides (pCi/g)						
Radium-226	2.1 ± 0.42	1.9 ± 0.34	2.69 ± 0.47	19.1 ± 2.4	19.9 ± 2.5	2.69 ± 0.46
Thorium-228	0.74 ± 0.14	0.66 ± 0.13	1 ± 0.18	1.38 ± 0.23	1.48 ± 0.25	1.16 ± 0.2
Thorium-230	1.41 ± 0.24	1.42 ± 0.25	1.94 ± 0.33	11.7 ± 1.8	12.3 ± 1.9	1.88 ± 0.31
Thorium-232	0.67 ± 0.13	0.75 ± 0.14	0.99 ± 0.18	1.26 ± 0.21	1.41 ± 0.24	1.15 ± 0.2

Notes

Bold	Bolded result indicates positively identified compound
pCi/g	picocuries per gram

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-CX-001	S078-CX-002	S078-CX-003	S078-CX-004	S078-CX-005	S078-CX-006	S078-CX-011	S078-CX-011Dup	S078-SCX-006	S078-SCX-006	S078-SCX-006	S078-SCX-007	S078-SCX-007	S078-SCX-007	S078-SCX-008
Date Collected		4/18/2017	4/18/2017	4/18/2017	4/18/2017	4/18/2017	4/18/2017	4/19/2017	4/19/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017
Depth (feet)		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0.5 - 1.5	1.5 - 2.5	0 - 0.5	0.5 - 2.0	2.0 - 2.5	0 - 0.5
Sample Category		surface	surface	surface	surface	surface	surface	surface	surface	surface	subsurface	subsurface	surface	subsurface	subsurface	surface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	composite	grab	grab
Media		sediment	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	sediment	sediment	sediment	soil
Analyte (Units)																
Metals^1 (mg/kg)	Investigation Level															
Arsenic	3.35	4	4.5	3.3	1.8	3.5	4.2	7.1	7.3	3.9	5.2	4.5	4.2 J+	5.9	3.8	4.4
Molybdenum	0.568	0.62	0.83	0.48	<0.2	0.68	0.6	0.85	0.84	0.67	0.46	0.38	0.62	0.64	0.54	0.27
Selenium	1.10	2	1.9	1.5	1.3	1.2	1.8	2.6	2.6	1.5	1.7	1.5	1.8	1.4	1.8	1.4
Uranium	3.21	8.7	23	6.8	1.3	7.1	5.6	6.3	7.6	8.8	4	2.4	4.7 J	6.8	4.8	3.1
Vanadium	12.2	25	26	15	14	32	26	22	21	17	19	15	30 J	26	36	39
Radionuclides (pCi/g)																
Radium-226	3.59	7.8 ± 1.1 J+	24.8 ± 3.1	8.3 ± 1.1	3.32 ± 0.54	15.3 ± 2	5.18 ± 0.74 J+	5.01 ± 0.7	4.92 ± 0.73	8.8 ± 1.2	3.49 ± 0.54 J+	1.2 ± 0.28 J+	3.81 ± 0.57	3.98 ± 0.57	4.05 ± 0.61	9.1 ± 1.2

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-009	S078-SCX-010	S078-SCX-010	S078-SCX-010	S078-SCX-011	S078-SCX-011	S078-SCX-011	S078-SCX-028	S078-SCX-028Dup	S078-SCX-028	S078-SCX-028	S078-SCX-028	S078-SCX-028	S078-SCX-029	S078-SCX-029
Date Collected		4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	4/20/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017
Depth (feet)		0 - 0.25	0 - 0.5	0.5 - 2.5	2.5 - 3.0	0 - 0.5	0.5 - 1.5	1.5 - 2.0	0 - 0.5	0 - 0.5	4.0 - 5.0	12.0 - 13.0	28.0 - 29.0	32.0 - 33.0	0 - 0.5	4.0 - 5.0
Sample Category		surface	surface	subsurface	subsurface	surface	subsurface	subsurface	surface	surface	subsurface	subsurface	subsurface	subsurface	surface	subsurface
Sample Collection Method		grab	grab	composite	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	sediment	sediment	soil	soil	soil	soil	soil	soil	soil	soil	bedrock	soil	soil
Analyte (Units)																
Metals^1 (mg/kg)	Investigation Level															
Arsenic	3.35	5.7	3.7	4.4	4.9	3.7	4.3	5	4.3	5.9	4.1	4.8	3.6	3.1	4.2	5.3
Molybdenum	0.568	0.25	0.29	1.1	0.48	0.45	0.32	0.36	0.45	0.61	0.49	0.6	0.33	2.5	0.42	0.58
Selenium	1.10	3.9	1.2	1.4	2	1.9	1.5	1.3	1.8	2.1	2	1.7	<1.1	1.6	1.4	2.7
Uranium	3.21	3.3	2.1	3	4.2	8	5	2.4	11	12	4.2	1.9	1.4	2.2	4.6	9.8
Vanadium	12.2	56	19	16	19	23	21	18	21	27	24	19	18	16	33	27
Radionuclides (pCi/g)																
Radium-226	3.59	6.34 ± 0.92 J+	2.86 ± 0.47	2.56 ± 0.42 J+	4.01 ± 0.65 J+	5.41 ± 0.79	3.48 ± 0.54 J+	1.86 ± 0.39	3.11 ± 0.52	2.71 ± 0.46	2.47 ± 0.43	2.11 ± 0.41	1.65 ± 0.33	2.78 ± 0.44	4.09 ± 0.6	4.93 ± 0.72

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
¹	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-029	S078-SCX-029	S078-SCX-030	S078-SCX-030Dup	S078-SCX-030	S078-SCX-030	S078-SCX-031	S078-SCX-031	S078-SCX-031	S078-SCX-031	S078-SCX-031	S078-SCX-032	S078-SCX-032	S078-SCX-032	S078-SCX-032
Date Collected		10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/14/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017
Depth (feet)		8.0 - 9.0	15.5 - 16.5	0 - 0.5	0 - 0.5	5.0 - 6.0	11.0 - 13.0	0 - 0.5	3.0 - 4.0	9.0 - 10.0	17.0 - 18.0	21.0 - 22.0	0 - 0.5	3.0 - 4.0	14.0 - 15.0	18.0 - 19.0
Sample Category		subsurface	subsurface	surface	surface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	composite	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	boulder	soil	soil
Analyte (Units)																
Metals¹ (mg/kg)	Investigation Level															
Arsenic	3.35	4.8	6.4	4	4.9	4.2	4.9	5.6	4.5	4.6	5.4	9.4	4.8	2.7	6.8	4.4
Molybdenum	0.568	0.68	0.59	0.56	0.61	0.59	0.5	0.53	0.46	0.71	1.5	1.5	0.49	0.27	1.3	0.53
Selenium	1.10	1.6	1.4	1.3	1.6	1.9	1.6	1.5	1.7	3	4.2	2.4	2.1	3.9	2.2	2
Uranium	3.21	2	1.5	7.5	5.9	7	3	4.3	15	47	39	16	6.6	140 D	11	8.5
Vanadium	12.2	16	16	31	36	26	20	110 J	33	48	56	39	27	95	23	23
Radionuclides (pCi/g)																
Radium-226	3.59	2.1 ± 0.32	1.4 ± 0.3	3.99 ± 0.6	4.22 ± 0.63	3.38 ± 0.5	1.99 ± 0.36	2.91 ± 0.48	8 ± 1	17 ± 2.1	24.8 ± 3	8 ± 1.1	3.23 ± 0.52	47.7 ± 5.6 J-	4.74 ± 0.7	2.47 ± 0.4

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
¹	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-032	S078-SCX-033	S078-SCX-033	S078-SCX-033Dup	S078-SCX-034	S078-SCX-034	S078-SCX-034	S078-SCX-034	S078-SCX-034	S078-SCX-035	S078-SCX-035	S078-SCX-035	S078-SCX-035	S078-SCX-035	S078-SCX-036
Date Collected		10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017
Depth (feet)		20.0 - 21.0	0 - 0.5	3.0 - 4.0	3.0 - 4.0	0 - 0.5	4.0 - 5.0	10.0 - 11.0	17.0 - 18.0	22.0 - 23.0	0 - 0.5	2.0 - 3.0	6.0 - 7.0	18.0 - 19.0	27.0 - 28.0	0 - 0.5
Sample Category		subsurface	surface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	subsurface	surface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil/bedrock	soil	soil	soil	boulder	soil	soil	soil	soil	soil	boulder	soil	soil
Analyte (Units)																
	Investigation Level															
Metals^1 (mg/kg)																
Arsenic	3.35	6.3	4.1	3.5	4.8	5.1	4.1	4.7	4.7	7.7	4.1	12	4.3	2.3	7.1	4.5
Molybdenum	0.568	2	0.35	0.3	0.39	0.67	0.59	0.73	0.51	1	0.38	1.1	0.67	0.43	1.3	0.62
Selenium	1.10	3.9	2.1	1.2	1.8	2.5	3.1	3.1	1.8	1.6	1.2	4.6	6.3	<1	2	1.4
Uranium	3.21	31	6	2.2	3.5	8	55	47	7.6	2.4	2.5	46	42	2	17	3.1
Vanadium	12.2	120	11	11	15	34	53	58	21	23	19	100	51	13	21	22
Radionuclides (pCi/g)																
Radium-226	3.59	15.9 ± 2	2.76 ± 0.43	2.88 ± 0.47	3.08 ± 0.52	3.81 ± 0.56	23.9 ± 2.9	19.9 ± 2.4	3.02 ± 0.51	1.9 ± 0.34	2.37 ± 0.4	21.7 ± 2.6	13.6 ± 1.7	1.68 ± 0.34	2 ± 0.39	2.59 ± 0.44

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-036	S078-SCX-036Dup	S078-SCX-036	S078-SCX-036	S078-SCX-037	S078-SCX-037	S078-SCX-037	S078-SCX-038	S078-SCX-038Dup	S078-SCX-038	S078-SCX-038	S078-SCX-039	S078-SCX-039	S078-SCX-039
Date Collected		10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017
Depth (feet)		1.0 - 2.0	1.0 - 2.0	11.0 - 12.0	15.0 - 16.0	0 - 0.5	5.0 - 6.0	7.0 - 8.0	0 - 0.5	0 - 0.5	10.0 - 11.0	12.0 - 13.0	0 - 0.5	12.0 - 13.0	16.0 - 17.0
Sample Category		subsurface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	surface	surface	subsurface	subsurface	surface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Analyte (Units)															
Metals[1] (mg/kg)	Investigation Level														
Arsenic	3.35	3.9	4.3	5	20	3.3	1.7	3.4	2.9	2.5	5.9 J	5.9	3	4.7	1.8
Molybdenum	0.568	0.46	0.49	1.2	0.59	0.48	0.61	1.9	0.2	0.24	0.75	0.59	0.22	0.48	0.44
Selenium	1.10	1.3	1.5	1.8	1.4	1.3	1.4	2	<0.98	<1	1.9	2.3	1.1	2.2	1.9
Uranium	3.21	3.5	4.3	17	2.8	3.1	13	9.9	1.4	1.1	15	32	2.4	16	5.8
Vanadium	12.2	18	19	35	14	30	67	51	12	13	30 J-	28	19	32	18
Radionuclides (pCi/g)															
Radium-226	3.59	3.06 ± 0.47	3.01 ± 0.48	8.2 ± 1.1	1.74 ± 0.31	4.77 ± 0.69	134 ± 16	13.4 ± 1.7	2.01 ± 0.36	2.3 ± 0.33	6.47 ± 0.89	4.64 ± 0.69	3.24 ± 0.49 J-	5.05 ± 0.72	6.94 ± 0.91

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
[1]	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-040	S078-SCX-040	S078-SCX-040	S078-SCX-041	S078-SCX-041	S078-SCX-041	S078-SCX-041	S078-SCX-041	S078-SCX-041	S078-SCX-041	S078-SCX-042	S078-SCX-042	S078-SCX-042	S078-SCX-043	S078-SCX-043Dup
Date Collected		10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017
Depth (feet)		0 - 0.5	4.0 - 5.0	11.0 - 12.0	0 - 0.5	3.0 - 4.0	5.0 - 6.0	7.0 - 9.0	10.0 - 11.0	14.0 - 15.0	17.0 - 18.0	0 - 0.5	6.0 - 7.0	12.0 - 13.0	0 - 0.5	0 - 0.5
Sample Category		surface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	surface	surface
Sample Collection Method		grab	grab	grab	grab	grab	grab	composite	grab	grab	grab	grab	grab	grab	grab	grab
Media		sediment	sediment	sediment	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Analyte (Units)																
Metals^1 (mg/kg)	Investigation Level															
Arsenic	3.35	3.9	3.8	2.5	4.4	4.4	4.9	3.4	5.1	4	4.3	3.4	3.1	4.1	3.7	3.5
Molybdenum	0.568	0.42	0.5	0.33	0.73	0.57	1.2	0.28	0.49	0.41	2.8	0.36	0.97	0.87	0.36	0.38
Selenium	1.10	1.9	1.6	1.5	1.5	1.6	1.6	3.2	1.8	1.6	1.5	1.5	1.5	1.5	1.3	1.3
Uranium	3.21	3.6	4.8	14	4.3	10	51	140 D	12	4.7	10	2.7	9.4	8.4	4.5	3.4
Vanadium	12.2	21	22	12	26	34	49	140	24	24	30	20	12	16	22	21
Radionuclides (pCi/g)																
Radium-226	3.59	4.54 ± 0.64	4.69 ± 0.65	2.49 ± 0.43	4.54 ± 0.58	5.95 ± 0.82 J-	21.5 ± 2.6	90 ± 11	5.3 ± 0.74	6.21 ± 0.84	8 ± 1.1	5.2 ± 0.67	3.1 ± 0.47	3.57 ± 0.55	4.88 ± 0.68	4.15 ± 0.61

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
¹	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-043	S078-SCX-044	S078-SCX-044	S078-SCX-044	S078-SCX-045	S078-SCX-045	S078-SCX-046	S078-SCX-046	S078-SCX-046	S078-SCX-047	S078-SCX-047	S078-SCX-047	S078-SCX-047	S078-SCX-048	S078-SCX-048
Date Collected		10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017
Depth (feet)		7.0 - 8.0	0 - 0.5	4.0 - 5.0	9.0 - 10.0	0 - 0.5	6.0 - 7.0	0 - 0.5	3.0 - 4.0	6.0 - 7.0	0 - 0.5	3.0 - 4.0	8.0 - 9.0	11.0 - 12.0	0 - 0.5	3.0 - 4.0
Sample Category		subsurface	surface	subsurface	subsurface	surface	subsurface	surface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	surface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	sediment	sediment	sediment	soil	soil	soil	soil	soil	soil	soil	soil	soil/bedrock	soil	soil
Analyte (Units)																
Metals[1] (mg/kg)	Investigation Level															
Arsenic	3.35	3.1	3.2	4	4.6	4.1 J	3.4	3.3	3.8	3	3.3	4.7	3.1	3.1	9.7	3.7
Molybdenum	0.568	0.43	0.53	0.37	0.72	0.56	0.49	0.4	0.48	0.48	0.37	0.5	0.49	0.34	0.51	0.45
Selenium	1.10	1.4	1.2	1.4	2.6	1.7	1.2	1.4	1.6	1.4	1.4	1.4	1.6	1.1	1.7	1.5
Uranium	3.21	5.3	4.1	2.1	12	4.6 J	7.2	5.6	5.9	6.6	7.2	9.4	5.7	10	8.8	6.7
Vanadium	12.2	17	18	18	20	23 J+	23	23	23	21	22	43	20	16	44	24
Radionuclides (pCi/g)																
Radium-226	3.59	2.96 ± 0.49	3.76 ± 0.54 J-	3.17 ± 0.49	4.14 ± 0.62	5.56 ± 0.73	4.16 ± 0.63	5.02 ± 0.68	4.43 ± 0.63	3.66 ± 0.53	5.14 ± 0.73	5.97 ± 0.82	4.07 ± 0.62	2.67 ± 0.47	6.89 ± 0.9	5.49 ± 0.74

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
¹	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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	Location Identification	S078-SCX-048	S078-SCX-048	S078-SCX-049	S078-SCX-049Dup	S078-SCX-049	S078-SCX-050	S078-SCX-050	S078-SCX-051	S078-SCX-051	S078-SCX-052	S078-SCX-052	S078-SCX-053	S078-SCX-053	S078-SCX-054
	Date Collected	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/20/2017
	Depth (feet)	8.0 - 9.0	12.0 - 13.0	0 - 0.5	0 - 0.5	2.0 - 3.0	0 - 0.5	7.0 - 8.0	0 - 0.5	16.0 - 17.0	0 - 0.5	9.0 - 10.0	0 - 0.5	9.0 - 10.0	0 - 0.5
	Sample Category	subsurface	subsurface	surface	surface	subsurface	surface	subsurface	surface	subsurface	surface	subsurface	surface	subsurface	surface
	Sample Collection Method	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
	Media	soil	soil/bedrock	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Analyte (Units)															
Metals^1 (mg/kg)	Investigation Level														
Arsenic	3.35	3.3	4.2	5.3	3.5	3.4	3	2.9	3.8	4.8	3.7	4.1	4.1	2.7	5.1
Molybdenum	0.568	0.38	0.34	0.42	0.41	0.32	0.37	0.86	0.77	0.5	1.5	1	0.3	0.26	0.39
Selenium	1.10	1.7	1.5	1.4	1.4	1.3	1.1	1.4	1.3	1.7	1.4	1.7	1.3	<1	1.4
Uranium	3.21	7.5	10	7.5	6.3	6	2.8	9	24	11	14	5.7	1.6	1.9	2
Vanadium	12.2	20	24	26	24	20	19	25	21	22	19	27	9.2	7.1	15
Radionuclides (pCi/g)															
Radium-226	3.59	4.28 ± 0.61	5.01 ± 0.74	5.25 ± 0.74	7.81 ± 0.97	4.14 ± 0.59	4.18 ± 0.6 J-	6.44 ± 0.86	14.4 ± 1.8	4.53 ± 0.7	9.4 ± 1.2	5.79 ± 0.78	2.7 ± 0.47	2.01 ± 0.38	1.66 ± 0.33

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
^{1}	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-054Dup	S078-SCX-054	S078-SCX-054Dup	S078-SCX-054	S078-SCX-055	S078-SCX-055Dup	S078-SCX-055	S078-SCX-055	S078-SCX-056	S078-SCX-056	S078-SCX-056	S078-SCX-057	S078-SCX-057	S078-SCX-057
Date Collected		10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017
Depth (feet)		0 - 0.5	8.0 - 9.0	8.0 - 9.0	16.0 - 17.0	0 - 0.5	0 - 0.5	14.0 - 15.0	18 .0- 19.0	0 - 0.5	2 .0- 3.0	9.0 - 10.0	0 - 0.5	6.0 - 7.0	22.0 - 23.0
Sample Category		surface	subsurface	subsurface	subsurface	surface	surface	subsurface	subsurface	surface	subsurface	subsurface	surface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil	soil	soil	soil	soil	bedrock	soil	soil	soil	soil	soil	soil
Analyte (Units)	Investigation Level														
Metals[1] (mg/kg)															
Arsenic	3.35	5.3	5.4	4.9	3.4	4.7	5	5.2	3	5.2	4.6	4.9	5.1	9.1	4.4
Molybdenum	0.568	0.53	0.45	0.4	0.35	0.75	0.64	0.35	0.29	0.37	0.36	0.41	0.36	0.88	0.36
Selenium	1.10	1.8	2.1	1.9	1.2	1.9	1.7	1.9	8.3	1.5	1.1	1.4	1.2	1.2	1.5
Uranium	3.21	7.8	2.3	2.1	1.6	24	16	1.5	3.8	5.2	1.3	2	3	1.3	2.4
Vanadium	12.2	19	18	17	15	23	21	20	10	17	12	16	17	27	20
Radionuclides (pCi/g)															
Radium-226	3.59	5.22 ± 0.76	2.85 ± 0.46	2.93 ± 0.48	2.95 ± 0.47	15.9 ± 2	10 ± 1.3	3.07 ± 0.48	5.31 ± 0.75	2.14 ± 0.39	1.2 ± 0.26	1.8 ± 0.37	2.32 ± 0.41	1.17 ± 0.26	2.88 ± 0.5

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
[1]	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4a
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area A
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Location Identification		S078-SCX-058	S078-SCX-058	S078-SCX-058	S078-SCX-058Dup	S078-SCX-059	S078-SCX-059	S078-SCX-059	S078-SCX-060	S078-SCX-060	S078-SCX-061	S078-SCX-061	S078-SCX-061Dup
Date Collected		10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/21/2017	10/21/2017	10/21/2017	10/21/2017	10/21/2017
Depth (feet)		0 - 0.5	7.0 - 8.0	14.0 - 15.0	14.0 - 15.0	0 - 0.5	3.0 - 4.0	6.0 - 7.0	0 - 0.5	0.5 - 2.1	0 - 0.5	0.5 - 1.5	0.5 - 1.5
Sample Category		surface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	surface	subsurface	surface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	composite	grab	grab	grab
Media		soil	soil	bedrock	soil	soil	soil	soil	soil	soil	soil	soil	soil
Analyte (Units)													
	Investigation Level												
Metals^1 (mg/kg)													
Arsenic	3.35	3.5	5.6	4.6	3.3	5.4	4	3.9	3.7	3.9	4.8	4.8	5
Molybdenum	0.568	0.52	0.57	1	0.72	0.6	0.73	0.51	0.3	0.42	0.39	0.32	0.37
Selenium	1.10	1.4	2	2.5	1.5	2.5	2.1	2.3	<0.99	<0.97	1.2	1.4	1.3
Uranium	3.21	6	5.9	5	2.8	1.8	17	21	0.73	0.93	1.3	1.4	1.3
Vanadium	12.2	17	35	29	24	30	30	25	11	12	17	18	18
Radionuclides (pCi/g)													
Radium-226	3.59	3.62 ± 0.55	4.71 ± 0.67	8 ± 1.1	7.8 ± 1	5.12 ± 0.69	6.63 ± 0.91	5.4 ± 0.76	1.19 ± 0.26	1.29 ± 0.29	1.94 ± 0.35	1.87 ± 0.37 J+	1.58 ± 0.34

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4b
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area B
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Location Identification		S078-CX-007Dup	S078-CX-007	S078-CX-008	S078-CX-009	S078-CX-010	S078-CX-012	S078-CX-013	S078-CX-014	S078-SCX-001	S078-SCX-001	S078-SCX-001	S078-SCX-001Dup	S078-SCX-002	S078-SCX-002	S078-SCX-002
Date Collected		4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	10/21/2017	10/21/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017
Depth (feet)		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	1.0 - 1.5	1.5 - 2.0	0 - 0.5	0 - 0.5	0.5 - 1.0	1.0 - 2.0
Sample Category		surface	surface	surface	surface	surface	surface	surface	surface	surface	subsurface	subsurface	surface	surface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	sediment	sediment	soil	sediment	soil	soil	sediment	sediment	sediment	sediment	soil	soil	soil
Analyte (Units)																
Metals[1] (mg/kg)	Investigation Level															
Arsenic	18.6	2	1.8	4.6 J	3.5	3.3	7.7	5.8	5.1	2.7	3.2	3.4	5	3	3.7	4.9
Molybdenum	0.371	0.51	0.49	0.6	1.5	1.6	0.53	0.31	0.27	0.33	0.81	0.66	0.63	0.72	0.91	0.98
Selenium	NA	1.6	1.5	<1	1.6	1.7	1.6	1.5	1.5	1.7	2.1	2.2	3	1.2	1.3	1.3
Uranium	1.46	2.8	2.8	2.3	22	2.3	3.5	1.8	2.2	6.4	4.8	4.6	31	4.3	4.7	4
Vanadium	22.3	13	10	16 J-	28	15	30	21	19	20	17	20	59	9.8	9.4	13
Radionuclides (pCi/g)																
Radium-226	2.02	2.55 ± 0.48	2.61 ± 0.46	1.72 ± 0.3	14.6 ± 1.9	2.21 ± 0.39	4.45 ± 0.63	2.08 ± 0.4	2.07 ± 0.33	5.61 ± 0.77	2.49 ± 0.44	3.03 ± 0.5	14.2 ± 1.8	1.9 ± 0.36	2.5 ± 0.4	2.57 ± 0.47

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
Shaded	Shaded result indicates analyte detected, where that analyte does not have an investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
NA	An investigation level is not identified because in BG-2 only two detections of selenium exist, and the detections both have the same value of 1 mg/kg. One distinct detection value is insufficient for Pro UCL to calculate an investigation level.
1	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4b
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area B
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Location Identification		S078-SCX-002	S078-SCX-003	S078-SCX-003	S078-SCX-004	S078-SCX-005	S078-SCX-012	S078-SCX-012	S078-SCX-012	S078-SCX-012	S078-SCX-012	S078-SCX-013	S078-SCX-013	S078-SCX-013	S078-SCX-014	S078-SCX-015
Date Collected		4/19/2017	4/19/2017	4/19/2017	4/19/2017	4/19/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017
Depth (feet)		2.0 - 2.75	0 - 0.5	0.5 - 1.0	0 - 0.5	0 - 0.5	0 - 0.5	7.5 - 8.5	10.0 - 11.0	11.5 - 12.0	12.0 - 13.0	0 - 0.5	1.0 - 1.5	2.5 - 3.0	0 - 0.5	0 - 0.5
Sample Category		subsurface	surface	subsurface	surface	surface	surface	subsurface	subsurface	subsurface	subsurface	surface	subsurface	subsurface	surface	surface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil	soil	soil	sediment	bedrock	bedrock	bedrock	bedrock	sediment	sediment	bedrock	soil	sediment
Analyte (Units)																
Metals¹ (mg/kg)	Investigation Level															
Arsenic	18.6	4.7	3.9	9	5.8	8	5	3.2	4.6	4.2	<0.2	4.5	5.2	6.3	2.4	2.8
Molybdenum	0.371	1.2	3.3	2.9	3.1	5	0.9	1.1	2.6	1.3	<0.2	0.4	0.5	1.3	0.29	0.41
Selenium	NA	1.8	1.6	1.5	1.6	1.6	1.6	2.9	1.3	1.1	<0.99	1.3	2.6	7.3	<0.99	<0.99
Uranium	1.46	12	5.6	4	3.7	3.5	3.5	400 D	140 D	140 D	25	2.4	5	130 D	4.7	1.9
Vanadium	22.3	25	11	12	15	16	22	410	160	220	24	16	21	270	13	11
Radionuclides (pCi/g)																
Radium-226	2.02	5.85 ± 0.8	4.63 ± 0.66	4.72 ± 0.69	4.68 ± 0.69	4.71 ± 0.66	2.3 ± 0.43	136 ± 16 J-	59.1 ± 7 J-	117 ± 14	18.5 ± 2.3 J-	2.29 ± 0.43	2.8 ± 0.45	51.5 ± 6.2	2.77 ± 0.44	1.48 ± 0.28

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
Shaded	Shaded result indicates analyte detected, where that analyte does not have an investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
NA	An investigation level is not identified because in BG-2 only two detections of selenium exist, and the detections both have the same value of 1 mg/kg. One distinct detection value is insufficient for Pro UCL to calculate an investigation level.
¹	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-4b
Site Characterization Soil and Sediment Sample Analytical Results for Survey Area B
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Location Identification		S078-SCX-015	S078-SCX-015Dup	S078-SCX-016	S078-SCX-017	S078-SCX-017	S078-SCX-018	S078-SCX-018	S078-SCX-019	S078-SCX-020	S078-SCX-021	S078-SCX-022	S078-SCX-023	S078-SCX-024	S078-SCX-024Dup
Date Collected		10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/11/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017	10/12/2017
Depth (feet)		3.0 - 4.0	3.0 - 4.0	0 - 0.5	0 - 0.5	0.5 - 2.0	0 - 0.5	0.5 - 1.0	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Sample Category		subsurface	subsurface	surface	surface	subsurface	surface	subsurface	surface	surface	surface	surface	surface	surface	surface
Sample Collection Method		grab	grab	grab	grab	composite	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		bedrock	sediment	sediment	soil	soil	soil	soil	bedrock	bedrock	soil	soil	bedrock	sediment	sediment
Analyte (Units)															
Metals[1] (mg/kg)	Investigation Level														
Arsenic	18.6	2.7	2.4	8.7	4.7	4.4	5	1.9	2.8	3.6	3.2	6.1	2.6	6.4	6
Molybdenum	0.371	1.2	1.4	1.9	0.36	0.41	0.33	0.41	1.6	<0.2	0.31 J-	0.62	0.49	0.5	0.49
Selenium	NA	<0.94	<1	1.4	0.96	<1.1	2.2	<1.1	1.8	<1	1.3	<0.99	1.2	1.4	1.4
Uranium	1.46	35	39	4.3	1.7	3.2	4.6	18	2.1	0.74	2.1	2.8	5.6	92	90
Vanadium	22.3	12	12	27	16	18	19	16	19	10	14 J+	17	20	74	72
Radionuclides (pCi/g)															
Radium-226	2.02	17.6 ± 2.2	17.7 ± 2.2	1.95 ± 0.39	1.64 ± 0.36	3.02 ± 0.47	2.36 ± 0.42	16.6 ± 2.1	2.02 ± 0.37	0.94 ± 0.26	2.31 ± 0.42	1.7 ± 0.33	2.55 ± 0.46	24.8 ± 3	22 ± 2.7

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
Shaded	Shaded result indicates analyte detected, where that analyte does not have an investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
NA	An investigation level is not identified because in BG-2 only two detections of selenium exist, and the detections both have the same value of 1 mg/kg. One distinct detection value is insufficient for Pro UCL to calculate an investigation level.
[1]	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

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Navajo Nation AUM Environmental Response Trust - First Phase

Location Identification		S078-SCX-025	S078-SCX-026	S078-SCX-026	S078-SCX-026	S078-SCX-027	S078-SCX-027	S078-SCX-027	S078-SCX-027	S078-SCX-027	S078-SCX-062
Date Collected		10/12/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017	10/13/2017
Depth (feet)		0 - 0.5	0 - 0.5	4.0 - 5.0	8.0 - 9.0	0 - 0.5	5.0 - 6.0	6.0 - 7.0	11.0 - 12.0	12.0 - 13.0	0 - 0.5
Sample Category		surface	surface	subsurface	subsurface	surface	subsurface	subsurface	subsurface	subsurface	subsurface
Sample Collection Method		grab	grab	grab	grab	grab	grab	grab	grab	grab	grab
Media		soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Analyte (Units)											
Metals^1 (mg/kg)	Investigation Level										
Arsenic	18.6	3.8	5.8	3	4.7	4.2	4	4.1	18	4.9	13 D
Molybdenum	0.371	1.3	0.7 J-	0.52	1.1	0.56	0.49	0.57	0.73	0.46	3.1 D
Selenium	NA	<1	3.5	3.7	13	2.1	2.4	1.8	2.7	3.3	7.8 D
Uranium	1.46	2.7	46	28	65	8.7	14	4.3	2.5	7.8	11 D
Vanadium	22.3	14	56	60	57	32	42	22	22	19	42 D
Radionuclides (pCi/g)											
Radium-226	2.02	2.8 ± 0.43	5.31 ± 0.78 J+	12.6 ± 1.6	5.91 ± 0.85	3.34 ± 0.51	4.72 ± 0.67	2.72 ± 0.44	2.28 ± 0.42	4.14 ± 0.56	5.89 ± 0.86 J+

Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result greater than or equal to the investigation level
Shaded	Shaded result indicates analyte detected, where that analyte does not have an investigation level
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
NA	An investigation level is not identified because in BG-2 only two detections of selenium exist, and the detections both have the same value of 1 mg/kg. One distinct detection value is insufficient for Pro UCL to calculate an investigation level.
^{1}	Analysis required a standard sample dilution of 10 times; reported values have been converted to non-diluted value
<	Result not detected above associated laboratory reporting limit
D	Sample dilution required for analysis; reported values reflect the dilution
J	Data are estimated due to associated quality control data
J-	Data are estimated and are potentially biased low due to associated quality control data
J+	Data are estimated and are potentially biased high due to associated quality control data

Table 4-5
Summary of Investigation Level Exceedances in Soil at Borehole Locations
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase

Sample Location	Survey Area	Investigation Level Exceedances
S078-SCX-001[1]	B	Mo, Se, U, Ra-226
S078-SCX-002[1]	B	Mo, Se, U, V, Ra-226
S078-SCX-003[1]	B	Mo, Se, U, Ra-226
S078-SCX-004[1]	B	Mo, Se, U, Ra-226
S078-SCX-005[1]	B	Mo, Se, U, Ra-226
S078-SCX-006	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-007	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-008	A	As, Se, V, Ra-226, Static Gamma
S078-SCX-009	A	As, Se, U, V, Ra-226
S078-SCX-010	A	As, Mo, Se, U, V, Ra-226
S078-SCX-011	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-012[1]	B	Mo, Se, U, V, Ra-226
S078-SCX-013[1]	B	Mo, Se, U, Ra-226
S078-SCX-014	B	U, Ra-226
S078-SCX-015	B	Mo, U
S078-SCX-016[1]	B	Mo, Se, U, V
S078-SCX-017[1]	B	Mo, Se, U, Ra-226
S078-SCX-018[1]	B	Mo, Se, U, Ra-226
S078-SCX-021[1]	B	Se, U, Ra-226
S078-SCX-022	B	Mo, U
S078-SCX-024[1]	B	Mo, Se, U, V, Ra-226
S078-SCX-025	B	Mo, U, Ra-226
S078-SCX-026[1]	B	Mo, Se, U, V, Ra-226
S078-SCX-027[1]	B	Mo, Se, U, V, Ra-226
S078-SCX-028	A	As, Mo, Se, U, V, Static Gamma
S078-SCX-029	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-030	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-031	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-032	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-033[2]	A	As, Se, U, Static Gamma
S078-SCX-034	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-035	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-036	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-037	A	As, Mo, Se, U, V, Ra-226, Static Gamma

Notes

[1] Detection of Se included for

[2] Includes a sample that crosses the soil to bedrock contact

IL - Investigation Level

As - Arsenic

Mo - Molybdenum

Ra-226 - Radium 226

Se - Selenium

U - Uranium

V - Vanadium

Summary of Investigation Level Exceedances in Soil at Borehole Locations

Claim 28

Removal Site Evaluation Report - Final

Navajo Nation AUM Environmental Response Trust - First Phase

S078-SCX-038	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-039	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-040	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-041	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-042	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-043	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-044	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-045	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-046	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-047[2]	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-048[2]	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-049	A	As, Se, U, V, Ra-226, Static Gamma
S078-SCX-050	A	Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-051	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-052	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-053	A	As, Se
S078-SCX-054	A	As, Se, V, Static Gamma
S078-SCX-055	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-056	A	As, Se, U, V
S078-SCX-057	A	As, Mo, Se, V, Static Gamma
S078-SCX-058	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-059	A	As, Mo, Se, U, V, Ra-226, Static Gamma
S078-SCX-060	A	As
S078-SCX-061	A	As, Se, V
S078-SCX-062[1]	B	Mo, Se, U, V, Ra-226

Notes

[1] Detection of Se included for

[2] Includes a sample that crosses the soil to bedrock contact

IL - Investigation Level

As - Arsenic

Mo - Molybdenum

Ra-226 - Radium 226

Se - Selenium

U - Uranium

V - Vanadium

Table 4-6a
Water Sampling Investigation Level Derivation
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase
Page 1 of 1

Analyte (Units)	USEPA		Navajo Nation		Investigation Level
	MCL [a]	Secondary Standard [b]	Surface Water Quality Standards [c]	Primary Drinking Water MCL[d]	
Radionuclides (pCi/L)					
Ra-226 [e]	5	*	5	5	5
Ra-228 [e]	5	*	5	5	5
Gross Alpha	15	*	15	15	15
Metals (ng/L)					
Mercury	2000	*	2000	2000	2000
Metals (µg/L)					
Antimony	6	*	5.6	6	5.6
Arsenic	10	*	10	10	10
Barium	2000	*	2000	2000	2000
Beryllium	4	*	4	4	4
Cadmium	5	*	5	5	5
Chromium, Total	100	*	100	100	100
Cobalt	*	*	*	*	*
Copper	1300	*	1300	*	1300
Lead	15	*	15	15	15
Molybdenum	*	*	*	*	*
Nickel	*	*	610	*	610
Selenium	50	*	50	50	50
Silver	*	100	35	*	35
Thallium	2	*	2	2	2
Uranium	30	*	30	30	30
Vanadium	*	*	*	*	*
Zinc	*	5000	2100	*	2100
General Chemistry Parameters (mg/L) [f]					
Bicarbonate	*	*	*	*	*
Calcium	*	*	*	*	*
Carbonate	*	*	*	*	*
Chloride	*	250	*	*	250
Sodium	*	*	*	*	*
Sulfate	*	250	*	*	250
TDS	*	500	*	*	500

Notes

Bold – indicates the most conservative value to be used for comparison.

[a] "Table of Regulated Drinking Water Contaminants", Groundwater and Drinking Water (USEPA, 2016a).

[b] "Table of Secondary Drinking Water Standards", Secondary Drinking Water Standards: Guidance for Nuisance Chemicals (USEPA, 2016b).

[c] Navajo Nation Surface Water Quality Standards (NNEPA, 2015)

[d] Maximum Contaminant Levels Navajo Nation Primary Drinking Water Regulations (NNPDWR, 2015)

[e] The MCL for Ra-226 and Ra-228 have a combined limit of 5 pCi/L, and are not individually 5pCi/L

[f] Collected data will be used for water quality analysis purposes

* USEPA primary (MCL), secondary standard, Navajo Nation Surface Water Quality Standards, or Navajo Drinking Water MCLs are not established for these analytes.

MCL - maximum contaminant level
µg/L - micrograms per liter
mg/L - milligrams per liter
ng/L - nanograms per liter
pCi/L - picocuries per liter
TDS - Total Dissolved Solids
Ra-226 - Radium 226
Ra-228 - Radium 228
USEPA - Unites States Environmental Protection Agency

Table 4-6b
Water Sampling Analytical Results
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase
Page 1 of 1

Water Feature Identification		04T-386/Tank 4T-386/CH981123BGW002	04T-386/Tank 4T-386/CH981123BGW002	04T-386/Tank 4T-386/CH981123BGW002	04T-386/Tank 4T-386/CH981123BGW002	Pond/Well/1050475	Pond/Well/1050475	S078-Seep-1	S078-Seep-1
Field Sample Identification		S078-WL-001	S078-WL-001	S078-WL-001 Dup	S078-WL-001 Dup	S078-WS-001	S078-WS-001	S078-WS-002	S078-WS-002
Date Collected		10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	11/5/2016	11/5/2016
Matrix		Water Well	Water Well	Water Well	Water Well	Surface Wate	Surface Wate	Surface Water	Surface Water
Preparation		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analyte (Units)									
Radionuclides (pCi/L)	Investigation Level								
Ra-226	5 ¹	NS	2 ± 0.56	NS	2.04 ± 0.57	NS	0.35 ± 0.17	NS	74 ± 18
Ra-228	5 ¹	NS	2.49 ± 0.7	NS	3.15 ± 0.84	NS	0 ± 0.32	NS	25.9 ± 6
Gross Alpha	--	NS	0 ± 4	NS	7.8 ± 4.7	NS	13.1 ± 2.9	NS	549 ± 90 B
Adjusted Gross Alpha ²	15	NS	NA	NS	NA	NS	3.6	NS	421
Gross Beta	--	NS	8.1 ± 4.1	NS	12.9 ± 4.4	NS	32.7 ± 5.5	NS	254 ± 42
Mercury (ng/L)									
Mercury	2000	<0.5	<0.5	0.5	<0.5	2.9	1.6	4.5	12
Metals ³ (µg/L)									
Antimony	5.6	1.6	<0.3	<0.3	<0.3	0.79	1.3	<0.3	<0.3
Arsenic	10	<2	<2	<2	<2	<2	<2	4.1	4.2
Barium	2000	7.5	8.8	7.2	8.8	140	130	8.6	9.6
Beryllium	4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	65	65
Cadmium	5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	8.9	8.8
Chromium, Total	100	<10	<10	<10	<10	<10	<10	<10	<10
Cobalt	--	<1	<1	<1	<1	1.1	1	560	570
Copper	1300	<10	<10	<10	<10	<10	<10	<10	<10
Lead	15	<0.5	<0.5	<0.5	<0.5	1.1	1.2	12	12
Molybdenum	--	1.3	1.5	1	1.2	6.5	6.3	<1	<1
Nickel	610	<5	<5	6.1	<5	8.3	<5	530	530
Selenium	50	<1	<1	<1	<1	<1	<1	30	30
Silver	35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thallium	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	2.2	2.3
Uranium	30	12	13	12	12	15	14	180	190
Vanadium	--	<1	<1	<1	<1	2.7	2	3.8	4
Zinc	2100	340	360	340	350	<20	<20	2700	2700
General Chemistry Parameters (mg/L)									
TDS	500	--	2200	--	2300	--	460	--	3900
Carbonate	--	--	<20	--	<20	--	<20	--	<20
Bicarbonate	--	--	340	--	350	--	160	--	<20
Chloride	250	--	22 D	--	22 D	--	12	--	38 D
Sulfate	250	--	1500 D	--	1600 D	--	140 D	--	3100 D
Calcium	--	340000	340000	330000	340000	81000	77000	470000	480000
Sodium	--	160000	170000	160000	170000	4100	3900	53000	55000
Field Parameters									
Oxidation Reduction Potential(millivolts)	--	--	90	--	--	--	95.9	--	194.8
pH(pH units)	--	--	7.6	--	--	--	8.45	--	3.67
Salinity(PPTV)	--	--	1.57	--	--	--	0.33	--	2.71
Specific Conductivity(µS/cm)	--	--	2314	--	--	--	468.9	--	4057
Temperature(°C)	--	--	13.1	--	--	--	8.6	--	15.2
Turbidity(NTU)	--	--	1.02	--	--	--	33.2	--	9.09
Flow Rate(L/HR)	--	--	--	--	--	--	--	--	47

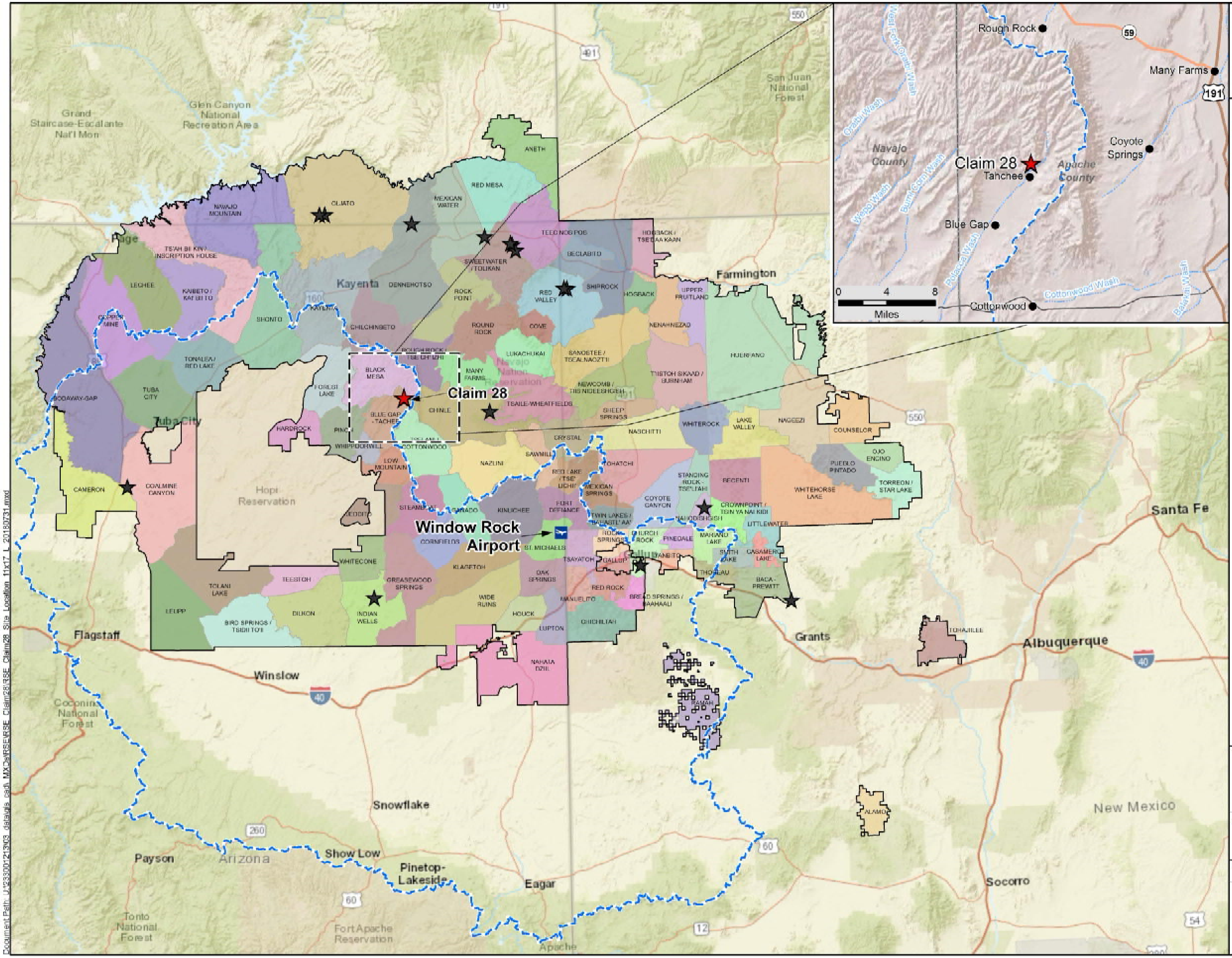
Notes

Bold	Bolded result indicates positively identified compound
Shaded	Shaded result indicates result or reporting limit greater than or equal to the investigation level
D	Analysis required non-standard dilution; reported values have been converted to non-dilute value
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less
°C	Degrees Celsius
µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
mg/L	milligrams per liter
ng/L	nanograms per liter
L/HR	liters per hour
NTU	nephelometric turbidity unit
pCi/L	picocuries per liter
PPTV	parts per trillion volume
--	Not established
NS	Not scheduled
Ra-226	Radium 226
Ra-228	Radium 228
TDS	Total Dissolved Solids
<	Result not detected above associated laboratory reporting limit
1	The Investigation Level for Ra-226 and Ra-228 have a combined limit of 5 pCi/L, and are not individually 5pCi/L
2	Adjusted Gross Alpha = Gross alpha concentration - uranium concentration, using the conversion factor of 0.6757 to convert uranium µg/L to pCi/L (U.S. Department of Energy, 2011)
3	Analysis required sample dilution of 10 times; reported values have been converted to non-diluted value

FIGURES

FIGURE ACRONYMS/ABBREVIATIONS

As	arsenic
BG	potential background reference area
bgs	below ground surface
byd^3	bank cubic yards
cpm	counts per minute
ft	feet
IL	investigation level
mg/kg	milligrams per kilogram
Mo	molybdenum
NA	not applicable
NAD	North American Datum
NAVD88	North American Vertical Datum of 1988
pCi/g	picocuries per gram
Ra	radium-226
Ra-226	radium-226
Se	selenium
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
uk	unknown
U	uranium
UTL	upper tolerance limit
UTM	Universal Transverse Mercator
V	vanadium

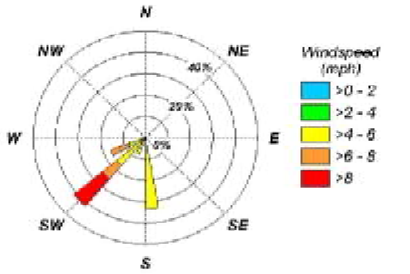


NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

- ★ Claim 28 Mine Site
- ★ Priority Abandoned Uranium Mine (AUM) Site
- ● Populated Place
- US Highway
- State Highway
- Major Road
- Intermittent Stream
- Little Colorado River Valley Watershed
- Navajo Nation Boundary
- Navajo Nation Chapter

Window Rock Airport, Arizona Wind Rose (KRQE), 1996-2006



REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap: ESRI World Street Map and World Shaded Relief accessed 07/2018.

Wind Rose: USEPA, 2007a

N
W E
S

0 25 50
Miles

TITLE:

Site Location

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 1-1

Stantec

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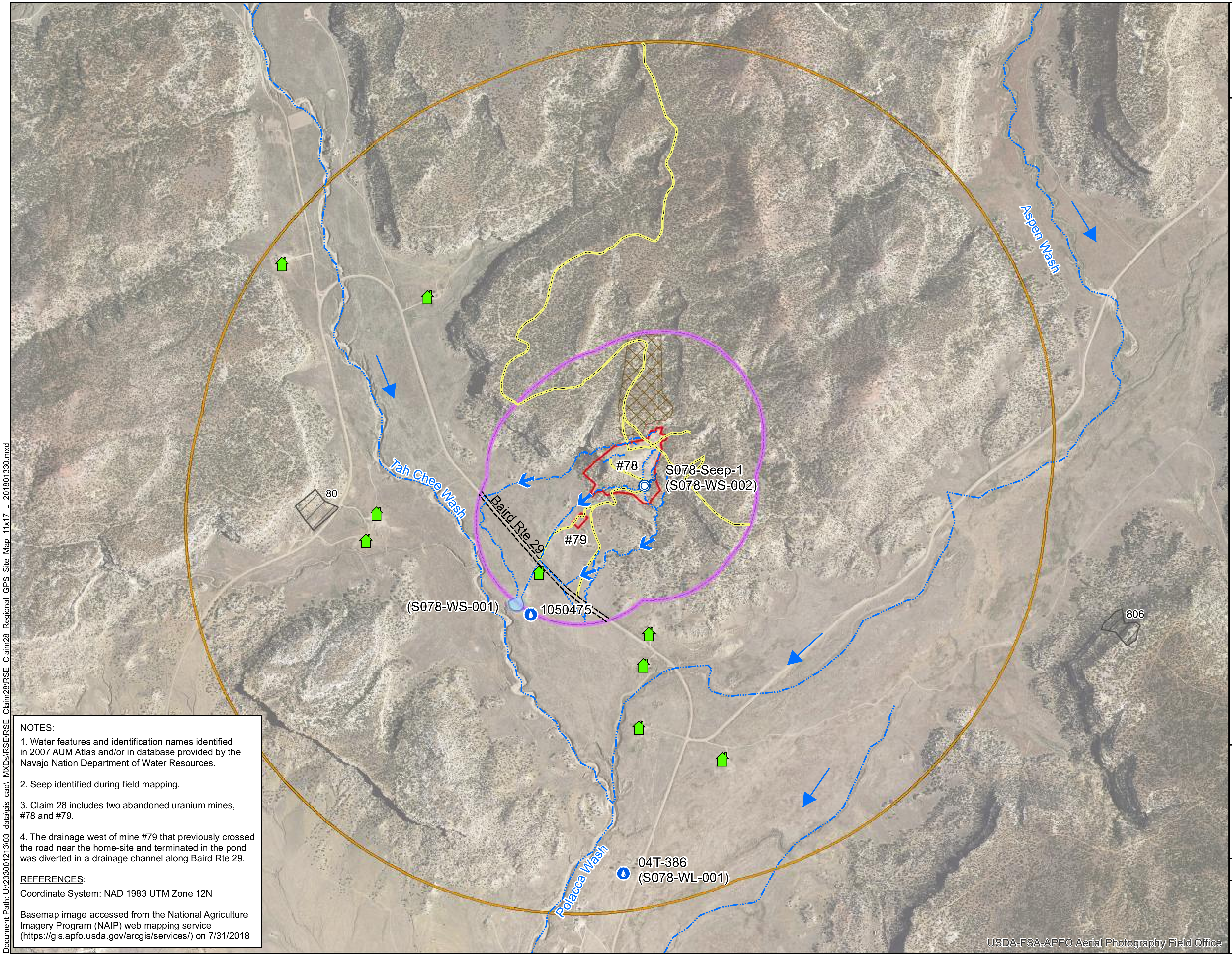

NOTES:

1. Water features and identification names identified in 2007 AUM Atlas and/or in database provided by the Navajo Nation Department of Water Resources.

2. Seep identified during field mapping.

3. Claim 28 includes two abandoned uranium mines, #78 and #79.

4. The drainage west of mine #79 that previously crossed the road near the home-site and terminated in the pond was diverted in a drainage channel along Baird Rte 29.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 7/31/2018

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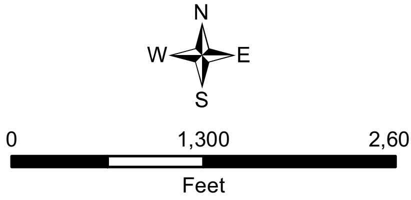
NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

💧	Site Clearance Identified Water Feature¹
🟩	Habitable Building
○	Seep²
↑	Flow Direction
-·-·-	Intermittent Stream/River
-----	Potential Haul Road
=====	Road
▨	Exploration Area
▭	Pond
🟥	Claim Boundary
▭	1/4-Mile Claim Boundary Buffer
▭	1-Mile Claim Boundary Buffer
▨	Other Claim Boundary



TITLE:
Site Features

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

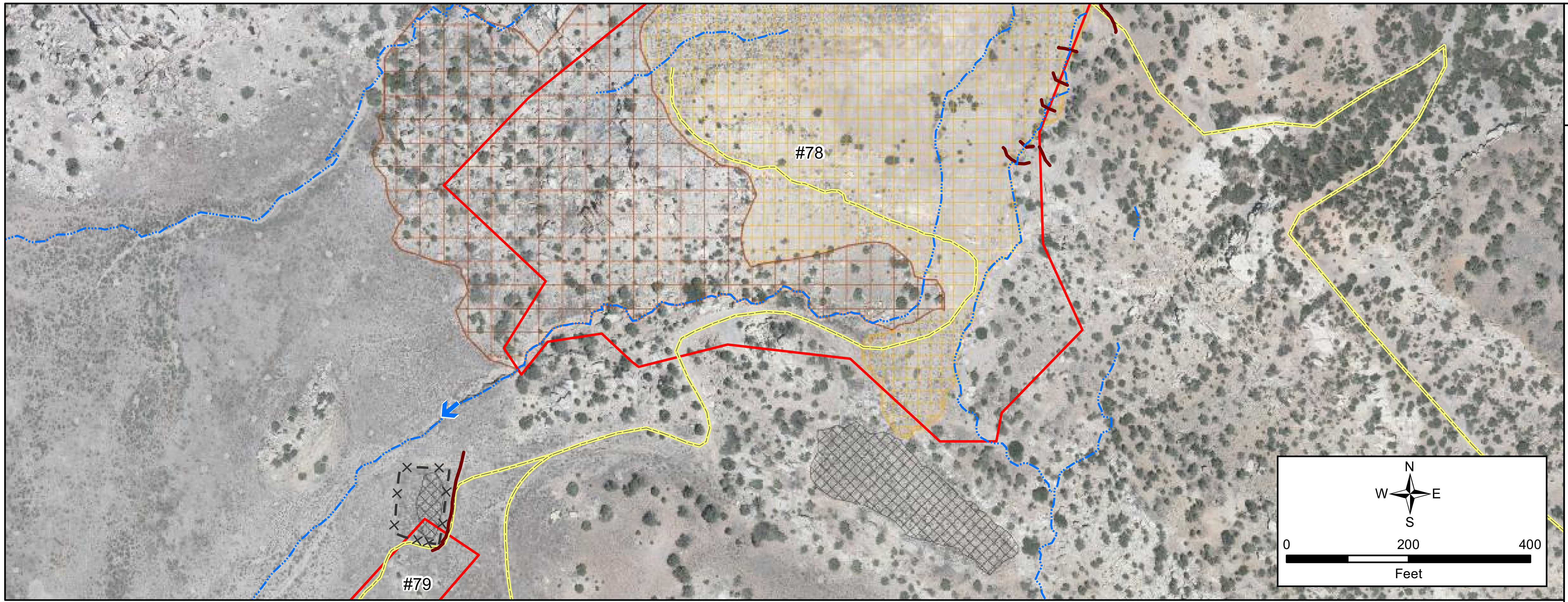
Stantec

AUTHOR: CBB

REVIEWER: EDZ

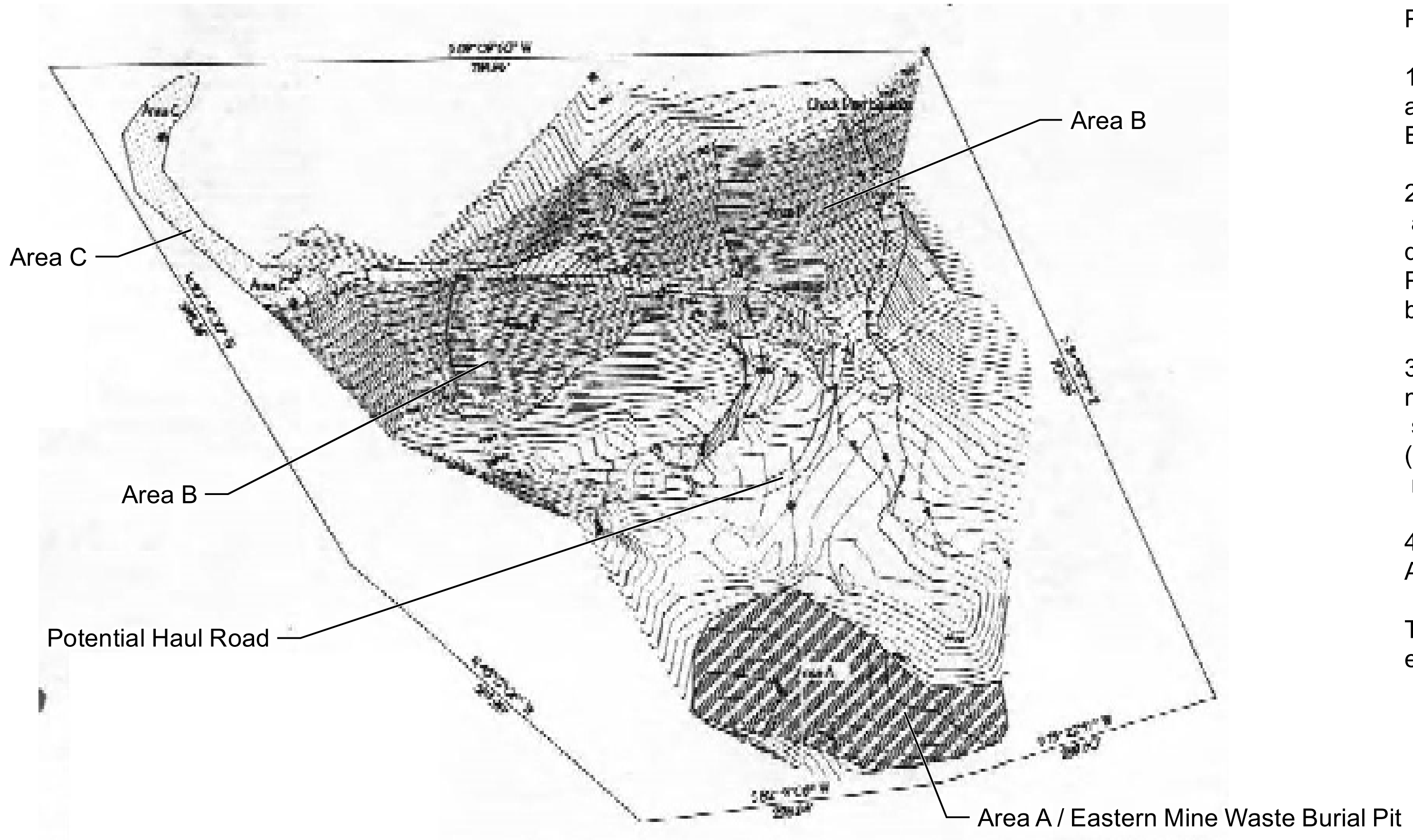
FIGURE: 2-1

NAVAJO NATION
AUM Environmental
Response Trust-First Phase



LEGEND

- ↑ Flow Direction
- Berm
- Drainage
- × — × — × Fence
- Potential Haul Road
- ▨ Mine Waste Burial Pit
- ⊞ Potential Mine Waste Material
- ⊞ Mining / Reclaimed Disturbed Area
- ☐ Claim Boundary



Planned Reclamation Activities Listed on Map No. 8

1. Excavate a burial pit 250 ft long x 100 ft wide x 3 ft deep in Area A and stockpile the excavated Class A material nearby the burial pit. Earthwork quantities for this work item were 2,800 byd^3.

2. Excavate completely the uranium mine waste material from Area B and any other radioactive material from the slopes of Area C per the direction of the Project Representative. Haul the materials to Area A. Place the waste materials in Area A and compact them for burial in the burial pit. Earthwork quantities for this work item were 8,000 byd^3.

3. Cover the deposited radioactive mine waste with the stockpiles Class A material spreading it in as uniform thickness as possible. The reclaimed surface should form a mound with side slopes no steeper than 3h:1v (horizontal to vertical). Cover any radioactive "Hot Spots" with Class A material. Earthwork quantities for this work item were 2,8000 byd^3.

4. Repair the riprap check dams on the previously reclaimed area over Area B with 50 yd^3 additional riprap.

Total work quantity for the site shall not exceed 13,600 byd^3 of earthwork and 50 yd^3 of riprap.

NOTES:

Historical site drawing orientation and scale is approximate due to lack of tie points needed for georeferencing.

Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Historical Site Drawing:
Navajo Abandoned Mine Land Reclamation Program (NAML), Tuba City Field Office, Tuba City, Arizona, 2000. Mesa Grande AMLR Project, Black Mesa 2, NA-0701, Map No. 8 (7/17/2000).

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

TITLE:
Historical Mine Drawing

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 2-2

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

↑	Flow Direction
-·-·-	Intermittent Stream/River
═	Tribal Road
—	Local Road
🟥	Claim Boundary
▨	Other Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 8/1/2018

N
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0 2,000 4,000
Feet

TITLE:

Regional Aerial Photograph

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/1/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 2-3

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NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

🟥	Claim Boundary
▨	Other Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap: ESRI USA Topo Maps service accessed 07/2018.

N
W E
S

0 2,000 4,000
Feet

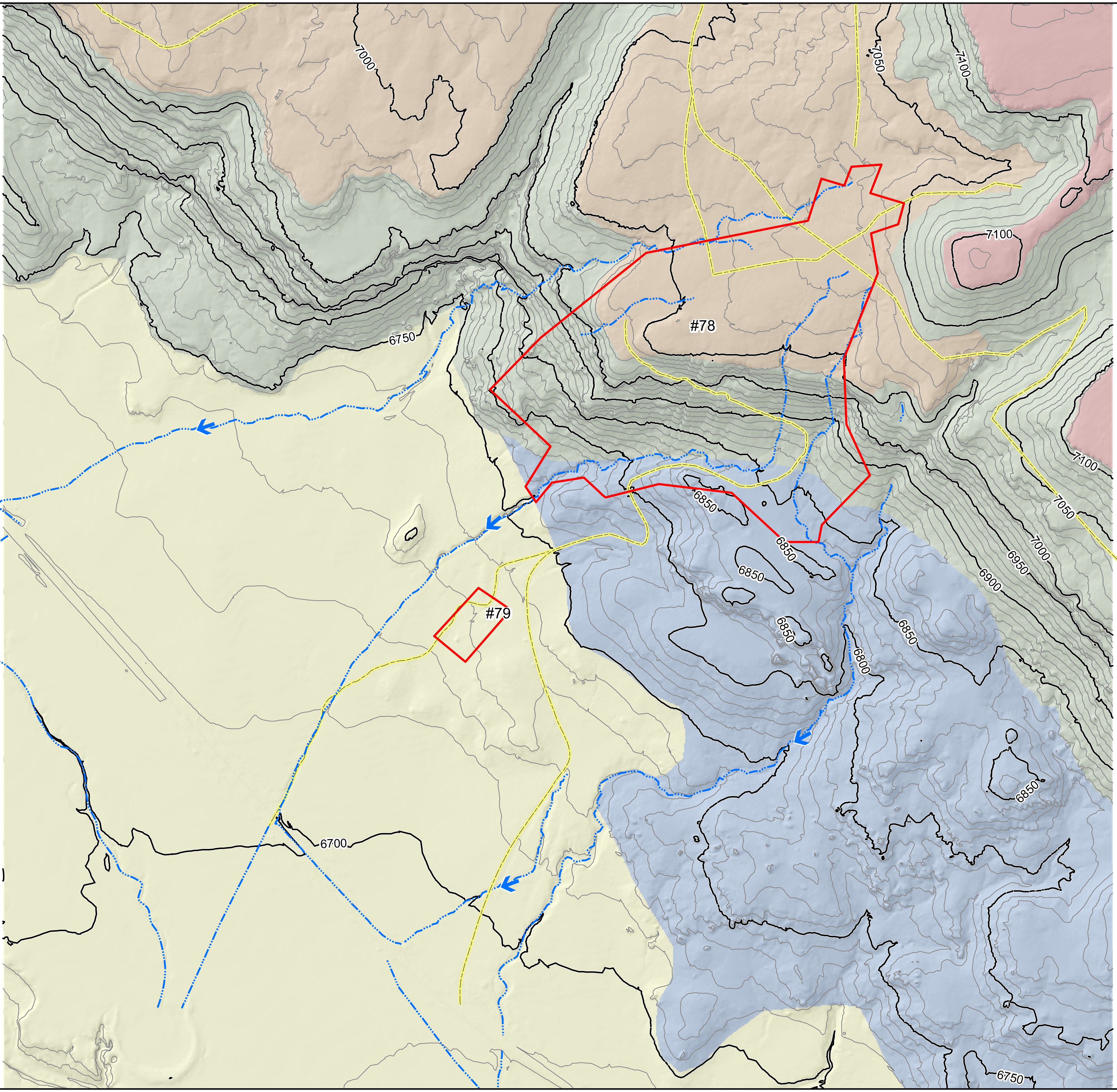
TITLE:
Regional Topographic Map

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: CBB
REVIEWER: EDZ
FIGURE: 2-4

Stantec

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Regional_Topo_11x17_20180731.mxd



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

↑	Flow Direction
-·-·-	Drainage
- - -	Potential Haul Road
～	Index Contour (50 ft Interval)
～	Intermediate Contour (10 ft Interval)
☐	Claim Boundary

Geomorphology Features

🟥	Mesa Top
🟫	Mesa Bench
🟩	Mesa Sidewall
🟦	Foothills
🟨	Valley Bottom

NOTES:

The extent of the base map is based on the Cooper aerial surveys conducted on June 16, 2017.

Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:

Site-specific contours were generated as part of aerial surveys conducted on June 16, 2017.

Coordinate System: NAD 1983 UTM Zone 12N

N
W E
S

0 300 600
Feet

TITLE:

Site Topography

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: EDZ

REVIEWER: CBB

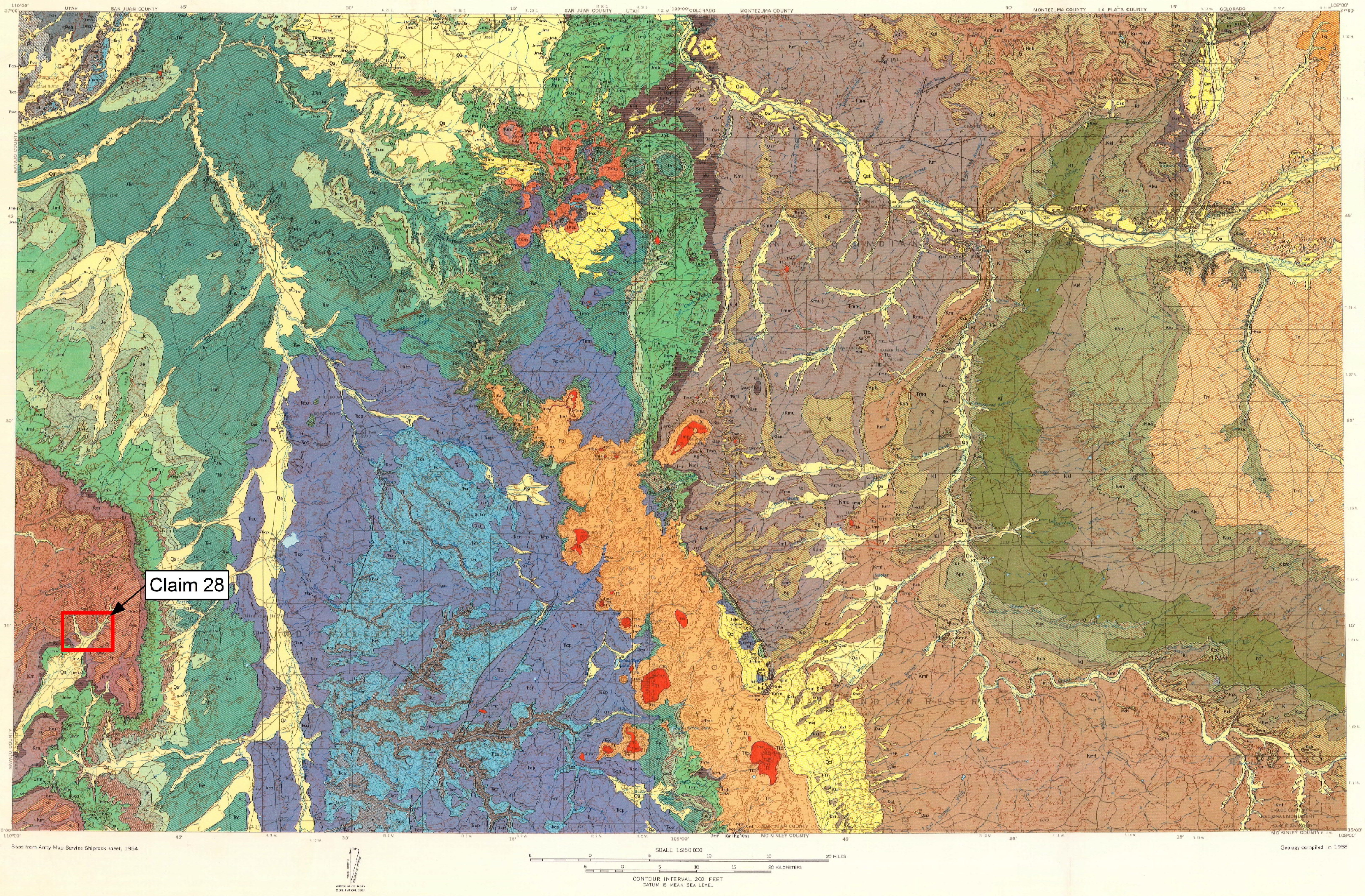
FIGURE: 2-5

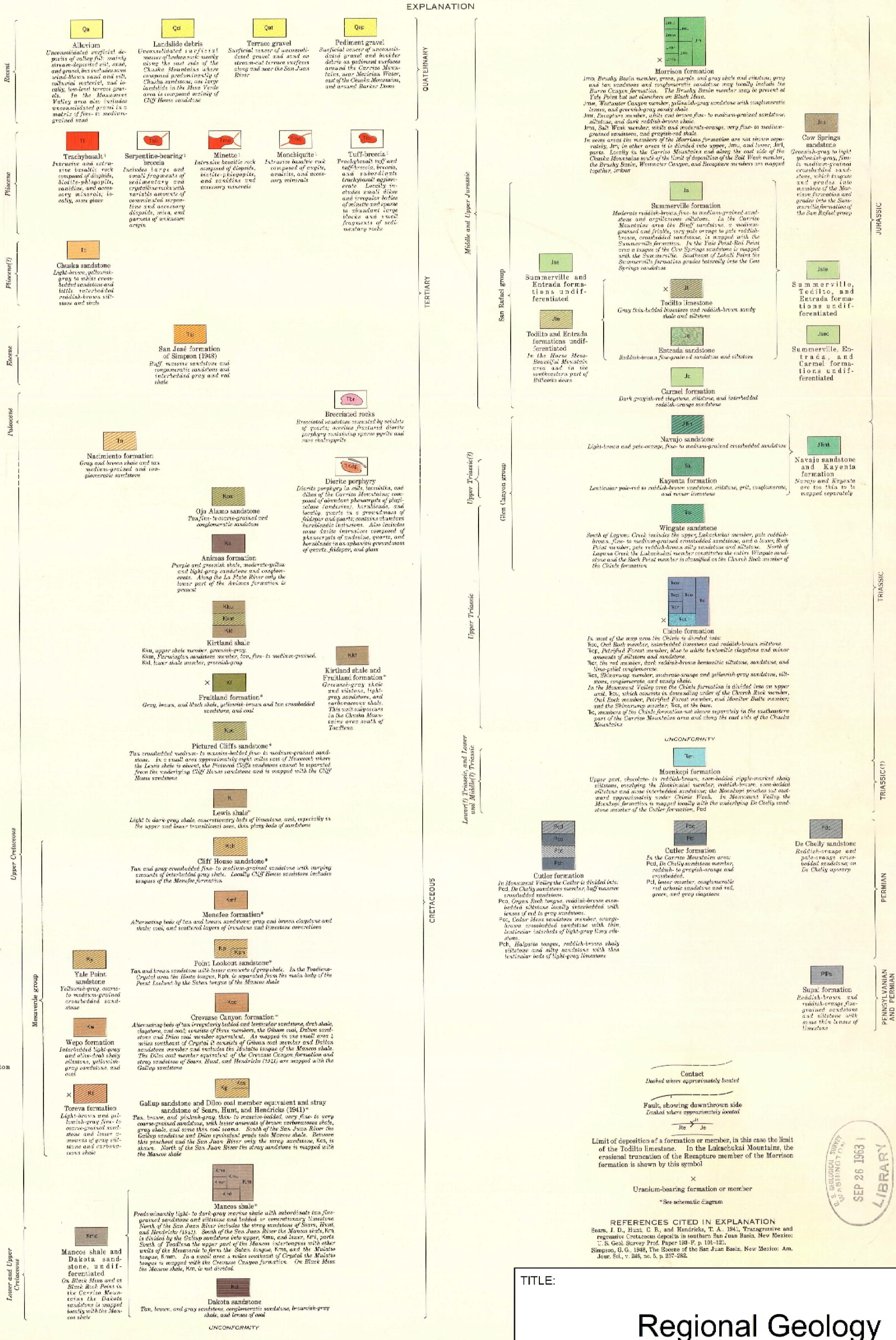
Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Site Topo 11x17 L 20180731.mxd

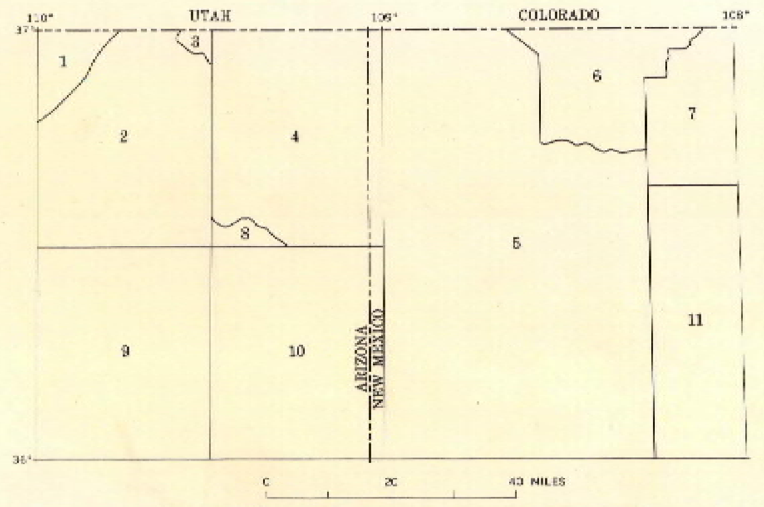
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U.S. ATOMIC ENERGY COMMISSION

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-345 (SHEET 1-GEOLOGY)





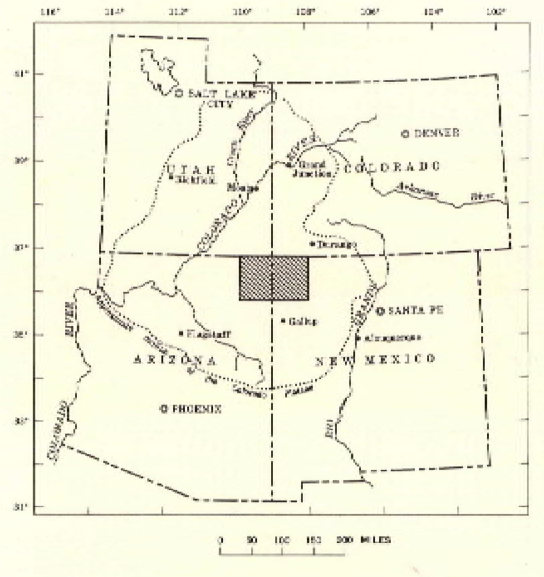


INDEX MAP SHOWING SOURCES OF GEOLOGIC DATA

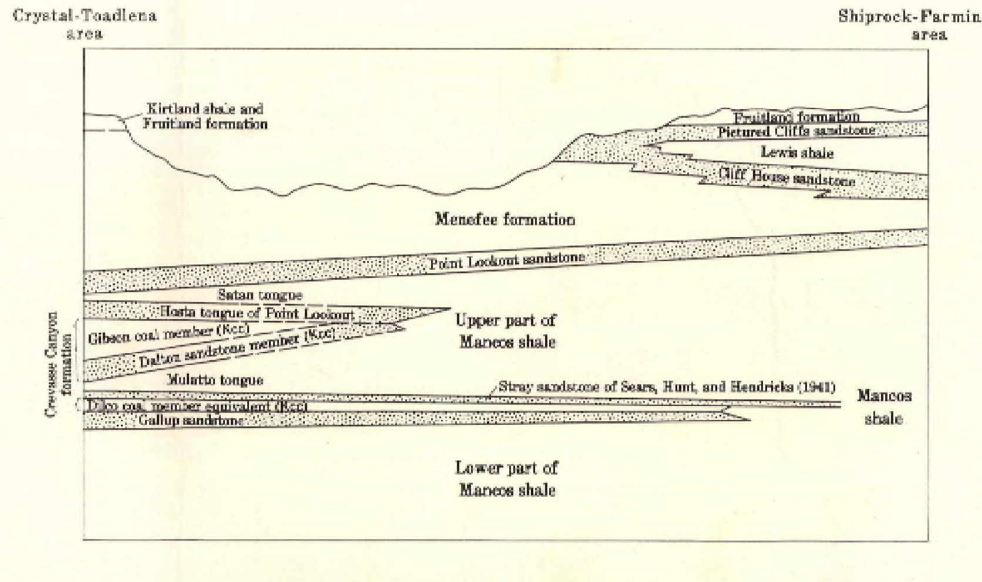
GEOLOGIC SOURCES

Numbers correspond to those given on key map
(*) indicates unpublished maps

1. Witkind, I. J., and others, U. S. Geol. Survey Mineral Inv. Field Studies Maps MF-92, 93, 95.
2. O'Sullivan, R. B., U. S. Geol. Survey detailed mapping (*).
3. Strobell, J. D., Jr., U. S. Geol. Survey detailed and photogeology mapping (*).
4. Strobell, J. D., Jr., U. S. Geol. Survey Oil and Gas Inv. Map OM-160 (supplemented by unpublished data in the central and southern part of the area).
5. O'Sullivan, R. B., and Beaumont, E. C., U. S. Geol. Survey Oil and Gas Inv. Map OM-190.
6. Hayes, P. T., and Zapp, A. D., U. S. Geol. Survey Oil and Gas Inv. Map OM-144.
7. Baltz, E. H., Beikman, H. M., and O'Sullivan, R. B., U. S. Geol. Survey photogeology and detailed geologic mapping (*).
8. Repenning, C. A., U. S. Geol. Survey detailed mapping (*).
9. Repenning, C. A., U. S. Geol. Survey open-file maps (modified in part by reconnaissance mapping by R. B. O'Sullivan).
10. Cooley, M. E., Irwin, J. H., Repenning, C. A., and Stevens, P. R., U. S. Geol. Survey open-file maps (modified in part by reconnaissance mapping by R.B. O'Sullivan).
11. O'Sullivan, R. B., U. S. Geol. Survey reconnaissance mapping (*).



INDEX MAP SHOWING AREA OF SHIPROCK QUADRANGLE



SCHEMATIC DIAGRAM SHOWING STRATIGRAPHIC RELATIONS OF MESAVERDE GROUP, EQUIVALENT FORMATIONS, AND THE MANCOS SHALE

GEOLOGY, STRUCTURE, AND URANIUM DEPOSITS OF THE SHIPROCK QUADRANGLE, NEW MEXICO AND ARIZONA
Compiled by
Robert B. O'Sullivan and Helen M. Beikman
1963

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-345 (SHEET 1-GEOLOGY)

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Geology_22x34_L_20180731.mxd

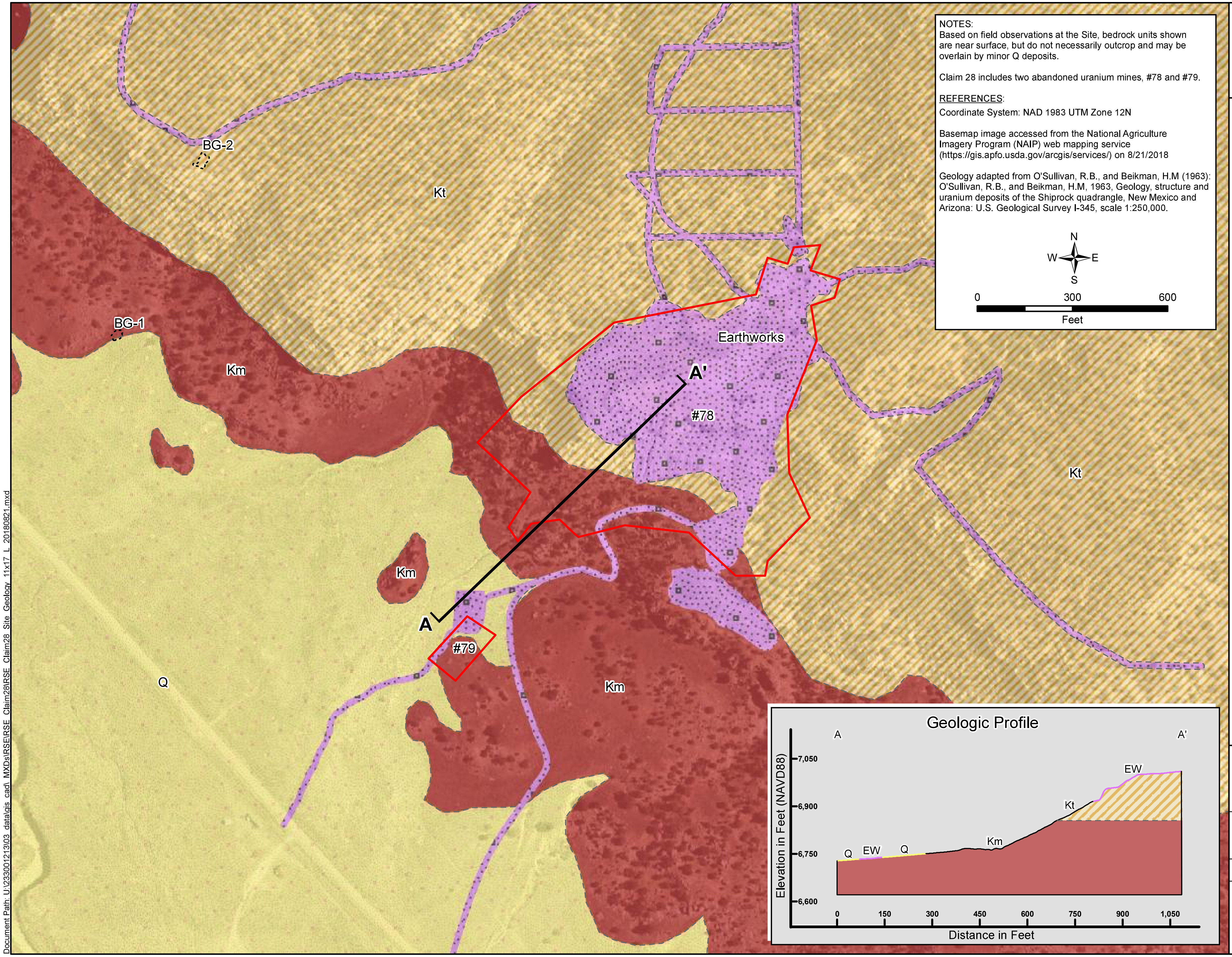
NAVAJO NATION
AUM Environmental Response Trust-First Phase

TITLE:
Regional Geology

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: CBB
REVIEWER: EDZ
FIGURE: 2-6

Stantec



NOTES:
Based on field observations at the Site, bedrock units shown are near surface, but do not necessarily outcrop and may be overlain by minor Q deposits.

Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 8/21/2018

Geology adapted from O'Sullivan, R.B., and Beikman, H.M (1963): O'Sullivan, R.B., and Beikman, H.M, 1963, Geology, structure and uranium deposits of the Shiprock quadrangle, New Mexico and Arizona: U.S. Geological Survey I-345, scale 1:250,000.

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

⌐	Geologic Profile
⬚	Potential Background Reference Area
🟥	Claim Boundary
╌	Geologic Contact (Inferred)

Site Geology

HOLOCENE / PLEISTOCENE

▨	Earthworks: Human-caused disturbance of the land surface related to mining or reclamation.
▨	Q: Quaternary Deposits – Undifferentiated (Pleistocene and Holocene) – includes sandy to gravelly colluvial and alluvial deposits, and eolian sand deposits.

CRETACEOUS

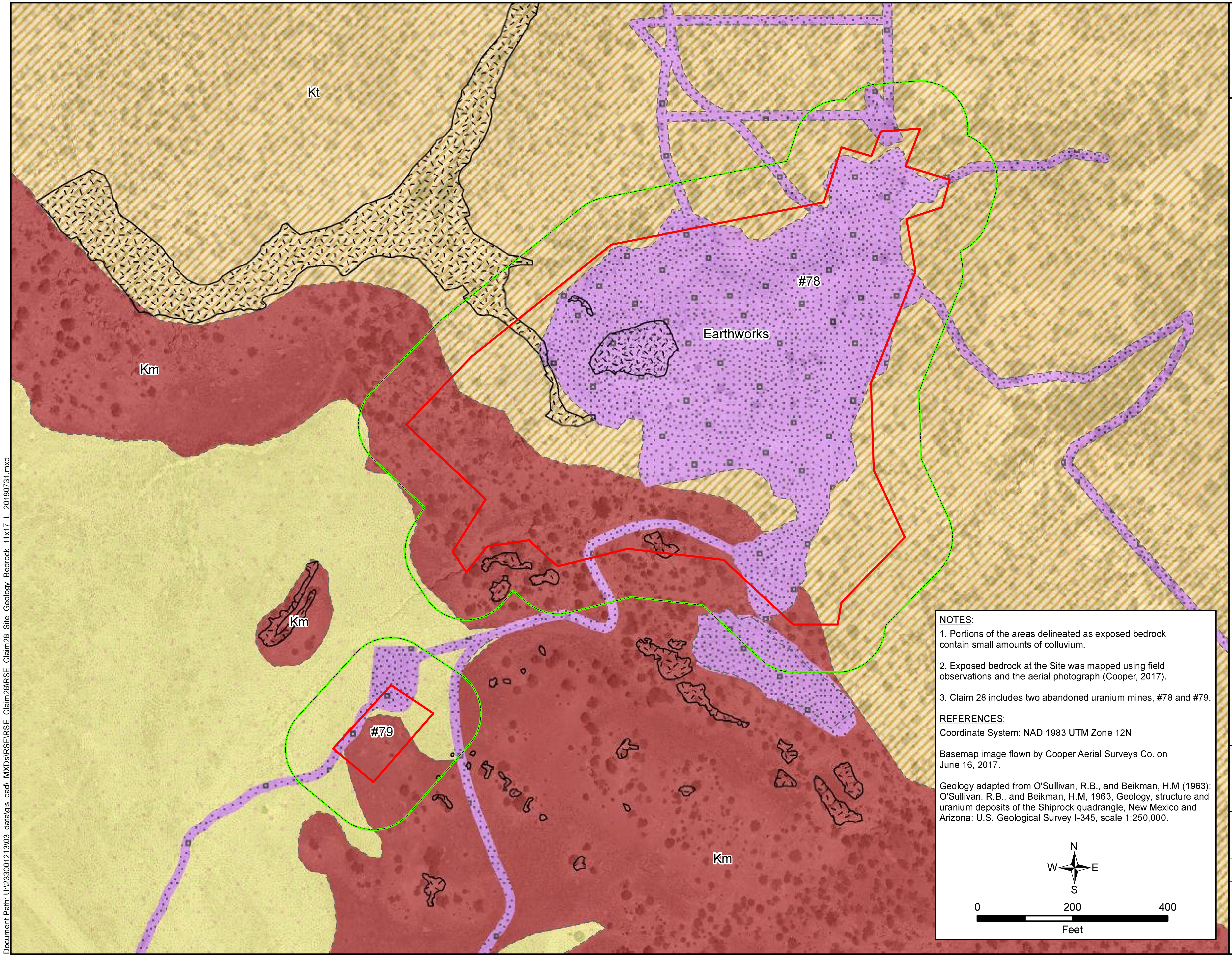
▨	Kt: Toreva Formation (Upper Cretaceous). Light-brown and yellowish-gray fine- to coarse-grained sandstone and lesser amounts of gray siltstone and carbonaceous shale.
🟥	Km: Mancos Shale – undifferentiated (Lower and Upper Cretaceous). Predominantly light- to dark-gray marine shale with subordinate tan fine-grained sandstone and siltstone and bedded or concretionary limestone. Locally discontinuous coal seams.

TITLE:
Site Geology

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/21/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: EDZ
REVIEWER: CBB
Stantec
FIGURE: 2-7a

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Site Geology 11x17 L 20180821.mxd



NOTES:

1. Portions of the areas delineated as exposed bedrock contain small amounts of colluvium.

2. Exposed bedrock at the Site was mapped using field observations and the aerial photograph (Cooper, 2017).

3. Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

Geology adapted from O'Sullivan, R.B., and Beikman, H.M (1963): O'Sullivan, R.B., and Beikman, H.M, 1963, Geology, structure and uranium deposits of the Shiprock quadrangle, New Mexico and Arizona: U.S. Geological Survey I-345, scale 1:250,000.

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

🟥	Claim Boundary
🟩	100-Foot Claim Buffer
⁓	Geologic Contact (Inferred)
▨	Exposed Bedrock[1]

Site Geology

HOLOCENE / PLEISTOCENE

▨	Earthworks: Human-caused disturbance of the land surface related to mining or reclamation.
▨	Q: Quaternary Deposits – Undifferentiated (Pleistocene and Holocene) – includes sandy to gravelly colluvial and alluvial deposits, and eolian sand deposits.

CRETACEOUS

▨	Kt: Toreva Formation (Upper Cretaceous). Light-brown and yellowish-gray fine- to coarse-grained sandstone and lesser amounts of gray siltstone and carbonaceous shale.
🟥	Km: Mancos Shale – undifferentiated (Lower and Upper Cretaceous). Predominantly light- to dark-gray marine shale with subordinate tan fine-grained sandstone and siltstone and bedded or concretionary limestone. Locally discontinuous coal seams.

TITLE:

Site Exposed Bedrock

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/21/2018

DOCUMENT NAME: Removal Site Evaluation Report

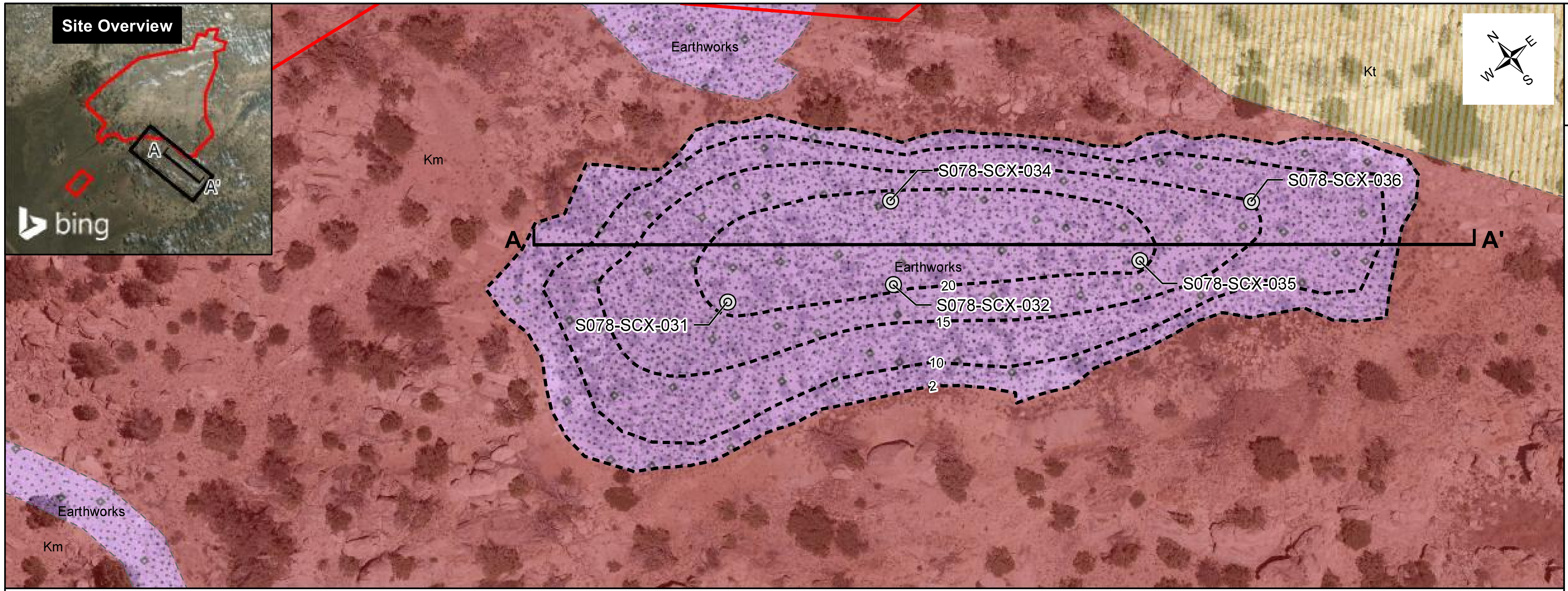
Stantec

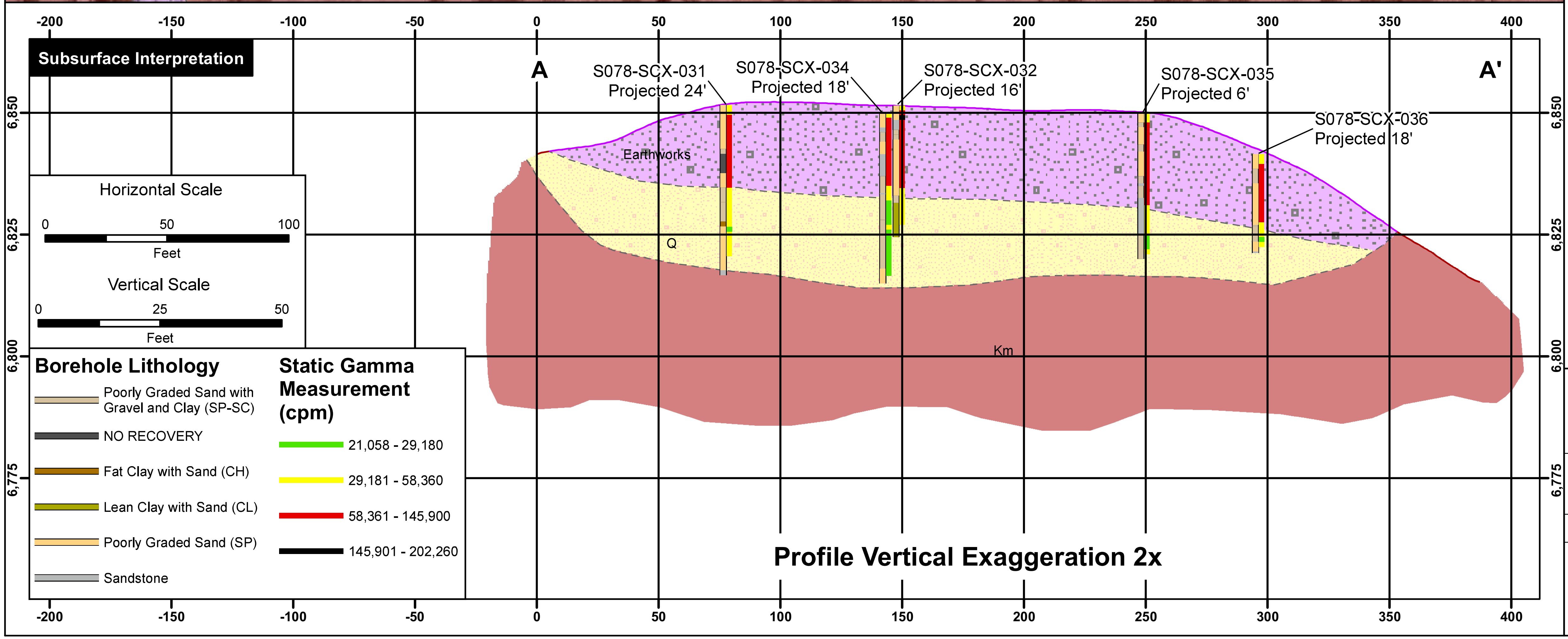
AUTHOR: EDZ

REVIEWER: CBB

FIGURE: 2-7b

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Site Geology Bedrock 11x17 L 20180731.mxd





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NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

◎ S078 -SCX-002 Subsurface Borehole Location (SCX)

Cross Section

Approximate Waste Pile Contour (thickness in feet)

Claim Boundary

Geologic Contact (Inferred)

QUATERNARY

Q: Quaternary Deposits – Undifferentiated (Pleistocene and Holocene) – includes sandy to gravelly colluvial and alluvial deposits, and eolian sand deposits.

Earthworks: Human-caused disturbance of the land surface related to mining or reclamation.

HOLOCENE / PLEISTOCENE

Kt: Toreva Formation (Upper Cretaceous). Light-brown and yellowish-gray fine- to coarse-grained sandstone and lesser amounts of gray siltstone and carbonaceous shale.

Km: Mancos Shale – undifferentiated (Lower and Upper Cretaceous). Predominantly light- to dark-gray marine shale with subordinate tan fine-grained sandstone and siltstone and bedded or concretionary limestone. Locally discontinuous coal seams.

NOTES:

1. Bedrock units shown are near surface (typically within 1 foot), but do not necessarily outcrop and may be overlain by minor residual soils, alluvium, or eolian deposits.

2. Projected distance indicates the distance the boring was offset from the cross-section line in plan view (not depth) for borings that are not located on the cross-section line.

REFERENCES:

Coordinate System: NAD 1983 StatePlane Arizona East FIPS 0201 Feet

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017

Geology adapted from O'Sullivan, R.B., and Beikman, H.M (1963): O'Sullivan, R.B., and Beikman, H.M, 1963, Geology, structure and uranium deposits of the Shiprock quadrangle, New Mexico and Arizona: U.S. Geological Survey I-345, scale 1:250,000.

TITLE:

Cross Section A - A'

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

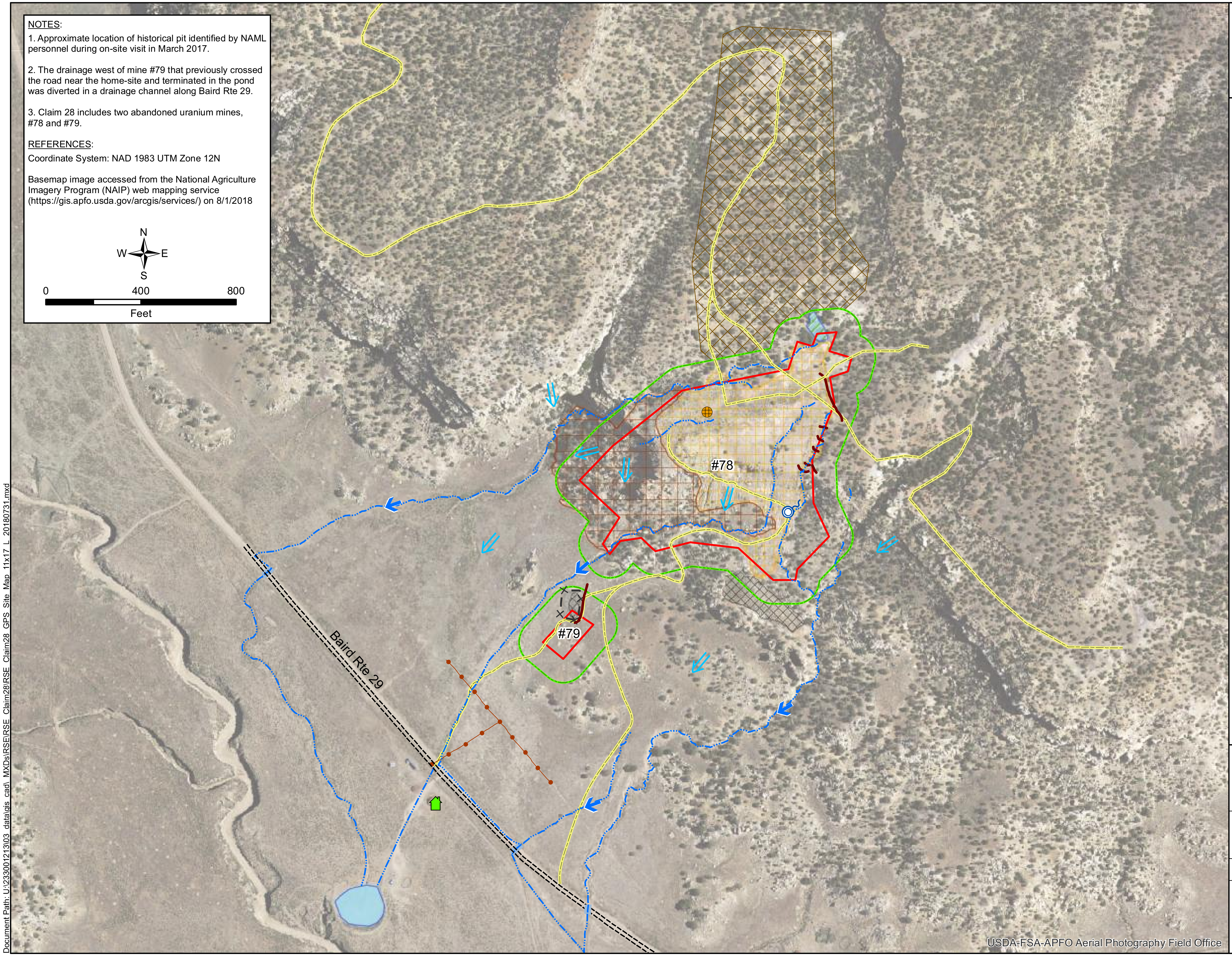
DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: EDZ

REVIEWER: CBB

FIGURE: 2-8



NOTES:

1. Approximate location of historical pit identified by NAML personnel during on-site visit in March 2017.

2. The drainage west of mine #79 that previously crossed the road near the home-site and terminated in the pond was diverted in a drainage channel along Baird Rte 29.

3. Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 8/1/2018

N
W E
S

0 400 800
Feet

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

●	Approximate Location of Historical Pit[1]
⌂	Habitable Building
◎	Seep
↑	Flow Direction
⇑	Approximate Overland Water Flow Direction
—	Berm
═	Culvert
-·-·-	Drainage
× — × — ×	Fence
- - -	Potential Haul Road
•—•—•	Power Line
========:	Road
▨	Exploration Area
▨	Mine Waste Burial Pit
▭	Pond
▦	Potential Mine Waste Material
▦	Mining / Reclaimed Disturbed Area
▨	Former Retention Pond
▭	Claim Boundary
▭	100-Foot Claim Buffer

TITLE:

Site Map

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/1/2018

DOCUMENT NAME: Removal Site Evaluation Report

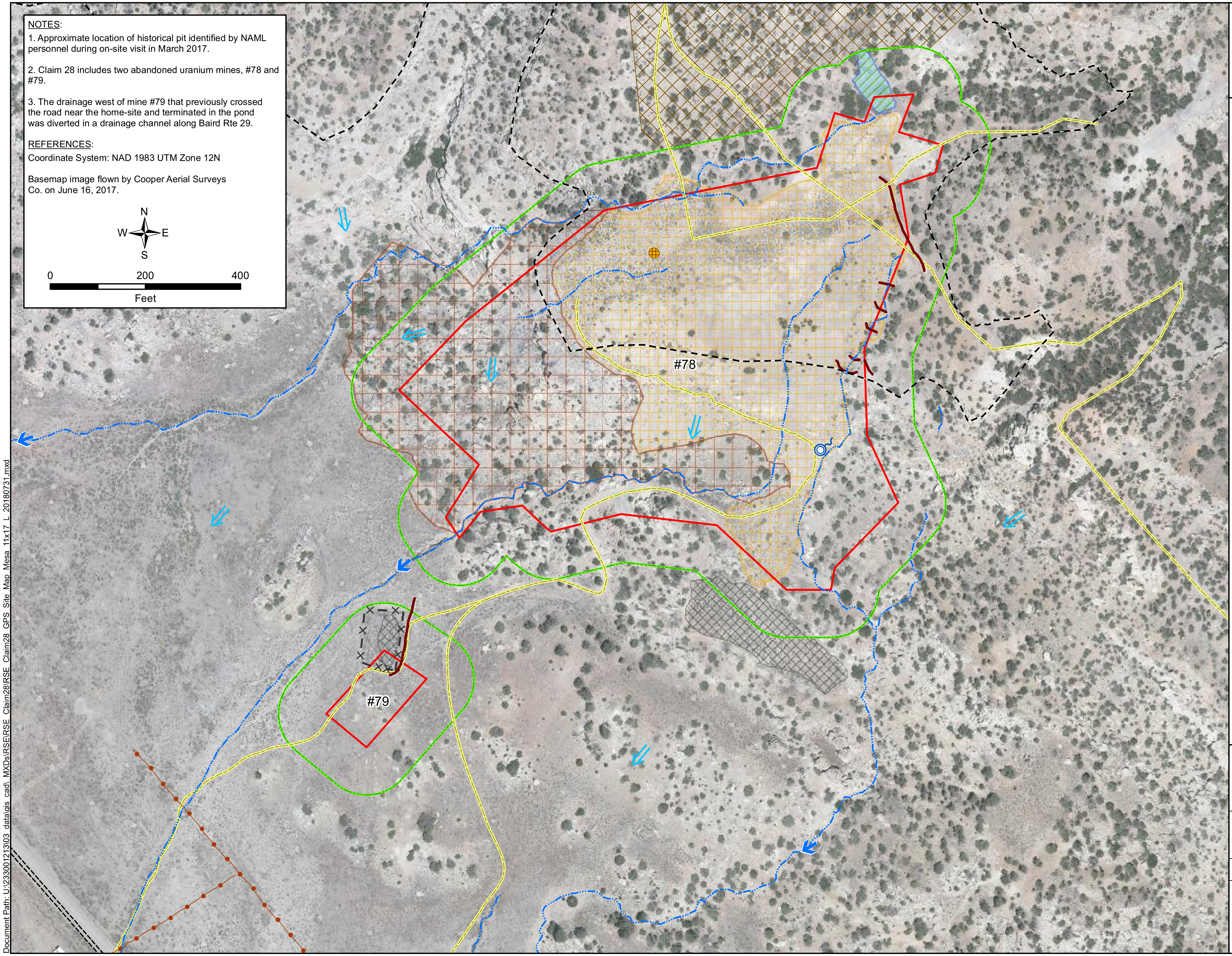
Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 2-9a

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 GPS Site Map 11x17 L 20180731.mxd



NOTES:

1. Approximate location of historical pit identified by NAML personnel during on-site visit in March 2017.

2. Claim 28 includes two abandoned uranium mines, #78 and #79.

3. The drainage west of mine #79 that previously crossed the road near the home-site and terminated in the pond was diverted in a drainage channel along Baird Rte 29.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 GPS Site Map Mesa 11x17 L 20180731.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

- ● Approximate Location of Historical Pit[1]
- Seep
- ↑ Flow Direction
- ⇑ Approximate Overland Water Flow Direction
- - - - - Approximate Edge of Mesa
- ── Berm
- -·-·- Drainage
- × — × — × Fence
- ── Potential Haul Road
- •—•— Power Line
- ======== Road
- ▨ Exploration Area
- ▩ Mine Waste Burial Pit
- ▭ Potential Mine Waste Material
- ⊞ Mining / Reclaimed Disturbed Area
- ▨ Former Retention Pond
- 🟥 Claim Boundary
- 🟩 100-Foot Claim Buffer

TITLE:

Mine Claim Area
Site Map

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/1/2018

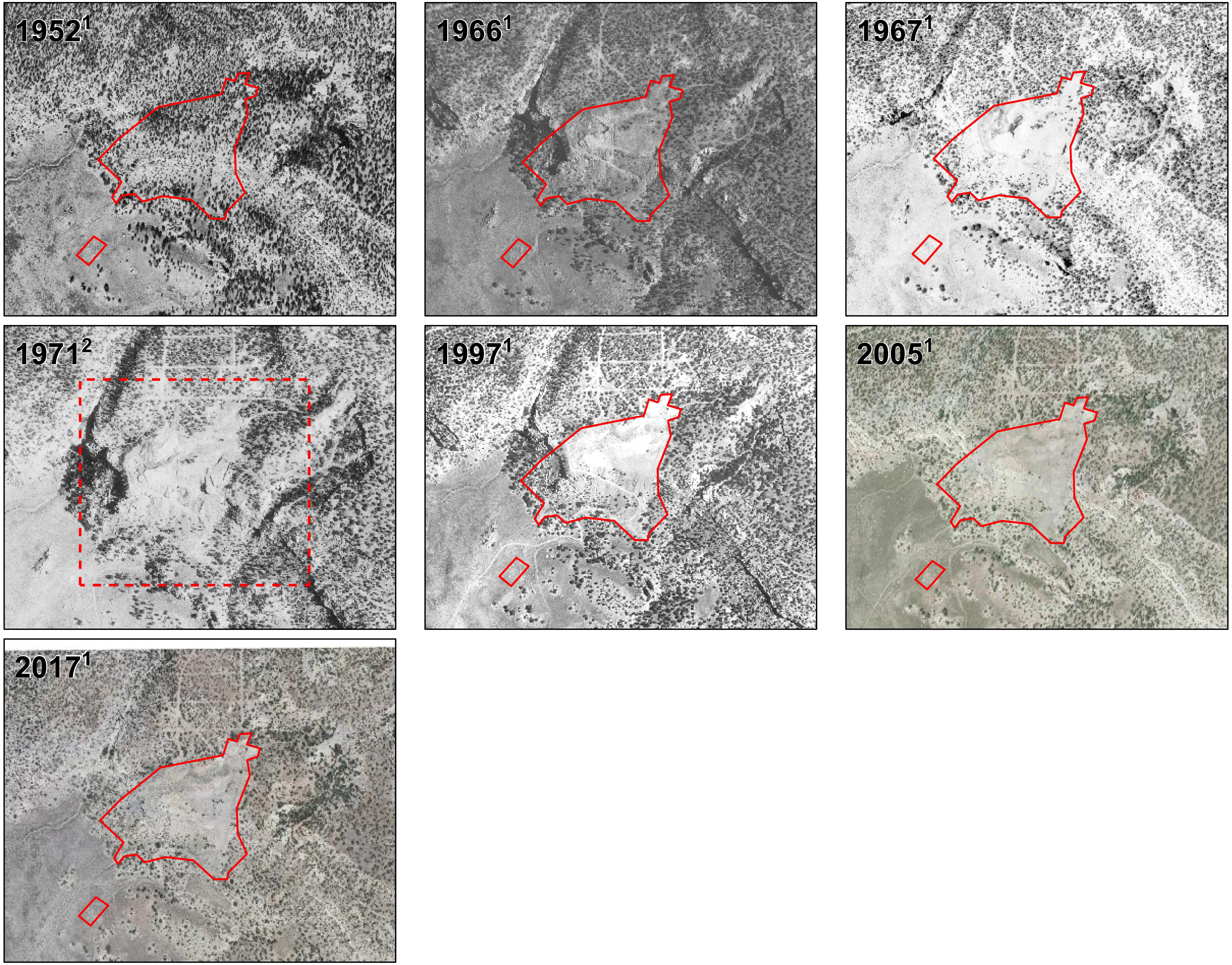
DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: CBB

REVIEWER: EDZ

Stantec

FIGURE: 2-9b



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

□ Claim 28
Claim Boundary

⬚ Approximate Site Location,
not georeferenced

NOTES:

1. Image is georeferenced. Scale bar applies to these image frames only.

2. Image is not georeferenced, scale not available.

3. Site-specific imagery flown by Cooper Aerial Surveys Co. on June 16, 2017.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Historical Aerial Imagery downloaded from https://earthexplorer.usgs.gov/ (01/2016)

N
W E
S

0 700 1,400
Feet

TITLE:

Historical Aerial Photograph Comparison

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

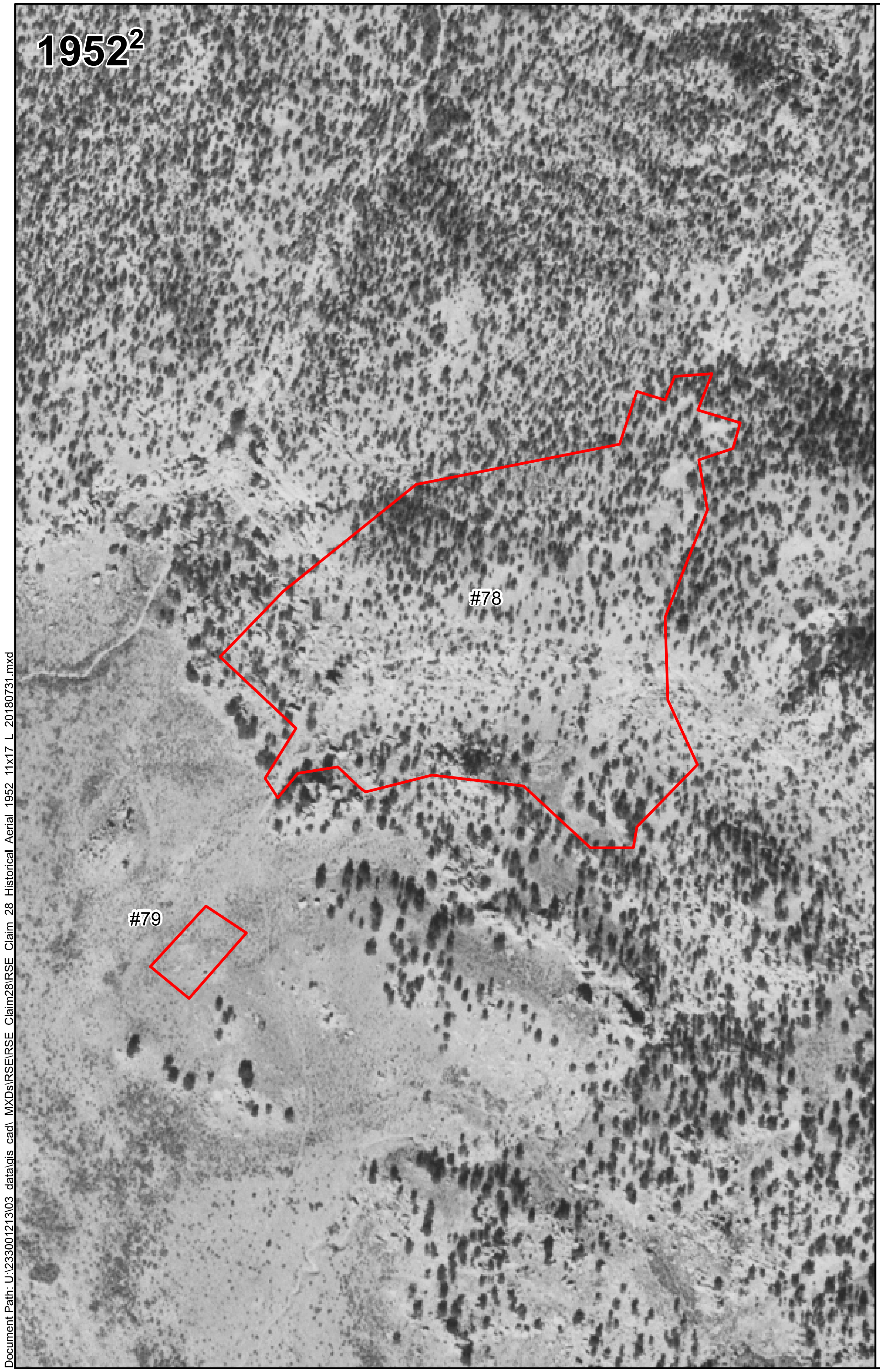
Stantec

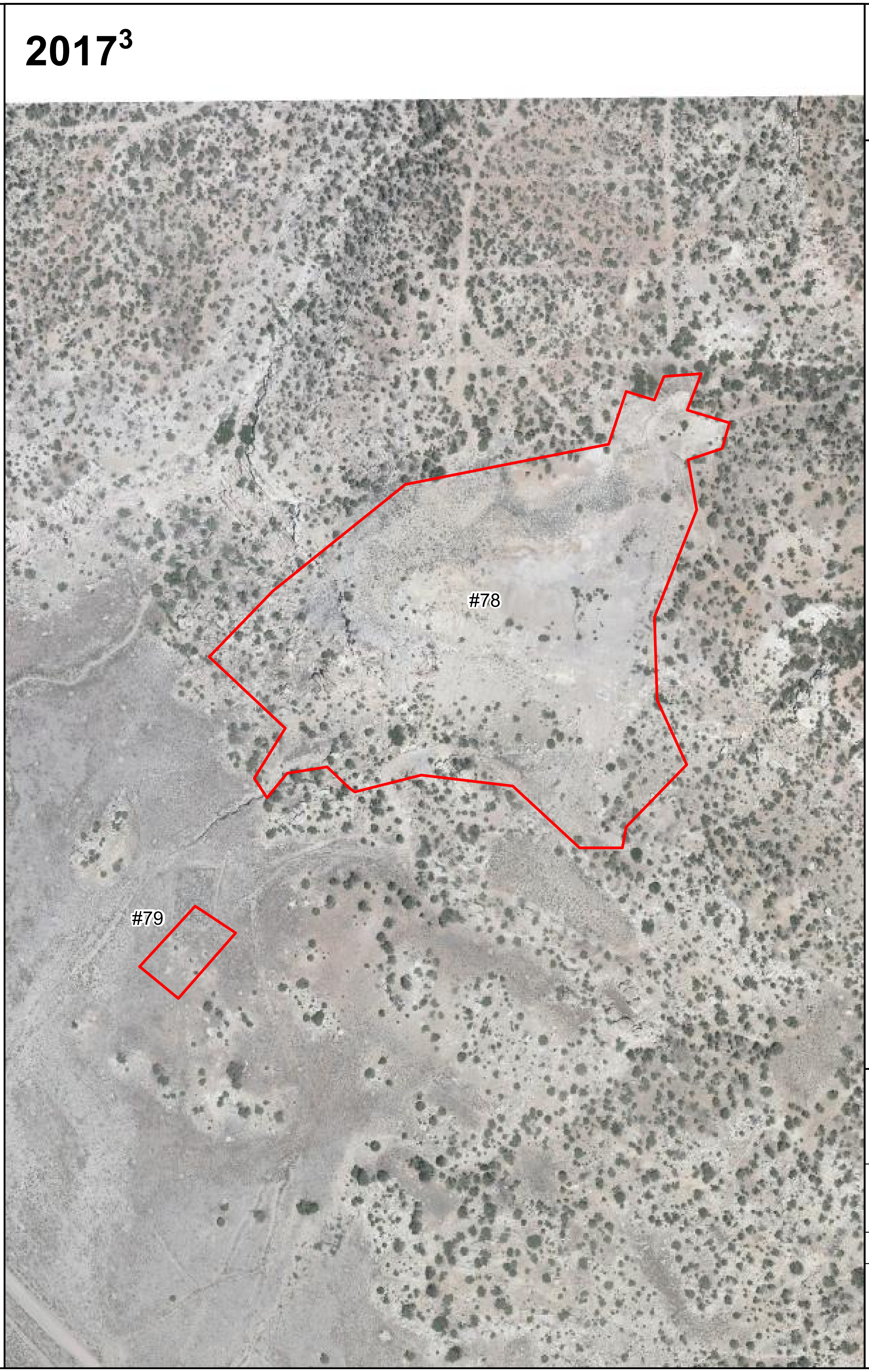
AUTHOR: EDZ

REVIEWER: CBB

FIGURE: 3-1a

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Historical Aerial Compilation 11x17 L 20180731.mxd





NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

🟥 Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
1. Coordinate System: NAD 1983 UTM Zone 12N

2. 1952 aerial image downloaded from https://earthexplorer.usgs.gov/ (01/2016) and georeferenced using current image from BING (03/2016).

3. Site-specific imagery flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 300 600
Feet

TITLE:
1952 Historical Aerial
Photograph Comparison

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

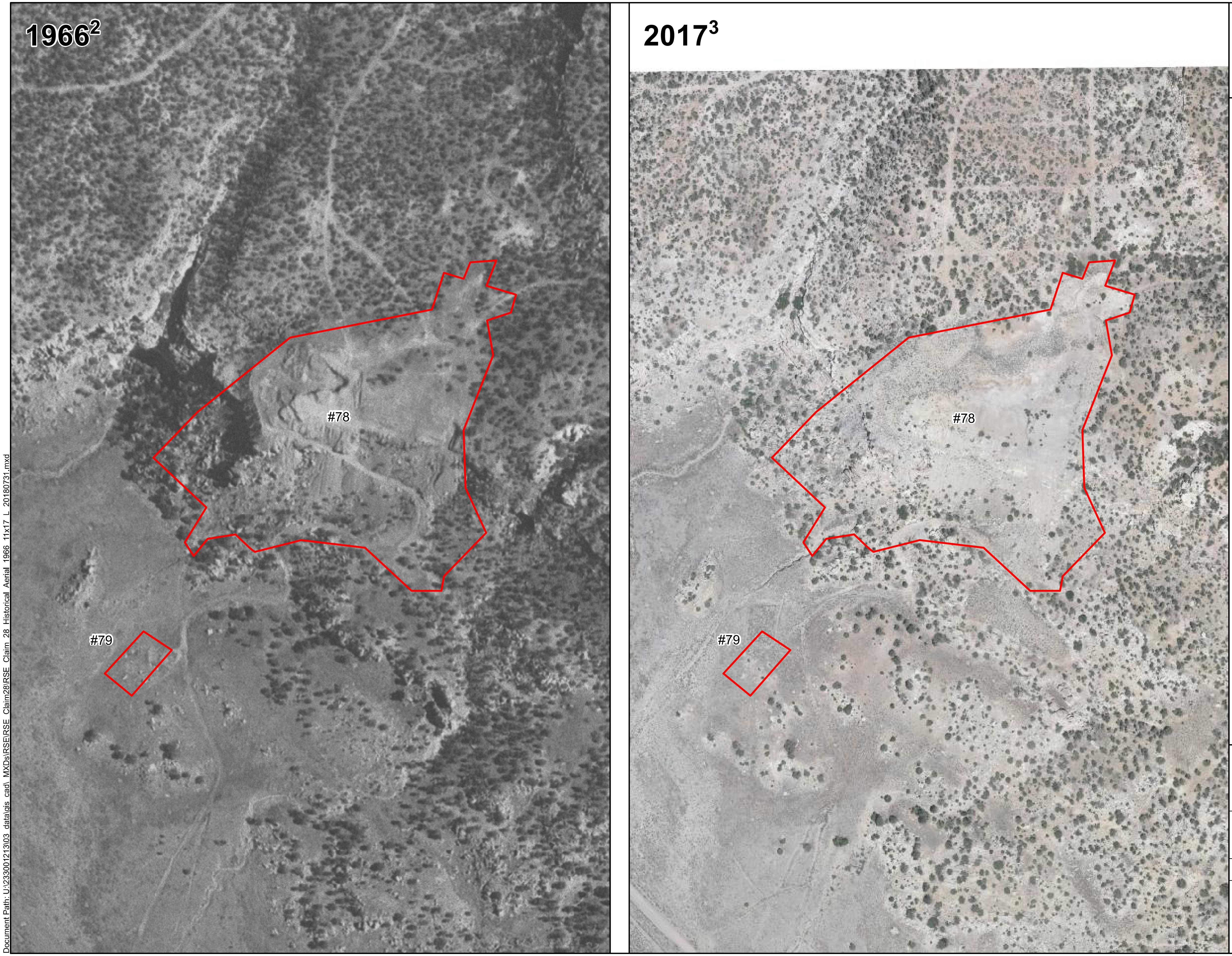
AUTHOR: CBB

REVIEWER: EDZ

Stantec

FIGURE: 3-1b

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim_28_Historical_Aerial_1952_11x17_L_20180731.mxd



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

🟥 Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
1. Coordinate System: NAD 1983 UTM Zone 12N

2. 1966 aerial image downloaded from https://earthexplorer.usgs.gov/ (01/2016) and georeferenced using current image from BING (03/2016).

3. Site-specific imagery flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S
0 300 600
Feet

TITLE:
1966 Historical Aerial
Photograph Comparison

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018	DOCUMENT NAME: Removal Site Evaluation Report
Stantec	AUTHOR: CBB
	REVIEWER: EDZ
	FIGURE: 3-1c

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim_28_Historical_Aerial_1966_11x17_L_20180731.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

▨	Potential Background Reference Area
🟥	Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 200 400
Feet

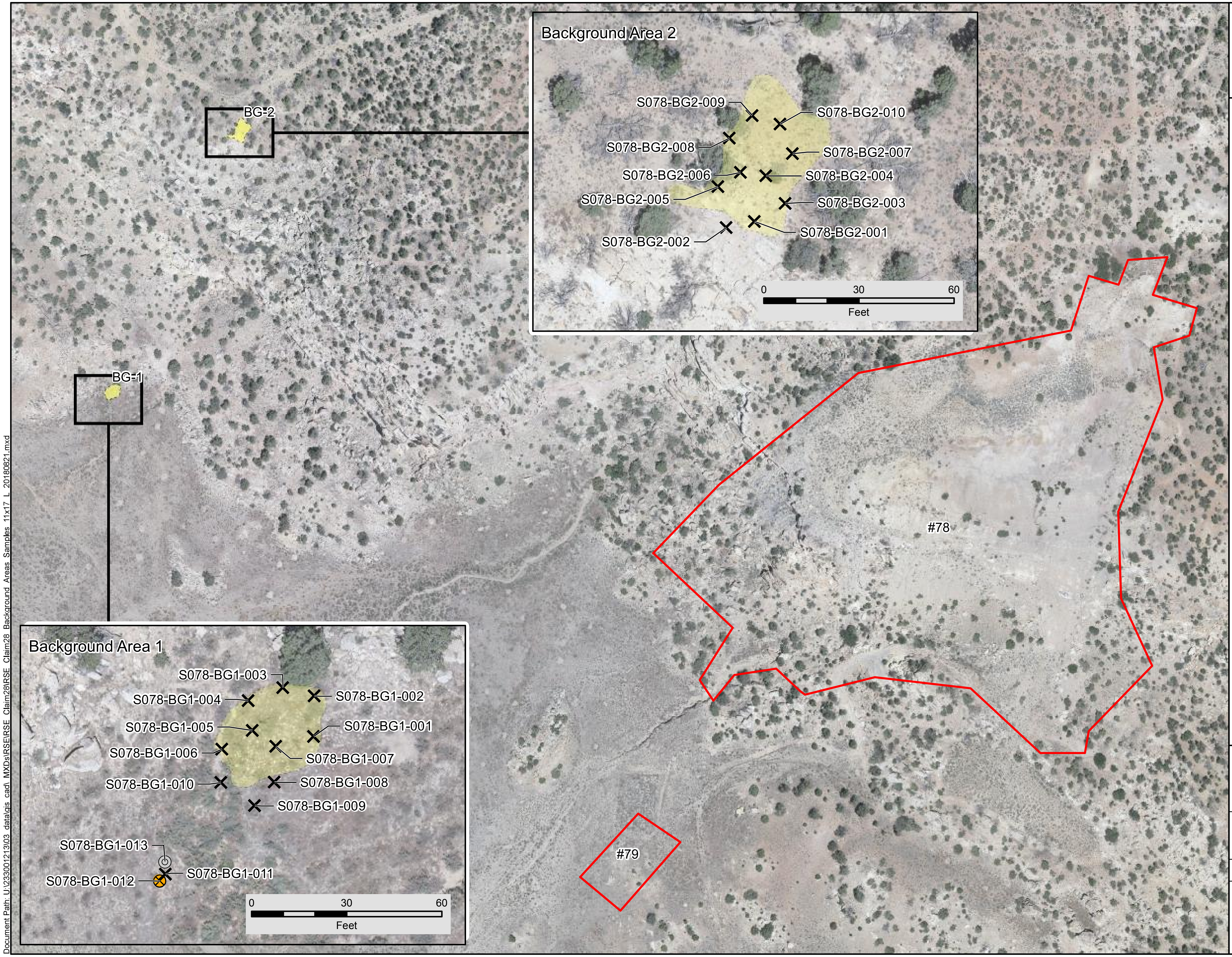
TITLE:
Potential Background
Reference Areas

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/21/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: CBB
REVIEWER: EDZ
FIGURE: 3-2

Stantec

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Background Areas 11x17 L 20180731.mxd



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Sample
⊗	Attempted Borehole Location
🟨	Background Reference Area
🟥	Claim Boundary

NOTE:
Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 200 400
Feet

TITLE:
Background Reference Areas - Sample Locations

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/22/2018

DOCUMENT NAME: Removal Site Evaluation Report

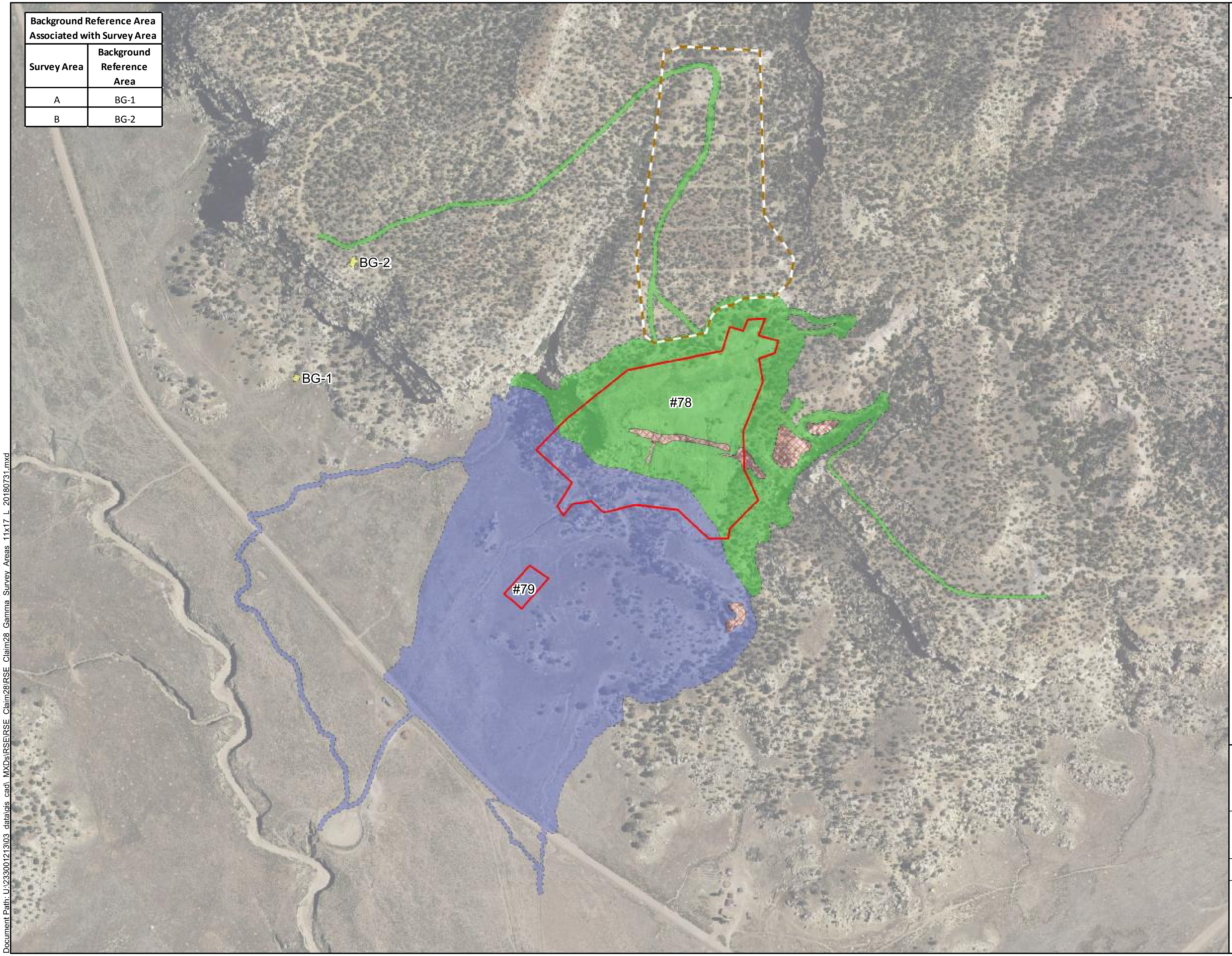
Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 3-3

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Background_Areas_Samples_11x17_L_20180821.mxd



Background Reference Area Associated with Survey Area	
Survey Area	Background Reference Area
A	BG-1
B	BG-2

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

▨	Background Reference Area
▭	Exploration
🟦	Survey Area A
🟩	Survey Area B
▨	Unsurveyed Area[1]
🟥	Claim Boundary

NOTES:

1. Areas within Survey Areas that were not surveyed (1.4 acres) due to steep/unsafe terrain.
2. Gamma survey area is approximately 73.1 acres.
3. Claim 28 includes two abandoned uranium mines, #78 and #79.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

N
W E
S

0 450 900
Feet

TITLE:
Gamma Radiation
Survey Areas

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

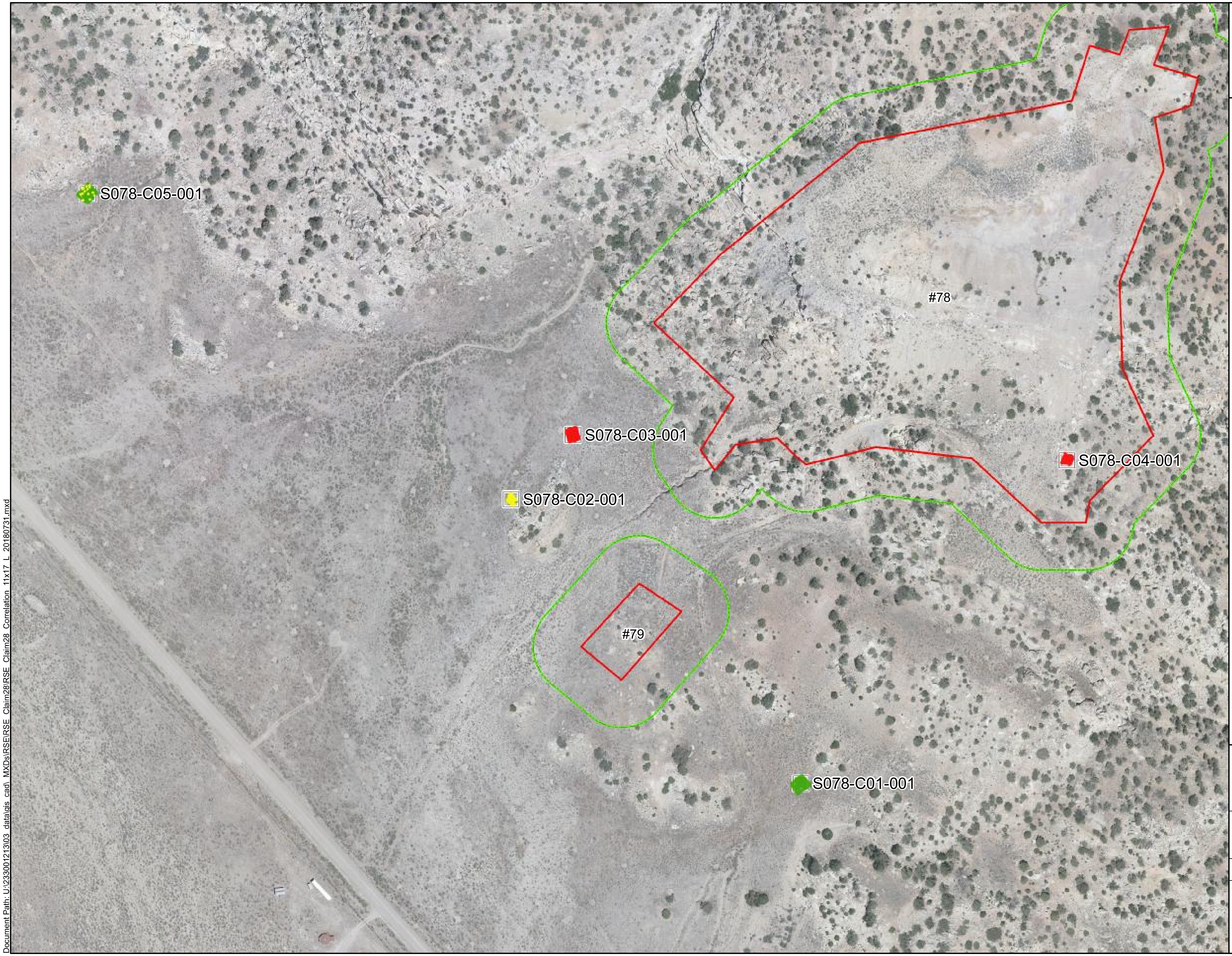
AUTHOR: CBB

REVIEWER: EDZ

Stantec

FIGURE: 3-4

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Gamma Survey Areas 11x17 L 20180731.mxd



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

☐ S225-C01-001 Correlation Location (30' x 30')

☐ Claim Boundary

☐ 100-Foot Claim Buffer

Gamma Survey

Counts per Minute (CPM)

● 14,772 - 20,677 (MinimumL to BG-1 UTL)

● 20,678 - 29,414 (>BG-1 UTL to 2x BG-2 UTL)

● 29,415 - 64,887 (>2x BG-2 UTL to Maximum)

NOTES:

Claim 28 includes two abandoned uranium mines, #78 and #79.

Each correlation sample consists of five grab samples collected from 0.0 - 0.5 feet below ground surface, composited together for laboratory analysis.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 200 400
Feet

TITLE:
Gamma Correlation
Study Locations

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/1/2018

DOCUMENT NAME: Removal Site Evaluation Report

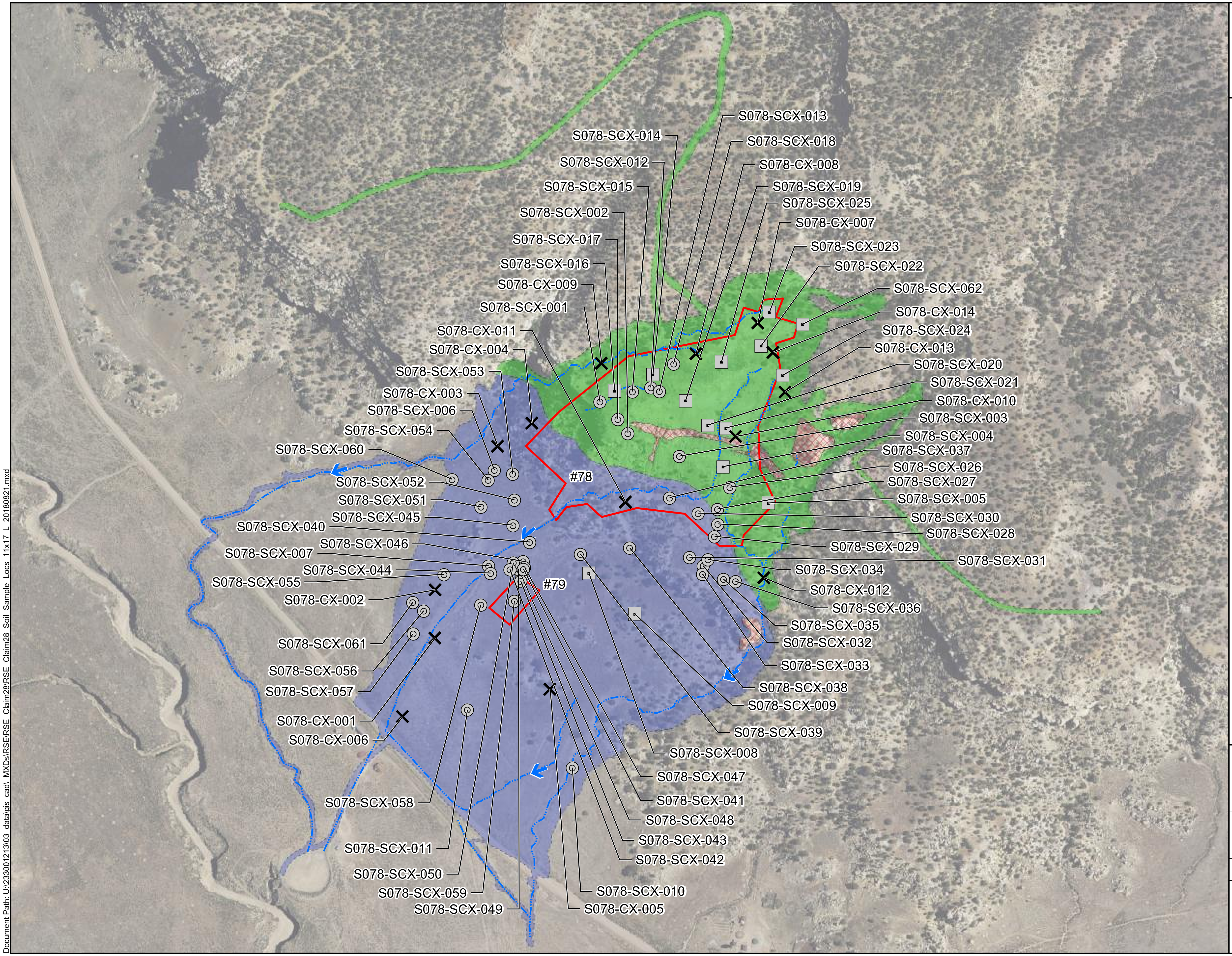
Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 3-5

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Correlation 11x17 L 20180731.mxd



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
↑	Flow Direction
⋯	Drainage
🟦	Survey Area A
🟩	Survey Area B
▨	Unsurveyed Area
🟥	Claim Boundary

NOTES:

Claim 28 includes two abandoned uranium mines, #78 and #79.

Surface soil samples range from 0.0 - 0.5 feet below ground surface (ft bgs)

Subsurface soil samples range from 0.5 - 33.0 ft bgs

Static gamma measurements range from 0.0 - 37.0 ft bgs

Surface and subsurface static gamma measurements were collected at all borehole locations with one exception; only subsurface static gamma measurements were collected at S078-SCX-058.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

N
W E
S

0 400 800
Feet

TITLE:

Site Characterization Surface and Subsurface Sample Locations

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 3-6a

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Soil_Sample_Locs_11x17_L_20180821.mxd

NOTES:

1. Approximate location of historical pit identified by NAML personnel during on-site visit in March 2017.

2. Claim 28 includes two abandoned uranium mines, #78 and #79.

3. Surface soil samples range from 0.0 - 0.5 feet below ground surface (ft bgs)

4. Subsurface soil samples range from 0.5 - 33.0 ft bgs

5. Static gamma measurements range from 0.0 - 37.0 ft bgs

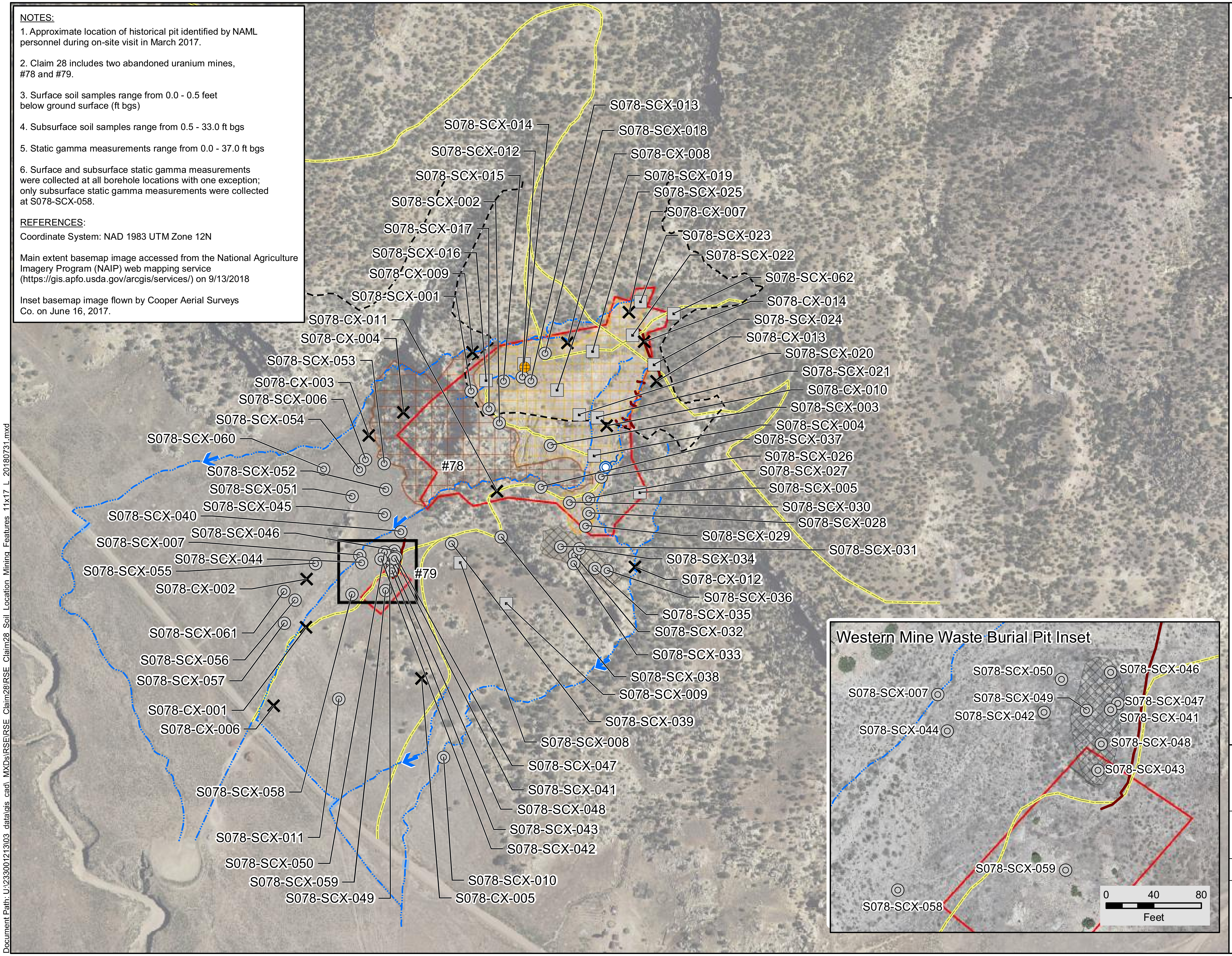
6. Surface and subsurface static gamma measurements were collected at all borehole locations with one exception; only subsurface static gamma measurements were collected at S078-SCX-058.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Main extent basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

Inset basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
⊕	Approximate Location of Historical Pit[1]
◎	Seep
↑	Flow Direction
- - -	Approximate Edge of Mesa
━	Berm
━	Culvert
-·-·-	Drainage
- - -	Potential Haul Road
▨	Mine Waste Burial Pit
☐	Potential Mine Waste Material
▦	Mining / Reclaimed Disturbed Area
☐	Claim Boundary

N
W E
S

0 400 800
Feet

TITLE:

Sample Locations Compared to Mining-Related Features

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

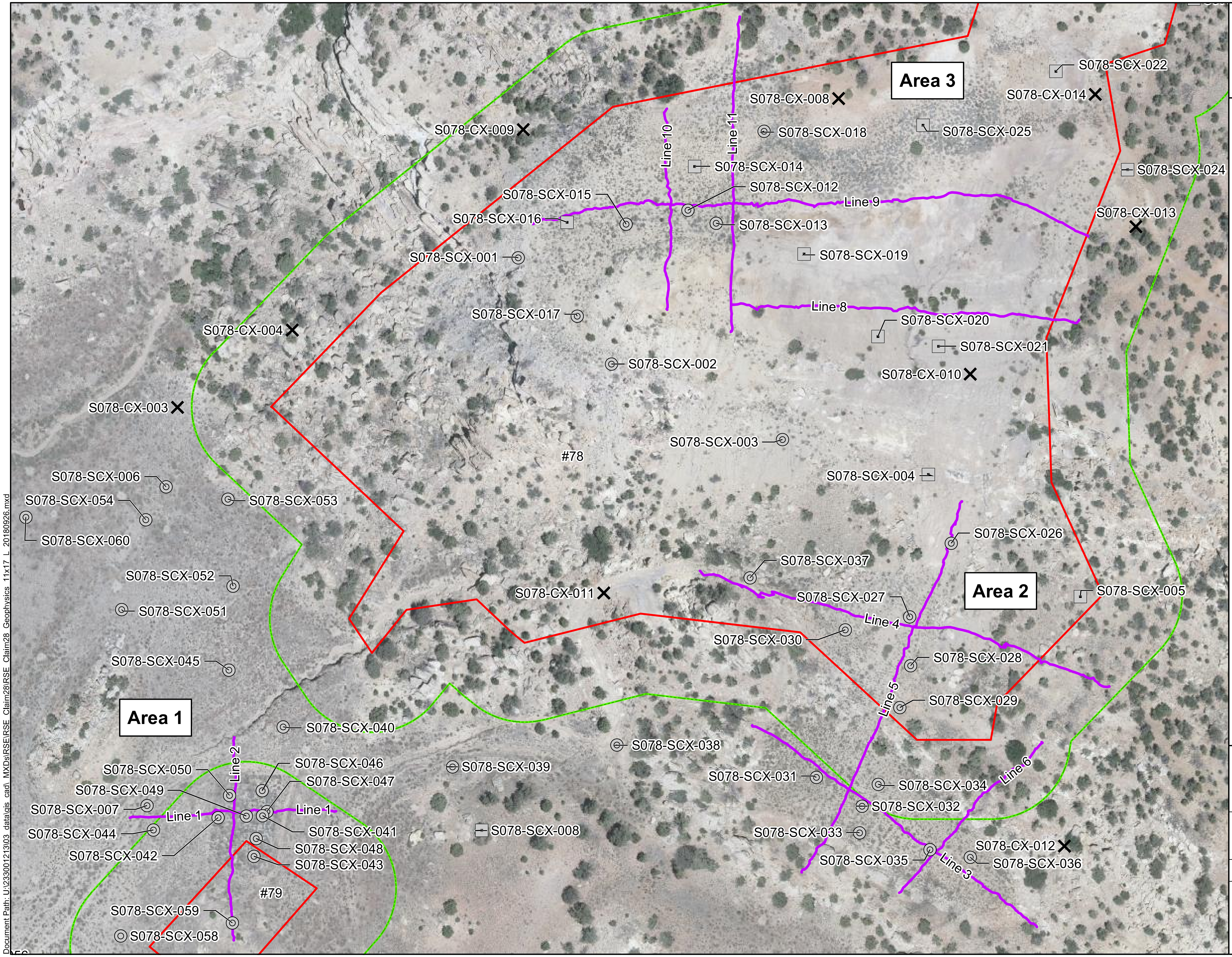
AUTHOR: AJS

REVIEWER: CBB

Stantec

FIGURE: 3-6b

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Soil_Location_Mining_Features_11x17_L_20180731.mxd



Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_Geophysics_11x17_L_20180926.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
—	Resistivity Survey Line
🟥	Claim Boundary
🟩	100-Foot Claim Buffer

NOTE:
Claim 28 includes two mines, #78 and #79

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Geophysical surveys were performed by Hydrogeophysics, Inc. The geophysical survey report is presented in Appendix A.2.

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/26/2018

N
W E
S

0 120 240
Feet

TITLE:
Geophysical Surveys

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/26/2018

DOCUMENT NAME: Removal Site Evaluation Report

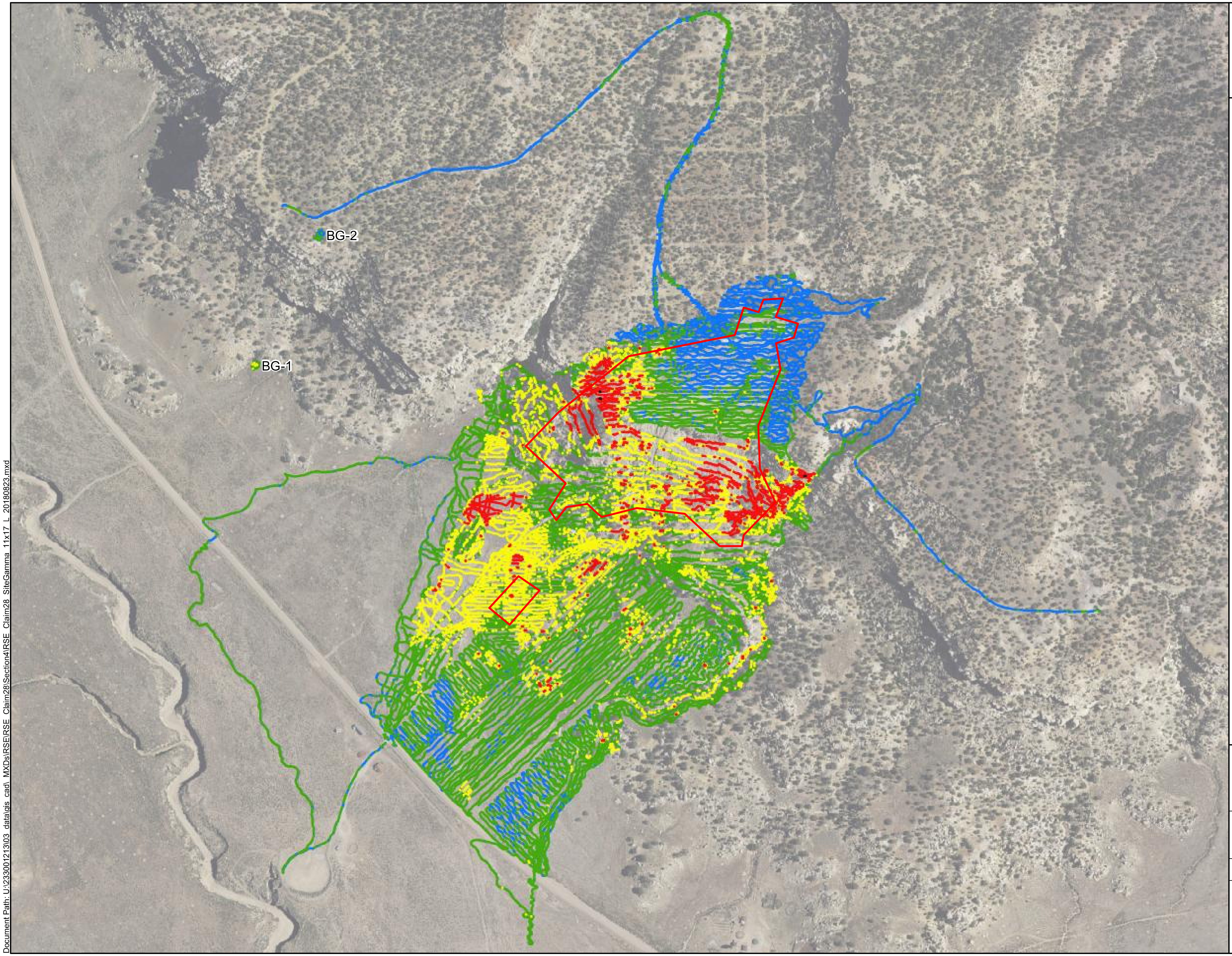
Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 3-7

NAVAJO
NATION
AUM Environmental
Response Trust-First Phase



LEGEND

▭ Claim Boundary

Gamma Survey

Counts per Minute (CPM)

●	5,437 - 14,707 (Minimum to BG-2 IL)
●	14,708 - 20,677 (>BG-2 IL to BG-1 IL)
●	20,678 - 29,414 (>BG-1 IL to 2x BG-2 IL)
●	29,415 - 147,070 (>2x BG-2 IL to 10x BG-2 IL)
●	147,071 - 301,035 (10x BG-2 IL to Maximum)

NOTE:
Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

N
W E
S

0 400 800
Feet

TITLE:
Gamma Radiation
Survey Results

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

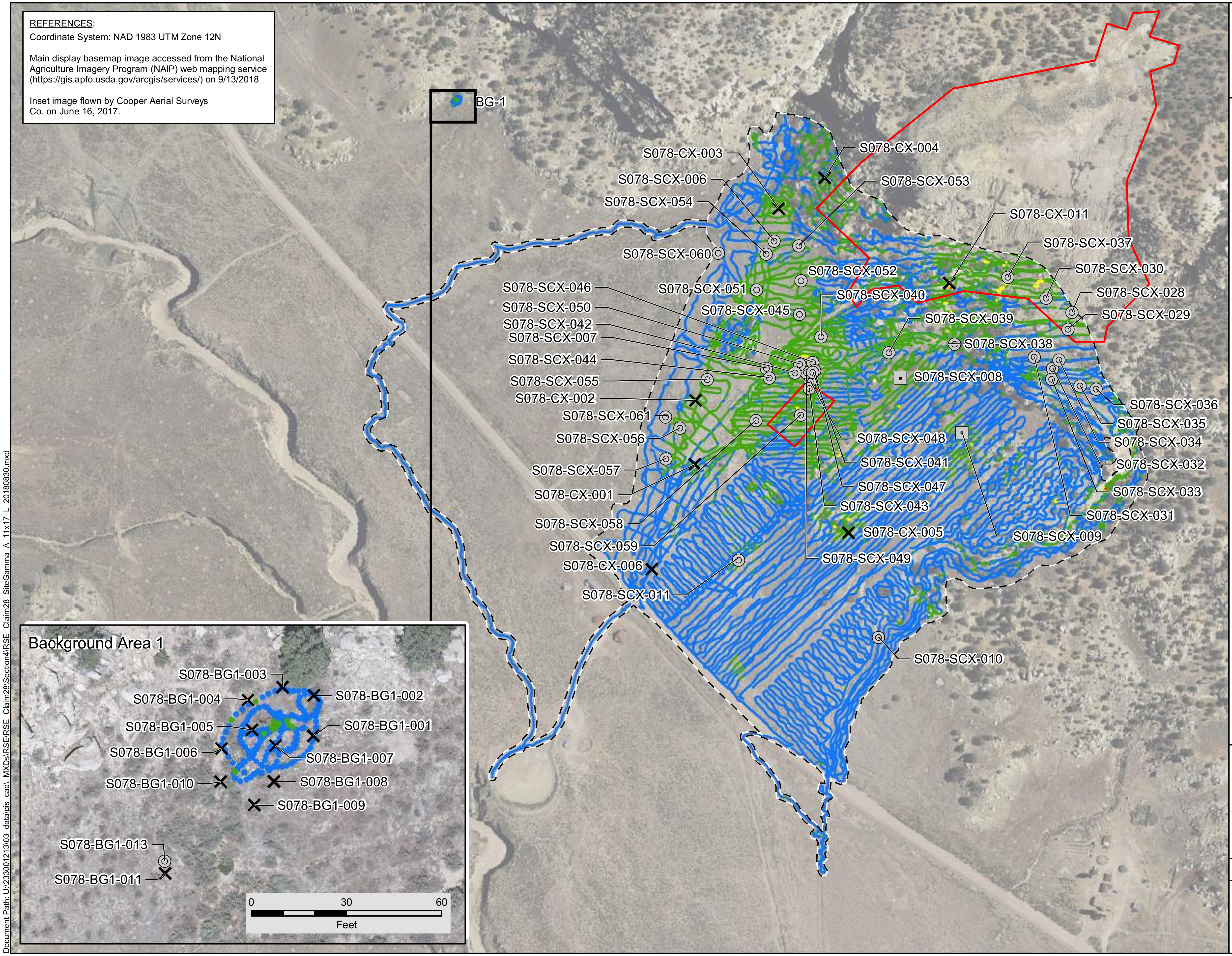
Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 4-1a

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 SiteGamma 11x17 L 20180823.mxd



REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Main display basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

Inset image flown by Cooper Aerial Surveys Co. on June 16, 2017.

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 SiteGamma A 11x17 L 20180830.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
⬚	Survey Area A
🟥	Claim Boundary

Gamma Survey

Counts per Minute (CPM)

●	5,437 - 20,677 (Minimum to BG-1 IL)
●	20,678 - 41,354 (>BG-1 IL to 2x BG-1 IL)
●	41,355 - 103,385 (>2x BG-1 IL to 5x BG-1 IL)
●	103,386 - 115,935 (>5x BG-1 IL to Maximum)

N
W E
S

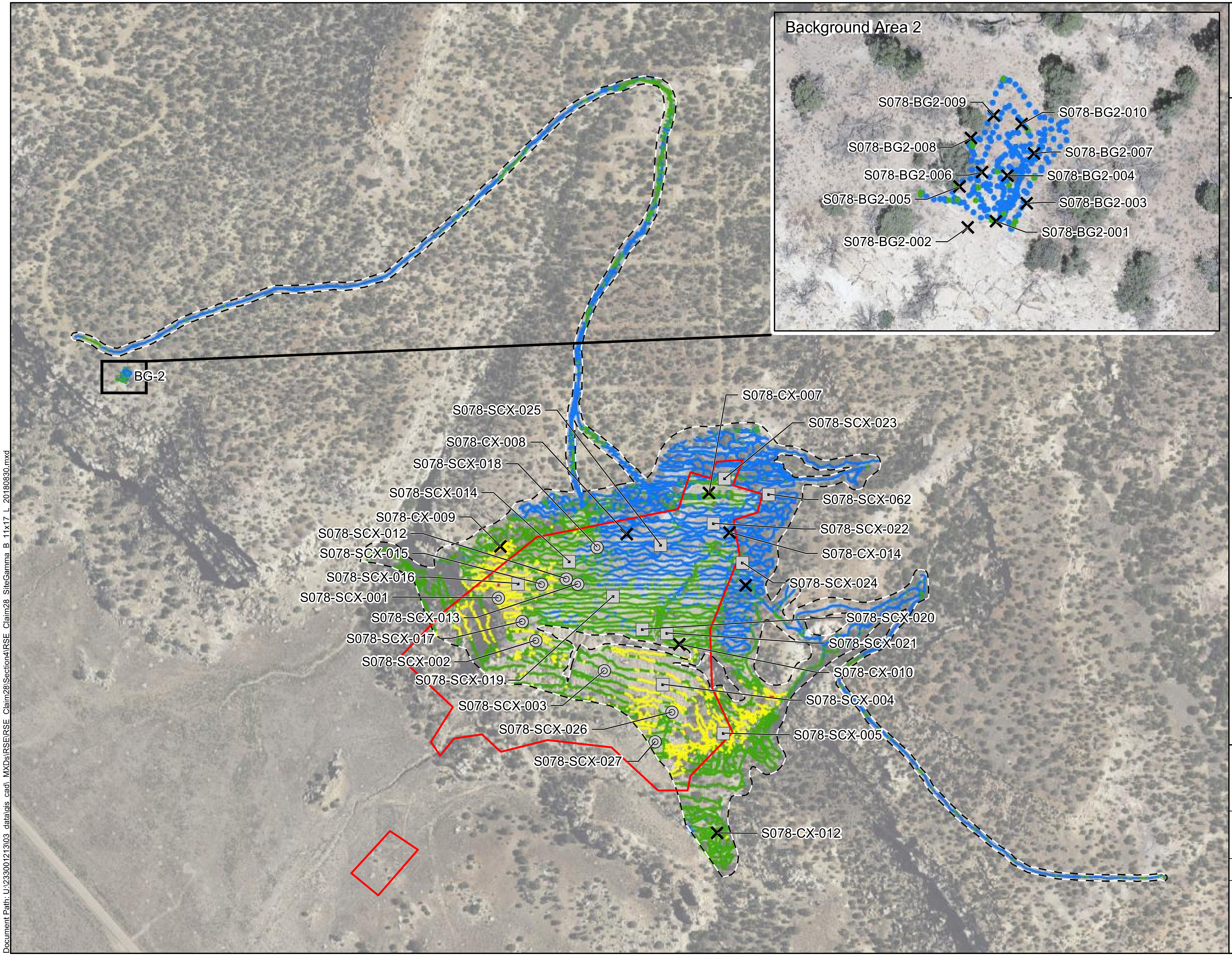
0 300 600
Feet

TITLE:
Gamma Radiation Survey
Results for Survey Area A

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: AJS
REVIEWER: CBB
FIGURE: 4-1b

Stantec



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕ Surface Sample Location

◎ Borehole Location - Surface and Subsurface Samples

▣ Borehole Location - Surface Samples Only

⬚ Survey Area B

🟥 Claim Boundary

Gamma Survey

Counts per Minute (CPM)

● 7,869 - 14,707 (Minimum to BG-2 IL)

● 14,708 - 29,414 (>BG-2 IL to 2x BG-2 IL)

● 29,415 - 147,070 (>2x BG-2 IL to 10x BG-2 IL)

● 147,071 - 301,035 (>10x BG-2 IL to Maximum)

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Main display basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

Inset image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 300 600
Feet

TITLE:
Gamma Radiation Survey
Results for Survey Area B

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

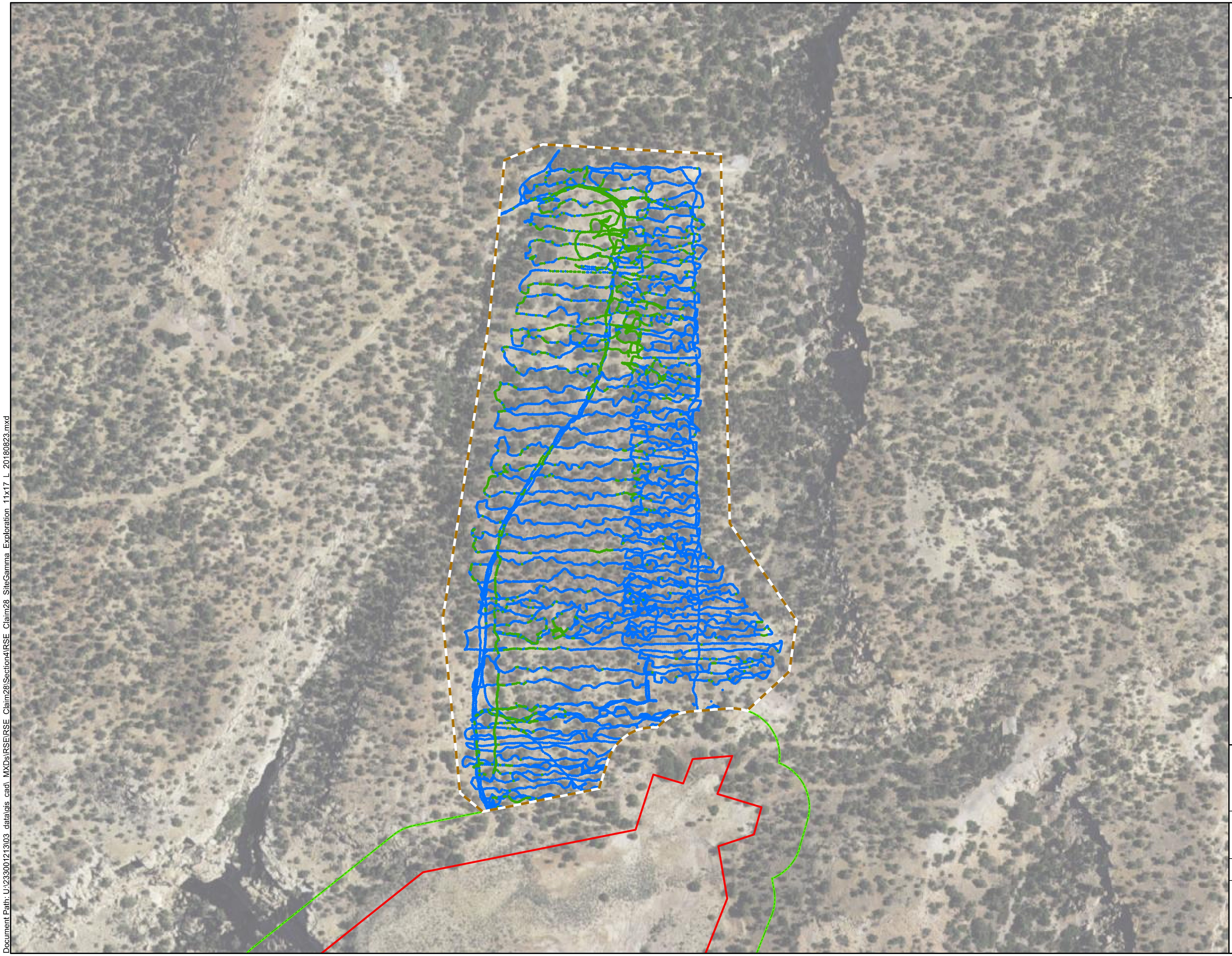
Stantec

AUTHOR: AS

REVIEWER: CBB

FIGURE: 4-1c

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 SiteGamma B 11x17 L 20180830.mxd



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

▭	Exploration Area
🟥	Claim Boundary
🟩	100-Foot Claim Buffer

Gamma Survey

Counts per Minute (CPM)

●	7,942 - 14,707 (Minimum to BG-2 IL)
●	14,708 - 20,428 (>BG-2 IL to Maximum)

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/12/2018

N
W E
S

0 200 400
Feet

TITLE:
Exploration Area - Gamma Radiation Survey Results

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/12/2018

DOCUMENT NAME: Removal Site Evaluation Report

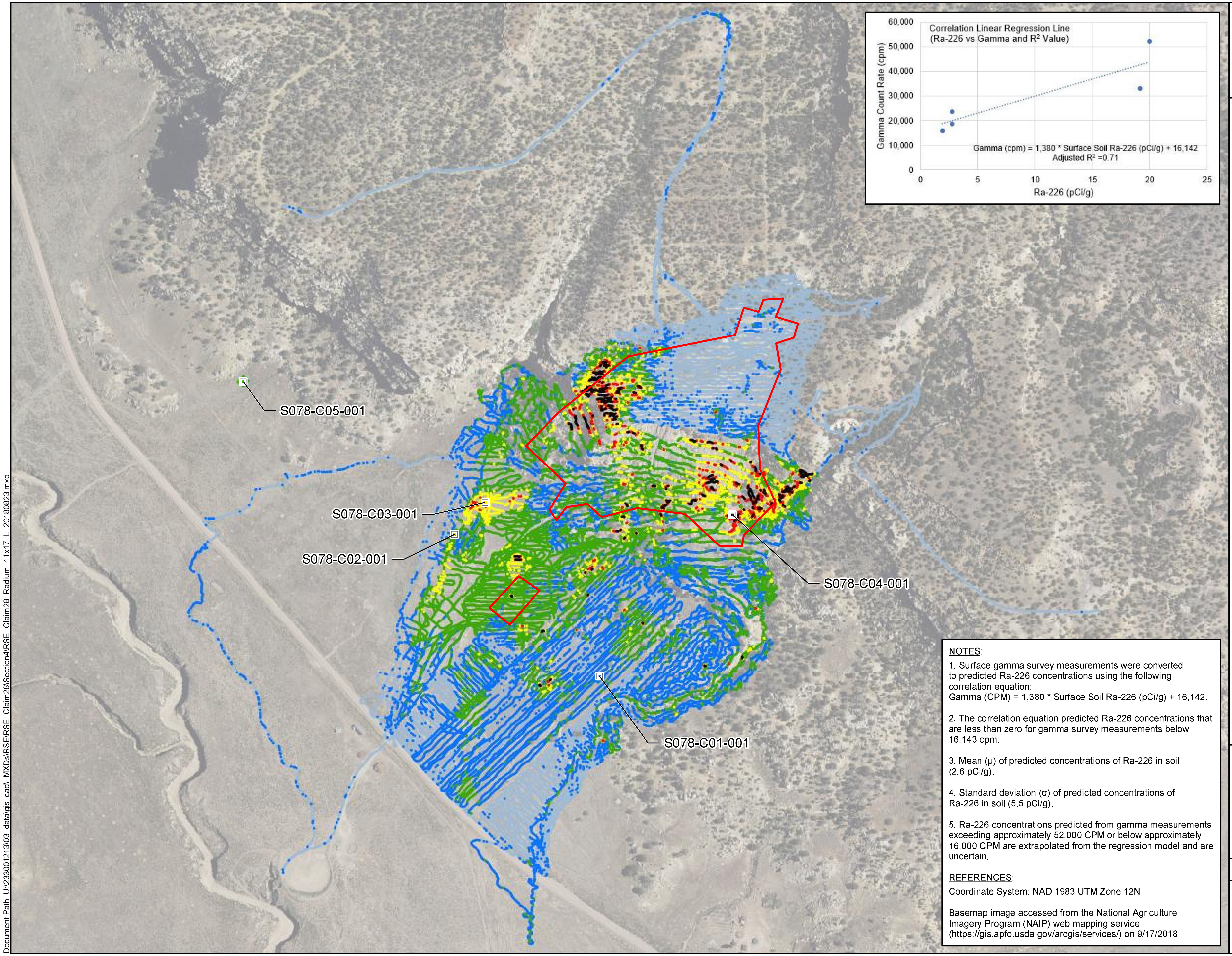
Stantec

AUTHOR: AS

REVIEWER: CBB

FIGURE: 4-1d

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_SiteGamma_Exploration_11x17_L_20180823.mxd



NOTES:

1. Surface gamma survey measurements were converted to predicted Ra-226 concentrations using the following correlation equation:
Gamma (CPM) = 1,380 * Surface Soil Ra-226 (pCi/g) + 16,142.

2. The correlation equation predicted Ra-226 concentrations that are less than zero for gamma survey measurements below 16,143 cpm.

3. Mean (μ) of predicted concentrations of Ra-226 in soil (2.6 pCi/g).

4. Standard deviation (σ) of predicted concentrations of Ra-226 in soil (5.5 pCi/g).

5. Ra-226 concentrations predicted from gamma measurements exceeding approximately 52,000 CPM or below approximately 16,000 CPM are extrapolated from the regression model and are uncertain.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

☐ S225-C01-001
Correlation Location
(30' x 30')

🟥 Claim Boundary

Predicted Ra-226
Concentration[1] (pCi/g)

- ● Less than 0[2]
- ● 0 - 2.6 (μ)[3]
- ● 2.7 - 8.1 (μ + 1σ[4])
- ● 8.2 - 13.6 (μ + 2σ)
- ● 13.7 - 19.1 (μ + 3σ)
- ● 19.2 - 206.4[5]

Correlation Data

Sample ID	Ra-226 (pCi/g)	Mean Gamma Count Rate (cpm)[1]
S078-C01-001	1.9	16,151
S078-C02-001	2.69	24,027
S078-C03-001	19.1	33,222
S078-C04-001	19.9	52,335
S078-C05-001	2.69	18,846

[1]Average gamma count rate for correlation

N
W E
S

0 400 800
Feet

TITLE:
Predicted Concentrations of Ra-226 in Soil using the Correlation Equation

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

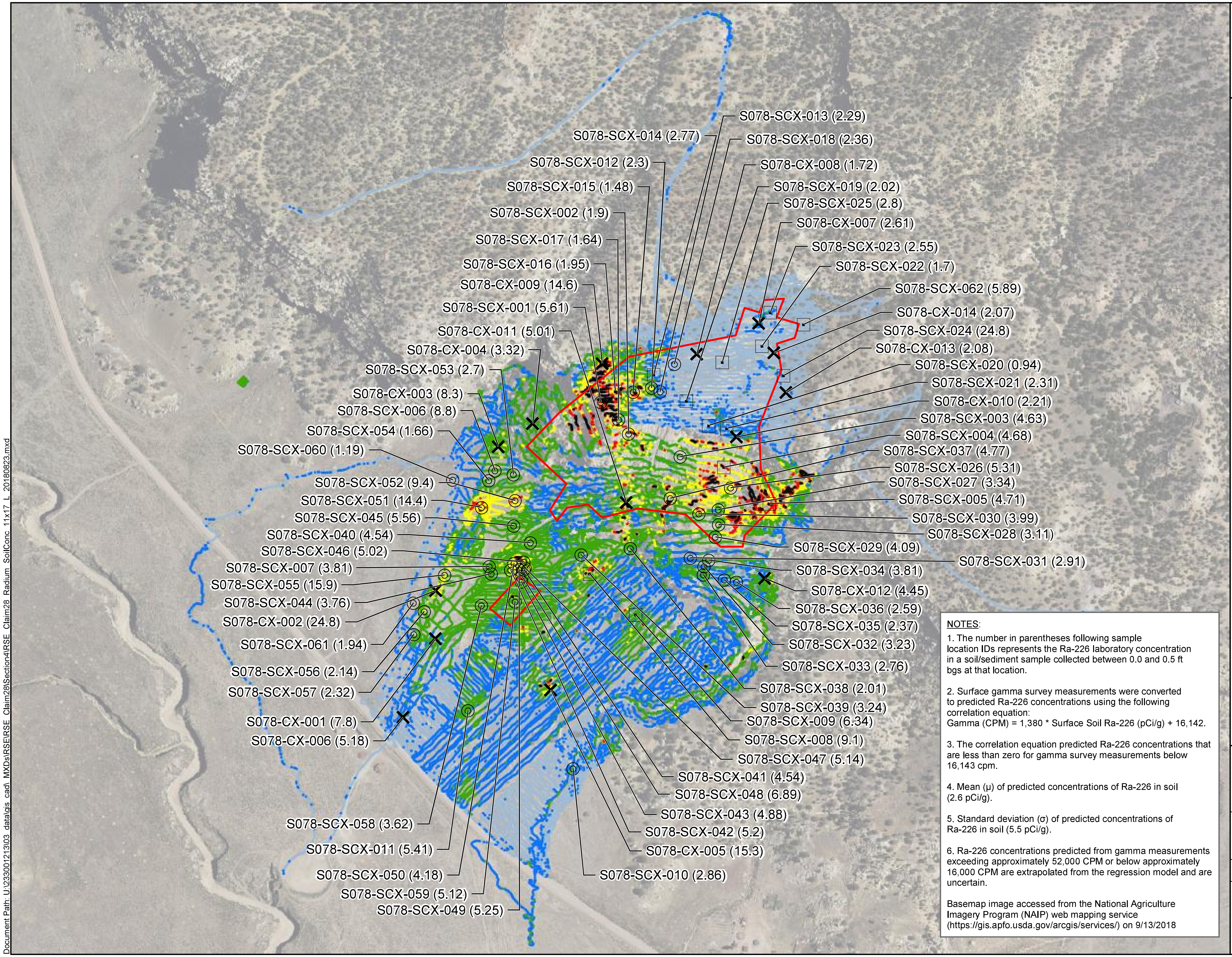
Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-2a

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Radium_11x17_L_20180823.mxd



NOTES:

1. The number in parentheses following sample location IDs represents the Ra-226 laboratory concentration in a soil/sediment sample collected between 0.0 and 0.5 ft bgs at that location.

2. Surface gamma survey measurements were converted to predicted Ra-226 concentrations using the following correlation equation:
Gamma (CPM) = 1,380 * Surface Soil Ra-226 (pCi/g) + 16,142.

3. The correlation equation predicted Ra-226 concentrations that are less than zero for gamma survey measurements below 16,143 cpm.

4. Mean (μ) of predicted concentrations of Ra-226 in soil (2.6 pCi/g).

5. Standard deviation (σ) of predicted concentrations of Ra-226 in soil (5.5 pCi/g).

6. Ra-226 concentrations predicted from gamma measurements exceeding approximately 52,000 CPM or below approximately 16,000 CPM are extrapolated from the regression model and are uncertain.

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/13/2018

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
⊡	Borehole Location - Surface Samples Only
🟥	Claim Boundary

Predicted Ra-226 Concentration^2 (pCi/g)

●	Less than 0^3
●	0 - 2.6 (μ)^4
●	2.7 - 8.1 (μ + 1σ^5)
●	8.2 - 13.6 (μ + 2σ)
●	13.7 - 19.1 (μ + 3σ)
●	19.2 - 206.4^6

N
W E
S
0 400 800
Feet

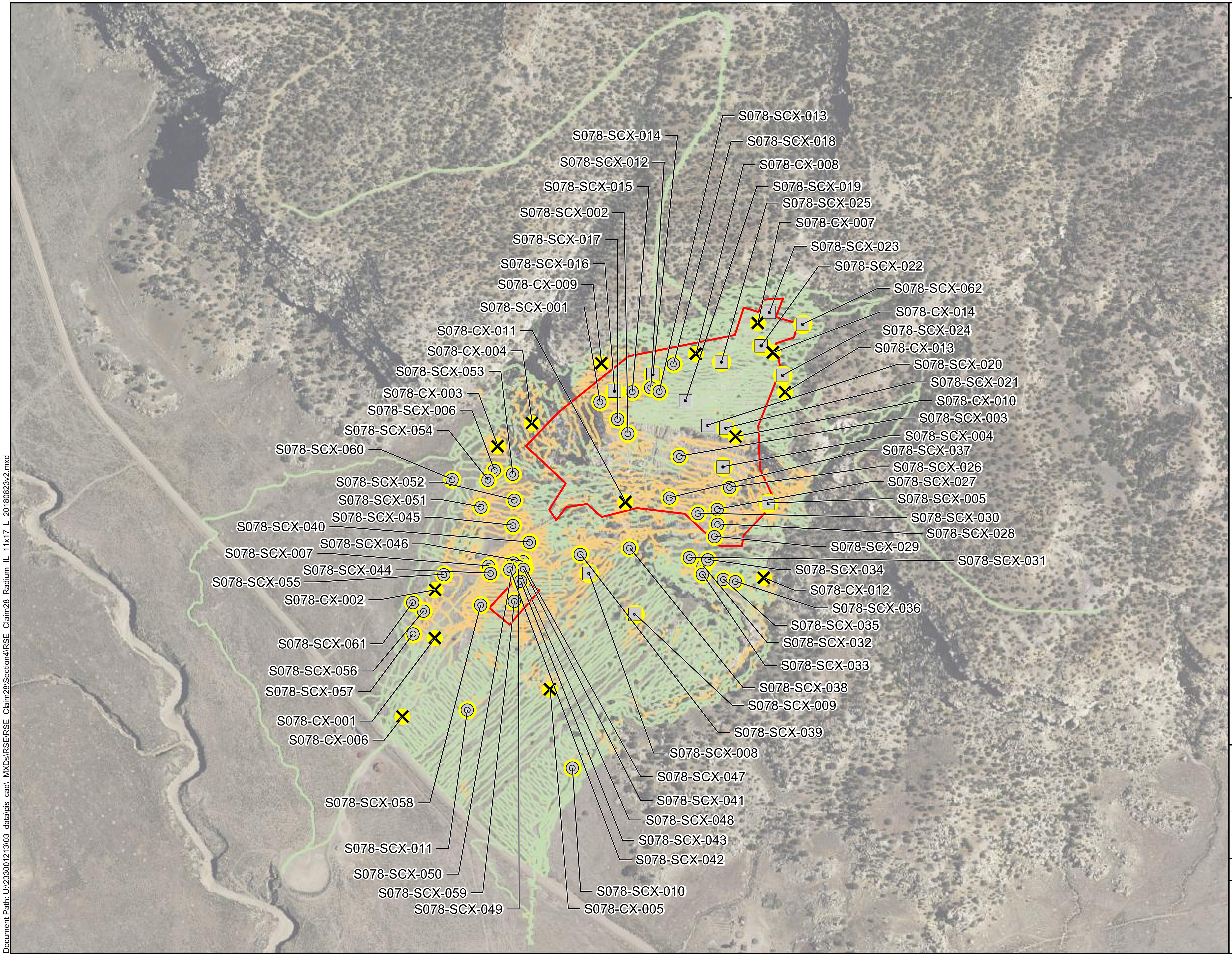
TITLE:
Predicted Concentrations of Ra-226 in Soil Compared to Ra-226 Concentrations in Soil/Sediment

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018
DOCUMENT NAME: Removal Site Evaluation Report
Stantec
AUTHOR: AJS
REVIEWER: CBB
FIGURE: 4-2b

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Radium_SoilConc_11x17_L_20180823.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase



LEGEND

✕ Surface Sample Location

◎ Borehole Location - Surface and Subsurface Samples

▣ Borehole Location - Surface Samples Only

● Ra-226 IL Exceedance in Surface Soil

▭ Claim Boundary

Predicted Ra-226 Concentration (pCi/g)

IL Not Exceeded
● Survey Area A: -7.8 - 3.59
Survey Area B: -6.0 - 5.65

IL Exceeded
● Survey Area A: 3.60 - 72.31
Survey Area B: 5.66 - 206.44

NOTES:

Surface gamma survey measurements were converted to predicted Ra-226 concentrations using the following correlation equation:
Gamma (CPM) = 1,380 * Surface Soil Ra-226 (pCi/g) + 16,142.

Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

N
W E
S

0 400 800
Feet

TITLE:
Predicted Ra-226 Concentrations in Surface Soil Compared to Ra-226 ILs

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: AJS

REVIEWER: CBB

Stantec

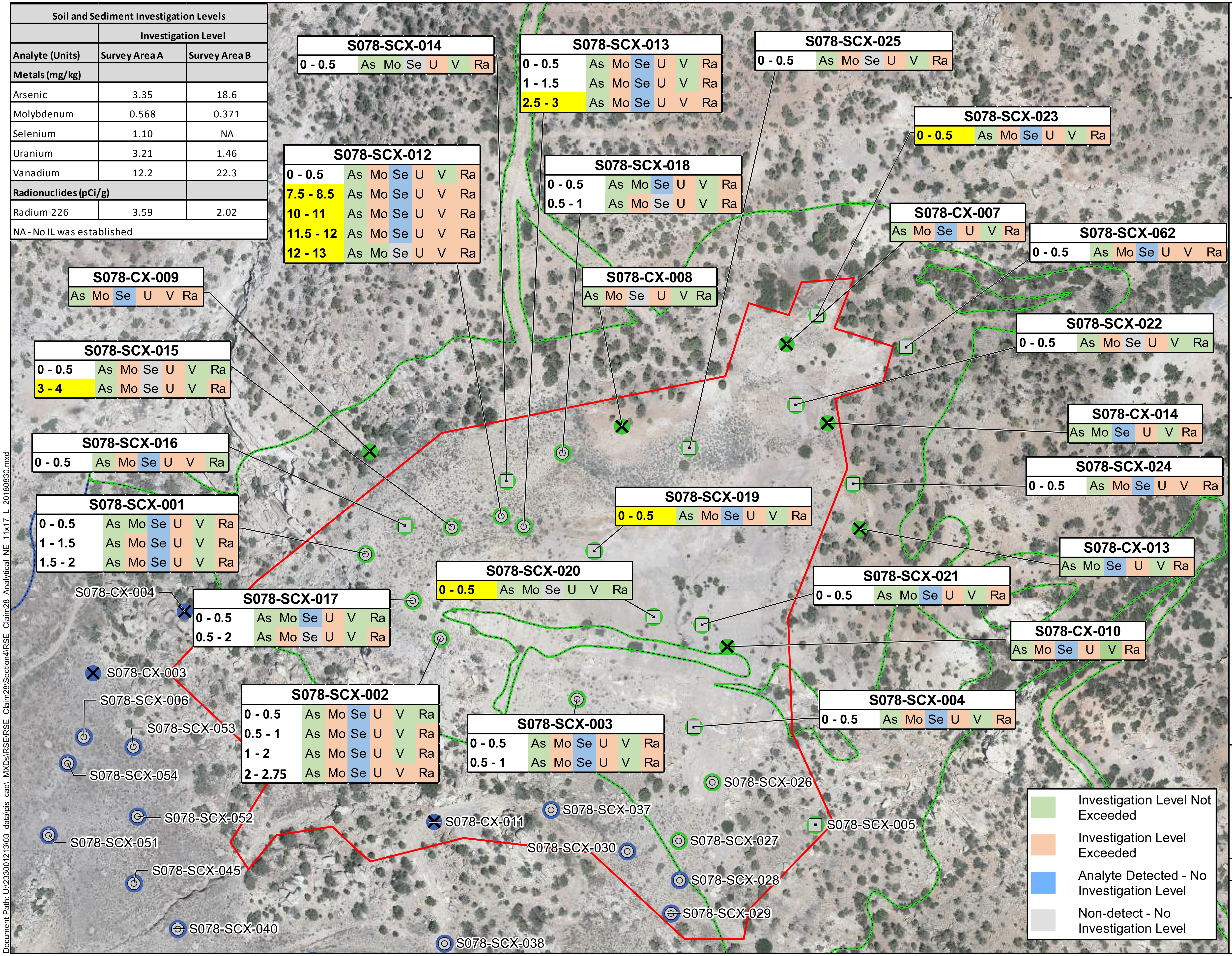
FIGURE: 4-2c

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Radium IL 11x17 L 20180823v2.mxd

Soil and Sediment Investigation Levels

Analyte (Units)	Investigation Level Survey Area A	 Survey Area B
Metals (mg/kg)		
Arsenic	3.35	18.6
Molybdenum	0.568	0.371
Selenium	1.10	NA
Uranium	3.21	1.46
Vanadium	12.2	22.3
Radionuclides (pCi/g)		
Radium-226	3.59	2.02

NA - No IL was established



🟩	Investigation Level Not Exceeded
🟧	Investigation Level Exceeded
🟦	Analyte Detected - No Investigation Level
⬜	Non-detect - No Investigation Level

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

⊗	Survey Area A - Surface Sample Location
◎	Survey Area A - Borehole Location - Surface and Subsurface Samples
⊗	Survey Area B - Surface Sample Location
◎	Survey Area B - Borehole Location - Surface and Subsurface Samples
▣	Survey Area B - Borehole Location - Surface Samples Only
▢	Survey Area A
▢	Survey Area B
▢	Claim Boundary

NOTES:
Sample Intervals (e.g 0 - 0.5) are in ft bgs.

Highlighted sample intervals are partially or completely within bedrock.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

TITLE:
Surface and Subsurface Metals and Ra-226 Analytical Results Northeast Quadrant

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

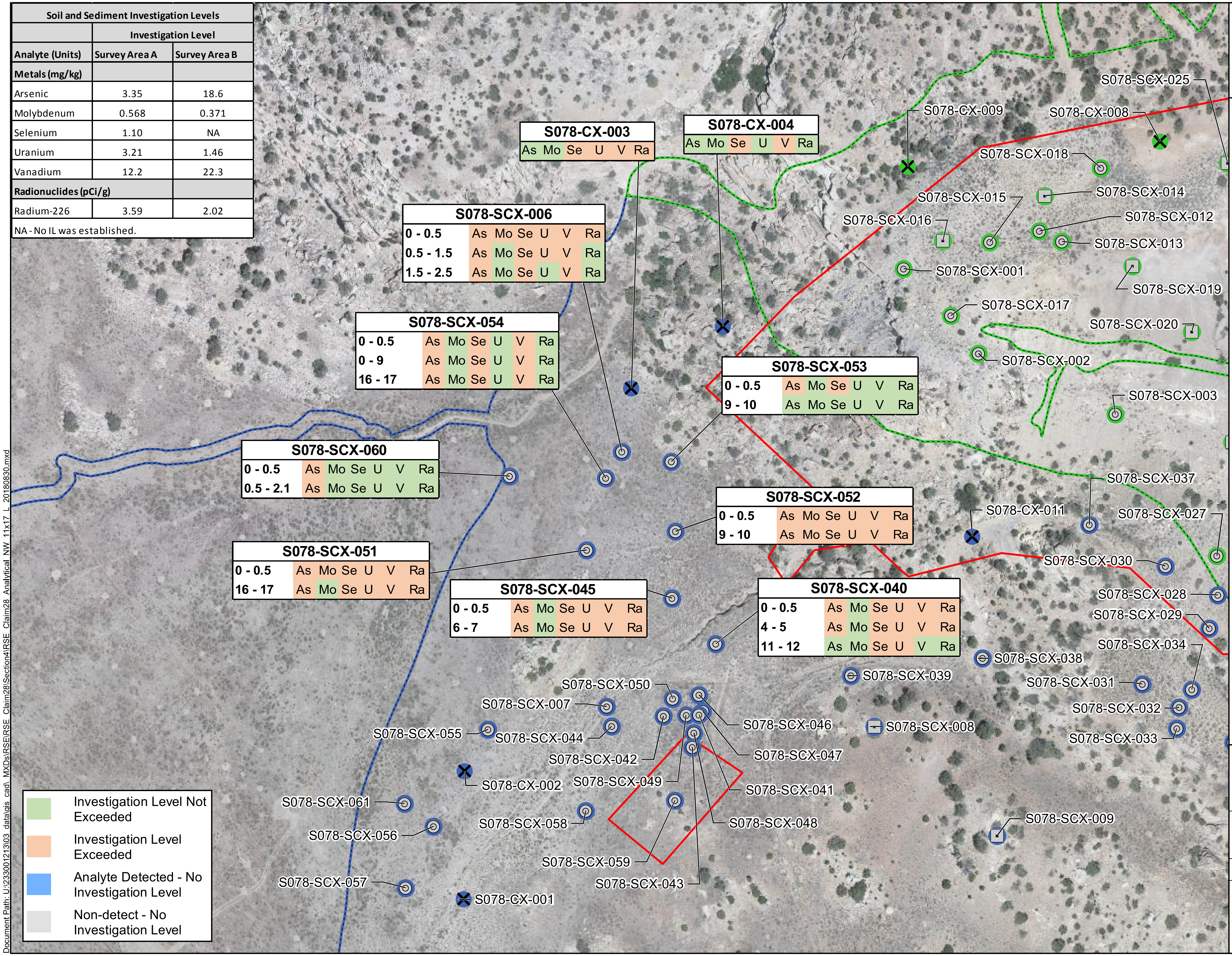
DATE: 9/17/2018
DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS
REVIEWER: CBB
FIGURE: 4-3a

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Analytical NE 11x17 L 20180830.mxd

Soil and Sediment Investigation Levels		
	Investigation Level	
Analyte (Units)	Survey Area A	Survey Area B
Metals (mg/kg)		
Arsenic	3.35	18.6
Molybdenum	0.568	0.371
Selenium	1.10	NA
Uranium	3.21	1.46
Vanadium	12.2	22.3
Radionuclides (pCi/g)		
Radium-226	3.59	2.02
NA - No IL was established.		



S078-CX-003					
As	Mo	Se	U	V	Ra

S078-CX-004					
As	Mo	Se	U	V	Ra

S078-SCX-006						
0 - 0.5	As	Mo	Se	U	V	Ra
0.5 - 1.5	As	Mo	Se	U	V	Ra
1.5 - 2.5	As	Mo	Se	U	V	Ra

S078-SCX-054						
0 - 0.5	As	Mo	Se	U	V	Ra
0 - 9	As	Mo	Se	U	V	Ra
16 - 17	As	Mo	Se	U	V	Ra

S078-SCX-053						
0 - 0.5	As	Mo	Se	U	V	Ra
9 - 10	As	Mo	Se	U	V	Ra

S078-SCX-060						
0 - 0.5	As	Mo	Se	U	V	Ra
0.5 - 2.1	As	Mo	Se	U	V	Ra

S078-SCX-052						
0 - 0.5	As	Mo	Se	U	V	Ra
9 - 10	As	Mo	Se	U	V	Ra

S078-SCX-051						
0 - 0.5	As	Mo	Se	U	V	Ra
16 - 17	As	Mo	Se	U	V	Ra

S078-SCX-045						
0 - 0.5	As	Mo	Se	U	V	Ra
6 - 7	As	Mo	Se	U	V	Ra

S078-SCX-040						
0 - 0.5	As	Mo	Se	U	V	Ra
4 - 5	As	Mo	Se	U	V	Ra
11 - 12	As	Mo	Se	U	V	Ra

🟩	Investigation Level Not Exceeded
🟧	Investigation Level Exceeded
🟦	Analyte Detected - No Investigation Level
⬜	Non-detect - No Investigation Level

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

⊗	Survey Area A - Surface Sample Location
◎	Survey Area A - Borehole Location - Surface and Subsurface Samples
⊡	Survey Area A - Borehole Location - Surface Samples Only
⊗	Survey Area B - Surface Sample Location
◎	Survey Area B - Borehole Location - Surface and Subsurface Samples
⊡	Survey Area B - Borehole Location - Surface Samples Only
▢	Survey Area A
▢	Survey Area B
▢	Claim Boundary

NOTE:
Sample Intervals (e.g 0 - 0.5) are in ft bgs.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

0 150 300
Feet

TITLE:
Surface and Subsurface Metals
and Ra-226 Analytical Results
Northwest Quadrant

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

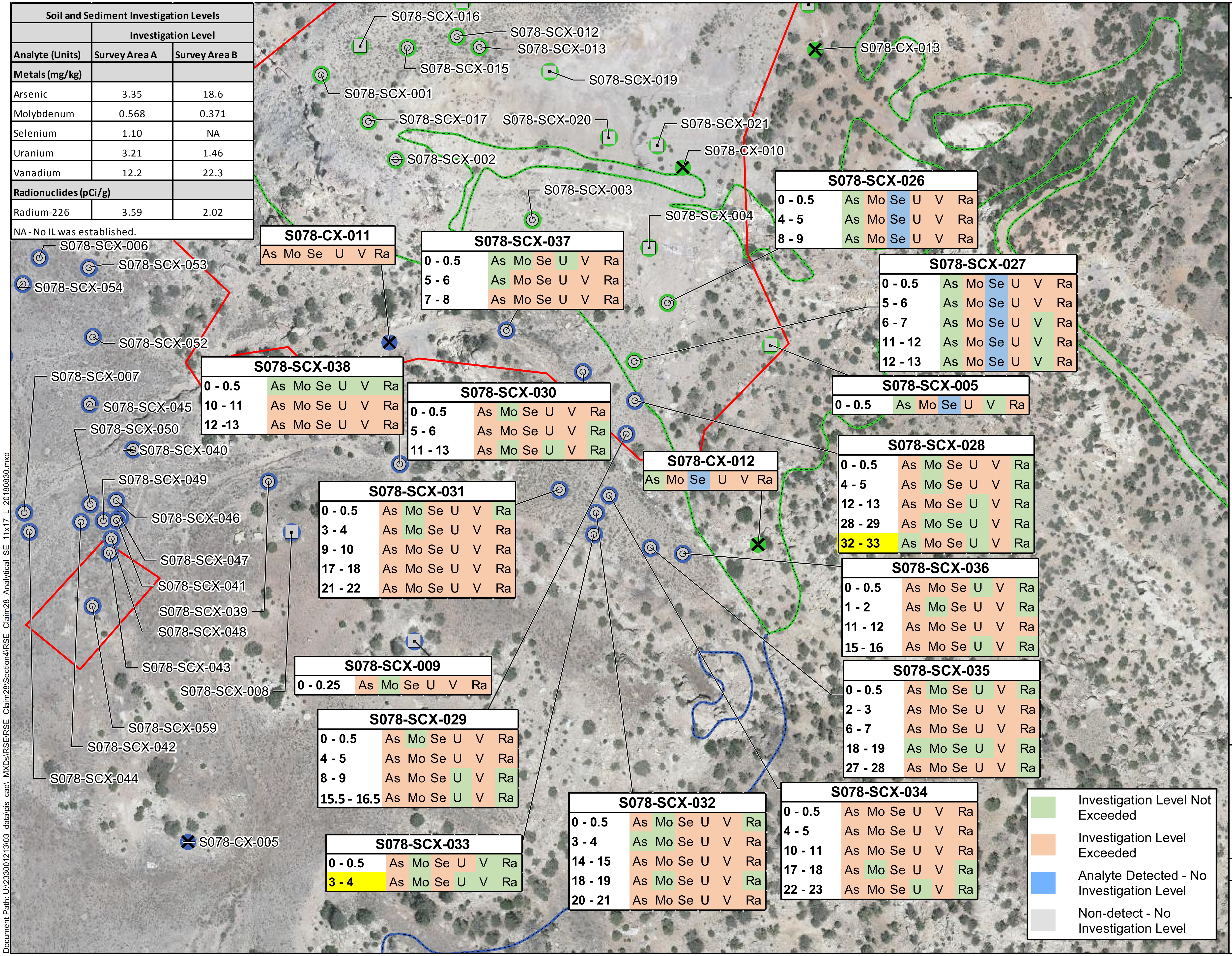
AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-3b

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Analytical_NW_11x17_L_20180830.mxd

Soil and Sediment Investigation Levels		
	Investigation Level	
Analyte (Units)	Survey Area A	Survey Area B
Metals (mg/kg)		
Arsenic	3.35	18.6
Molybdenum	0.568	0.371
Selenium	1.10	NA
Uranium	3.21	1.46
Vanadium	12.2	22.3
Radionuclides (pCi/g)		
Radium-226	3.59	2.02
NA - No IL was established.		



🟩	Investigation Level Not Exceeded
🟧	Investigation Level Exceeded
🟦	Analyte Detected - No Investigation Level
⬜	Non-detect - No Investigation Level

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

- Survey Area A - Surface Sample Location
- Survey Area A - Borehole Location - Surface and Subsurface Samples
- Survey Area A - Borehole Location - Surface Samples Only
- Survey Area B - Surface Sample Location
- Survey Area B - Borehole Location - Surface and Subsurface Samples
- Survey Area B - Borehole Location - Surface Samples Only
- Survey Area A
- Survey Area B
- Claim Boundary

NOTES:
Sample Intervals (e.g 0 - 0.5) are in ft bgs.

Highlighted sample intervals are partially or completely within bedrock.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

TITLE:
Surface and Subsurface Metals and Ra-226 Analytical Results Southeast Quadrant

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

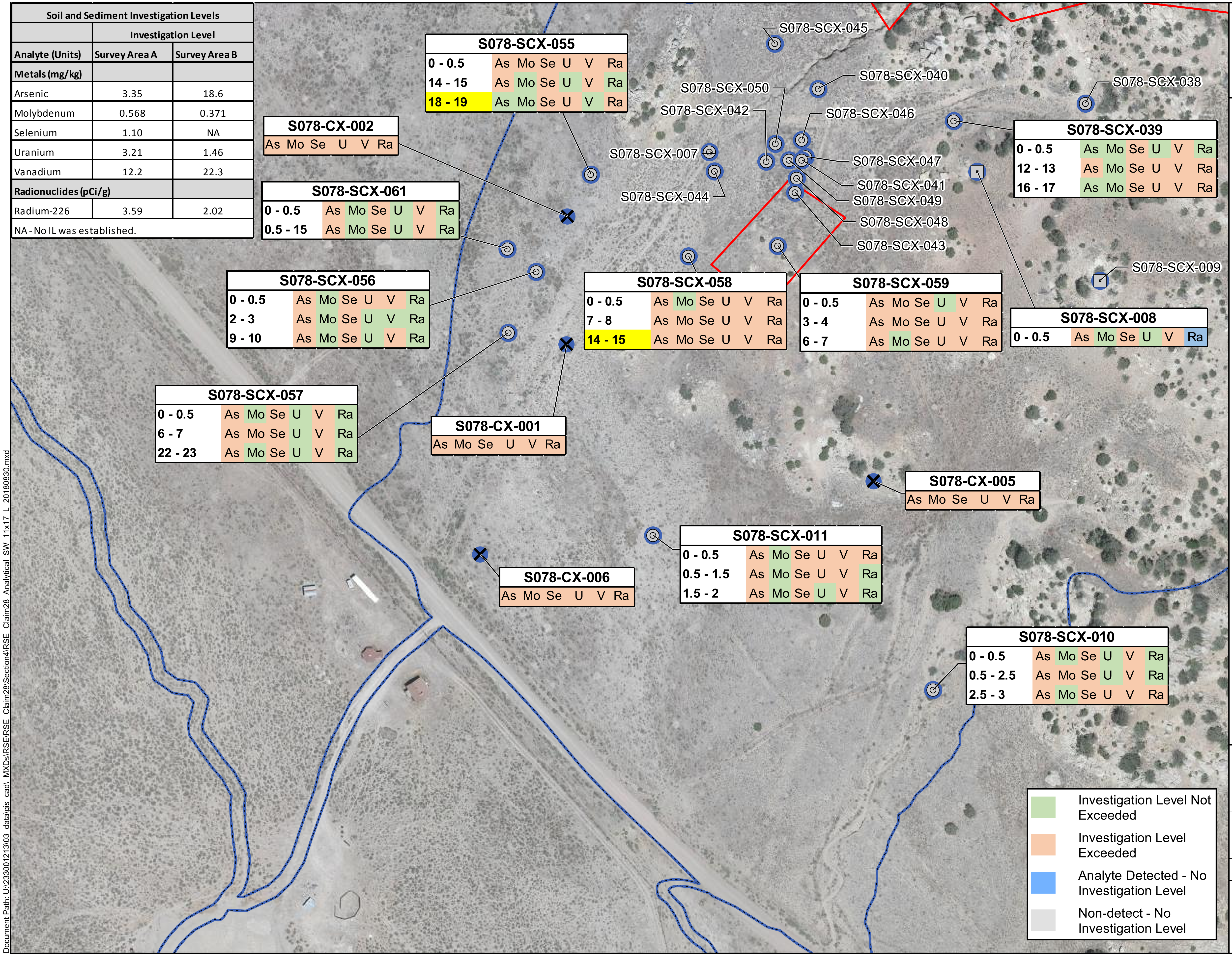
AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-3c

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Analytical_SE_11x17_L_20180830.mxd

Soil and Sediment Investigation Levels		
	Investigation Level	
Analyte (Units)	Survey Area A	Survey Area B
Metals (mg/kg)		
Arsenic	3.35	18.6
Molybdenum	0.568	0.371
Selenium	1.10	NA
Uranium	3.21	1.46
Vanadium	12.2	22.3
Radionuclides (pCi/g)		
Radium-226	3.59	2.02
NA - No IL was established.		



🟩	Investigation Level Not Exceeded
🟧	Investigation Level Exceeded
🟦	Analyte Detected - No Investigation Level
⬜	Non-detect - No Investigation Level

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

✖	Survey Area A - Surface Sample Location
◎	Survey Area A - Borehole Location - Surface and Subsurface Samples
▣	Survey Area A - Borehole Location - Surface Samples Only
▭	Survey Area A
▭	Claim Boundary

NOTES:
Sample Intervals (e.g 0 - 0.5) are in ft bgs.

Highlighted sample intervals are partially or completely within bedrock.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 150 300
Feet

TITLE:
Surface and Subsurface Metals and Ra-226 Analytical Results Southwest Quadrant

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS

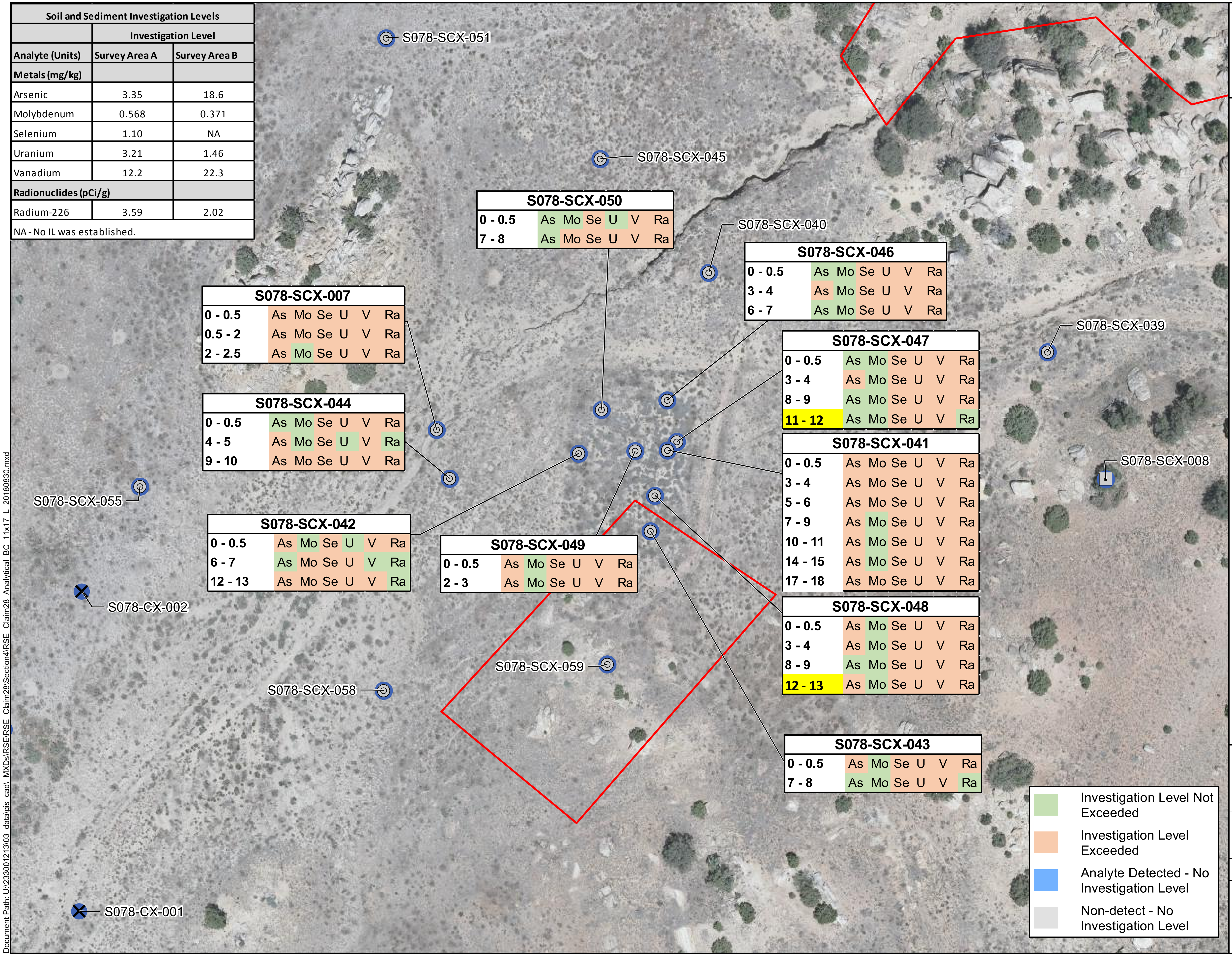
REVIEWER: CBB

FIGURE: 4-3d

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Analytical SW 11x17 L 20180830.mxd

Soil and Sediment Investigation Levels		
	Investigation Level	
Analyte (Units)	Survey Area A	Survey Area B
Metals (mg/kg)		
Arsenic	3.35	18.6
Molybdenum	0.568	0.371
Selenium	1.10	NA
Uranium	3.21	1.46
Vanadium	12.2	22.3
Radionuclides (pCi/g)		
Radium-226	3.59	2.02

NA - No IL was established.



S078-SCX-050

0 - 0.5	As	Mo	Se	U	V	Ra
7 - 8	As	Mo	Se	U	V	Ra

S078-SCX-046

0 - 0.5	As	Mo	Se	U	V	Ra
3 - 4	As	Mo	Se	U	V	Ra
6 - 7	As	Mo	Se	U	V	Ra

S078-SCX-007

0 - 0.5	As	Mo	Se	U	V	Ra
0.5 - 2	As	Mo	Se	U	V	Ra
2 - 2.5	As	Mo	Se	U	V	Ra

S078-SCX-047

0 - 0.5	As	Mo	Se	U	V	Ra
3 - 4	As	Mo	Se	U	V	Ra
8 - 9	As	Mo	Se	U	V	Ra
11 - 12	As	Mo	Se	U	V	Ra

S078-SCX-044

0 - 0.5	As	Mo	Se	U	V	Ra
4 - 5	As	Mo	Se	U	V	Ra
9 - 10	As	Mo	Se	U	V	Ra

S078-SCX-041

0 - 0.5	As	Mo	Se	U	V	Ra
3 - 4	As	Mo	Se	U	V	Ra
5 - 6	As	Mo	Se	U	V	Ra
7 - 9	As	Mo	Se	U	V	Ra
10 - 11	As	Mo	Se	U	V	Ra
14 - 15	As	Mo	Se	U	V	Ra
17 - 18	As	Mo	Se	U	V	Ra

S078-SCX-042

0 - 0.5	As	Mo	Se	U	V	Ra
6 - 7	As	Mo	Se	U	V	Ra
12 - 13	As	Mo	Se	U	V	Ra

S078-SCX-049

0 - 0.5	As	Mo	Se	U	V	Ra
2 - 3	As	Mo	Se	U	V	Ra

S078-SCX-048

0 - 0.5	As	Mo	Se	U	V	Ra
3 - 4	As	Mo	Se	U	V	Ra
8 - 9	As	Mo	Se	U	V	Ra
12 - 13	As	Mo	Se	U	V	Ra

S078-SCX-043

0 - 0.5	As	Mo	Se	U	V	Ra
7 - 8	As	Mo	Se	U	V	Ra

🟩	Investigation Level Not Exceeded
🟧	Investigation Level Exceeded
🟦	Analyte Detected - No Investigation Level
⬜	Non-detect - No Investigation Level

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Analytical BC 11x17 L 20180830.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✖	Survey Area A - Surface Sample Location
◎	Survey Area A - Borehole Location - Surface and Subsurface Samples
▣	Survey Area A - Borehole Location - Surface Samples Only
▢	Survey Area A
▢	Claim Boundary

NOTE:
Sample Intervals(e.g 0 - 0.5) are in ft bgs.

Highlighted sample intervals are partially or completely within bedrock.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 60 120
Feet

TITLE:
Surface and Subsurface Metals
and Ra-226 Analytical Results
Western Mine Waste Burial Pit

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/13/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-3e

NOTES:

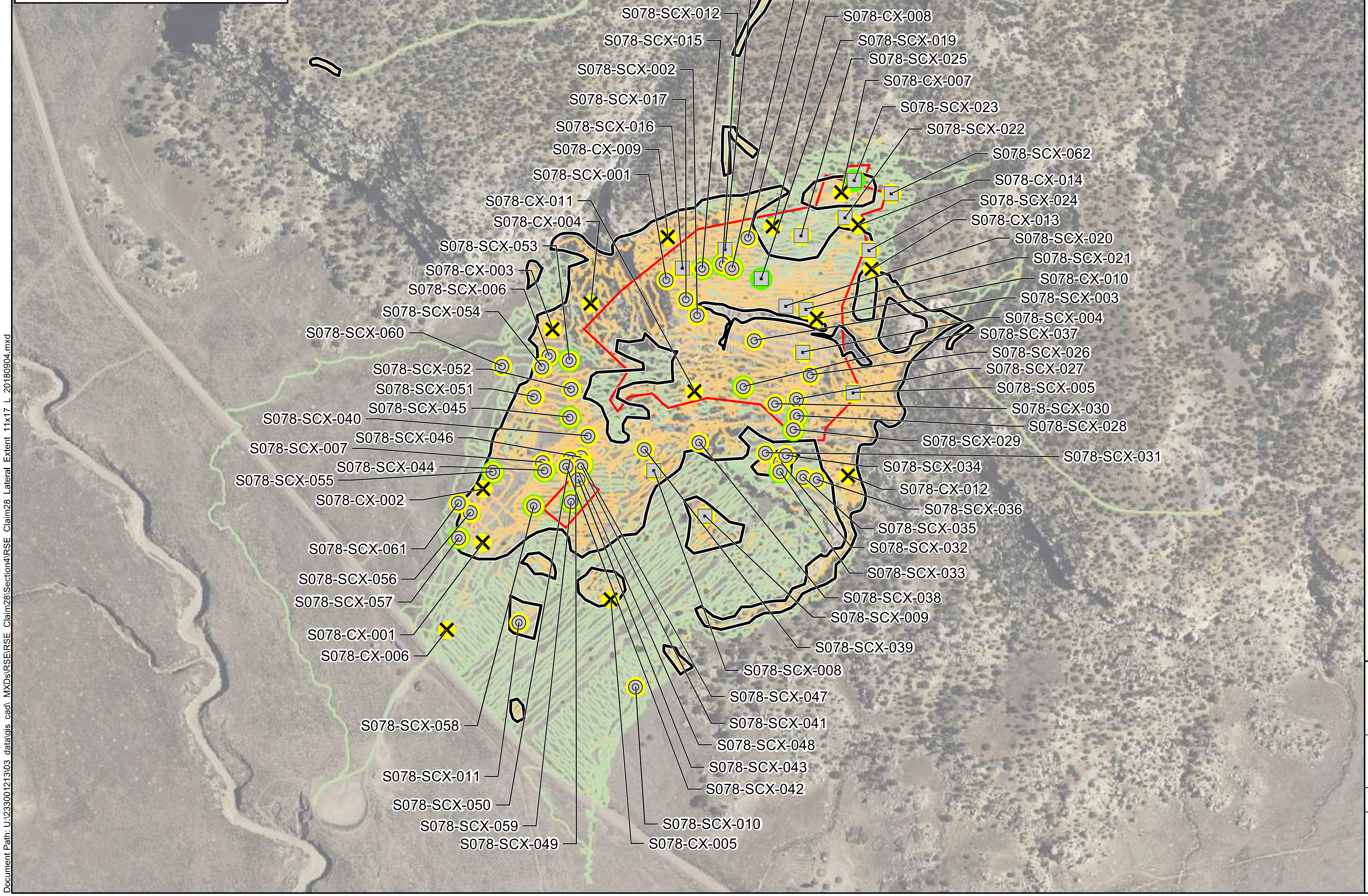
Refer to Figure 3-4 for Survey Area delineation.

A subsurface static gamma IL was not established for Survey Area B.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

- ✕ Surface Sample Location
- ◎ Borehole Location - Surface and Subsurface Samples
- ▣ Borehole Location - Surface Samples Only
- ● IL Exceedance in Unconsolidated Material at Location
- ● IL Exceedance in Bedrock in Borehole
- ▢ Approximate Area where Surface Gamma IL is Exceeded (35.3 acres)
- 🟥 Claim Boundary

Gamma Survey

Count per Minute (CPM)

IL Not Exceeded
- ● Survey Area A: 5,437 - 20,677
  Survey Area B: 7,869 - 14,707

IL Exceeded
- ● Survey Area A: 20,678 - 115,935
  Survey Area B: 14,708 - 301,035

N
W E
S

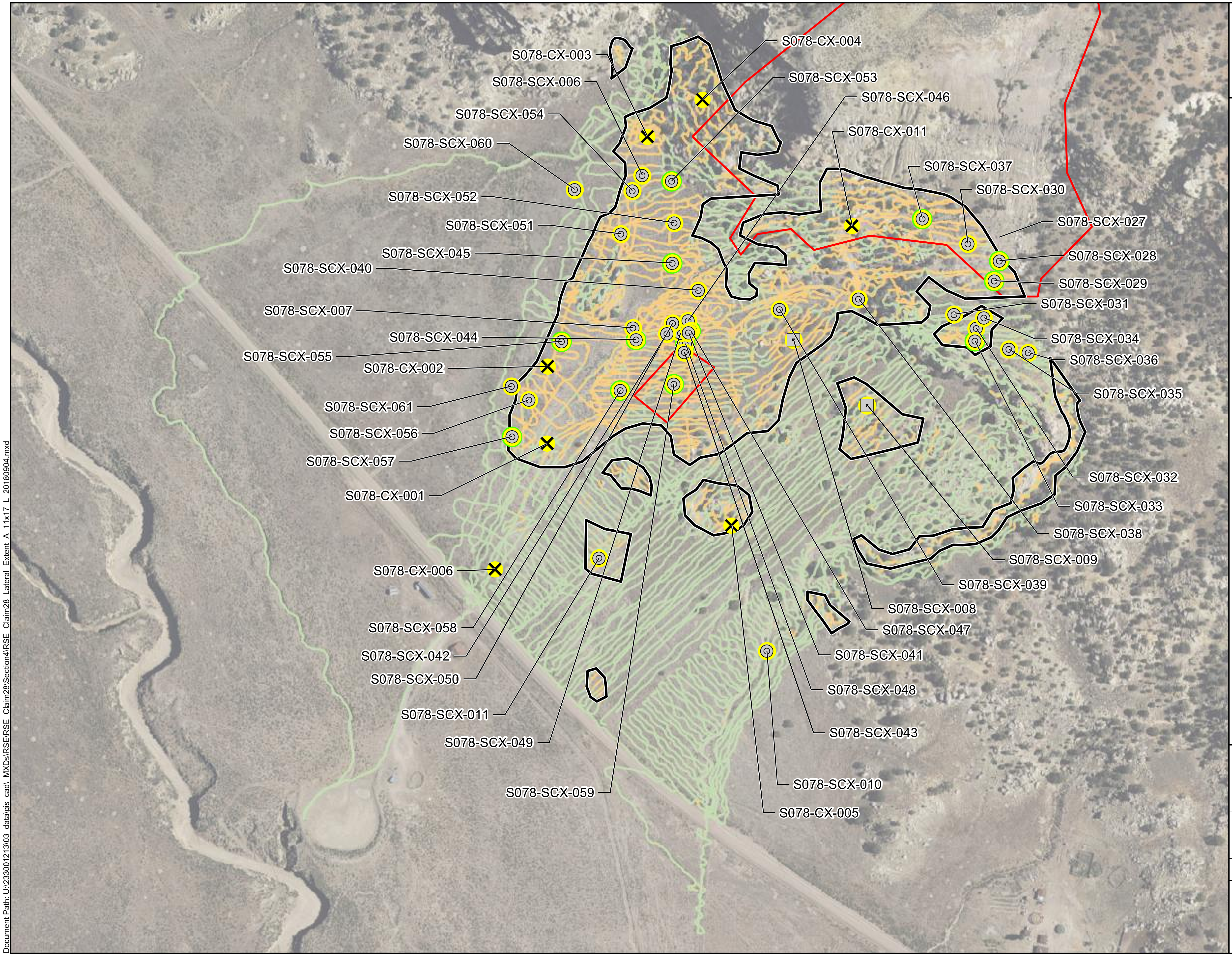
0 400 800
Feet

TITLE:
Lateral Extent of Surface and Subsurface IL Exceedances

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018	DOCUMENT NAME: Removal Site Evaluation Report	
Stantec	AUTHOR: AJS	REVIEWER: CBB
	FIGURE: 4-4a	

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Lateral Extent 11x17 L 20180904.mxd



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
●	IL Exceedance in Unconsolidated Material at Location
●	IL Exceedance in Bedrock in Borehole
▢	Approximate Area where Surface Gamma IL is Exceeded (18.3 acres)
▢	Claim Boundary

Gamma Survey

Count per Minute (CPM)

●	5,437 - 20,677 (IL Not Exceeded)
●	20,678 - 115,935 (IL Exceeded)

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

N
W E
S

0 250 500
Feet

TITLE:
Survey Area A
Lateral Extent of Surface and
Subsurface IL Exceedances

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS

REVIEWER: CBB

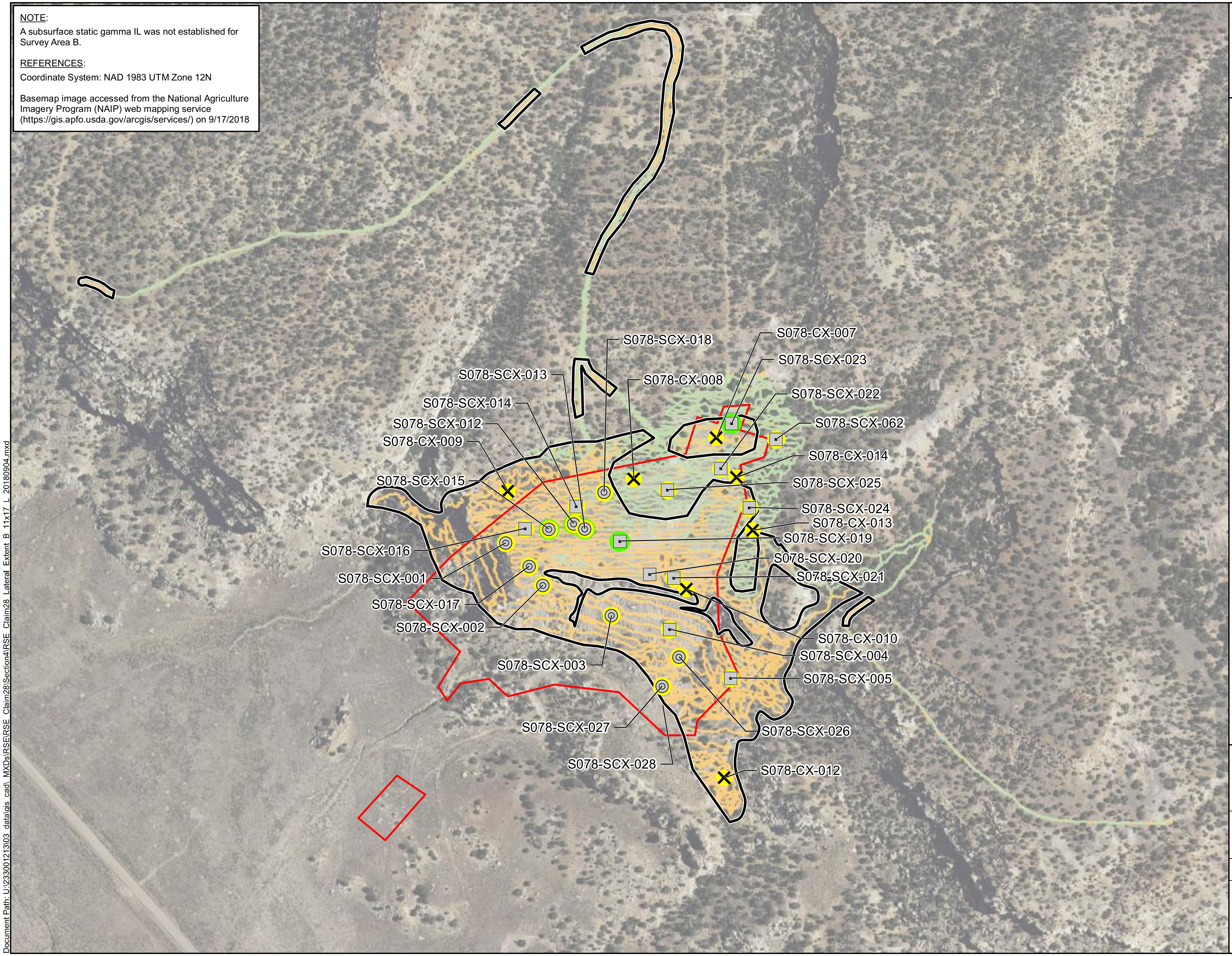
FIGURE: 4-4b

Document Path: U:\2330012103\03 data\gis cad\MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Lateral Extent A 11x17 L 20180904.mxd

NOTE:
A subsurface static gamma IL was not established for Survey Area B.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

- ✕ Surface Sample Location
- ◎ Borehole Location - Surface and Subsurface Samples
- ▣ Borehole Location - Surface Samples Only
- ● IL Exceedance in Unconsolidated Material at Location
- ● IL Exceedance in Bedrock in Borehole
- ▭ Approximate Area where Surface Gamma IL is Exceeded (17.0 acres)
- ▭ Claim Boundary

Gamma Survey

Count per Minute (CPM)

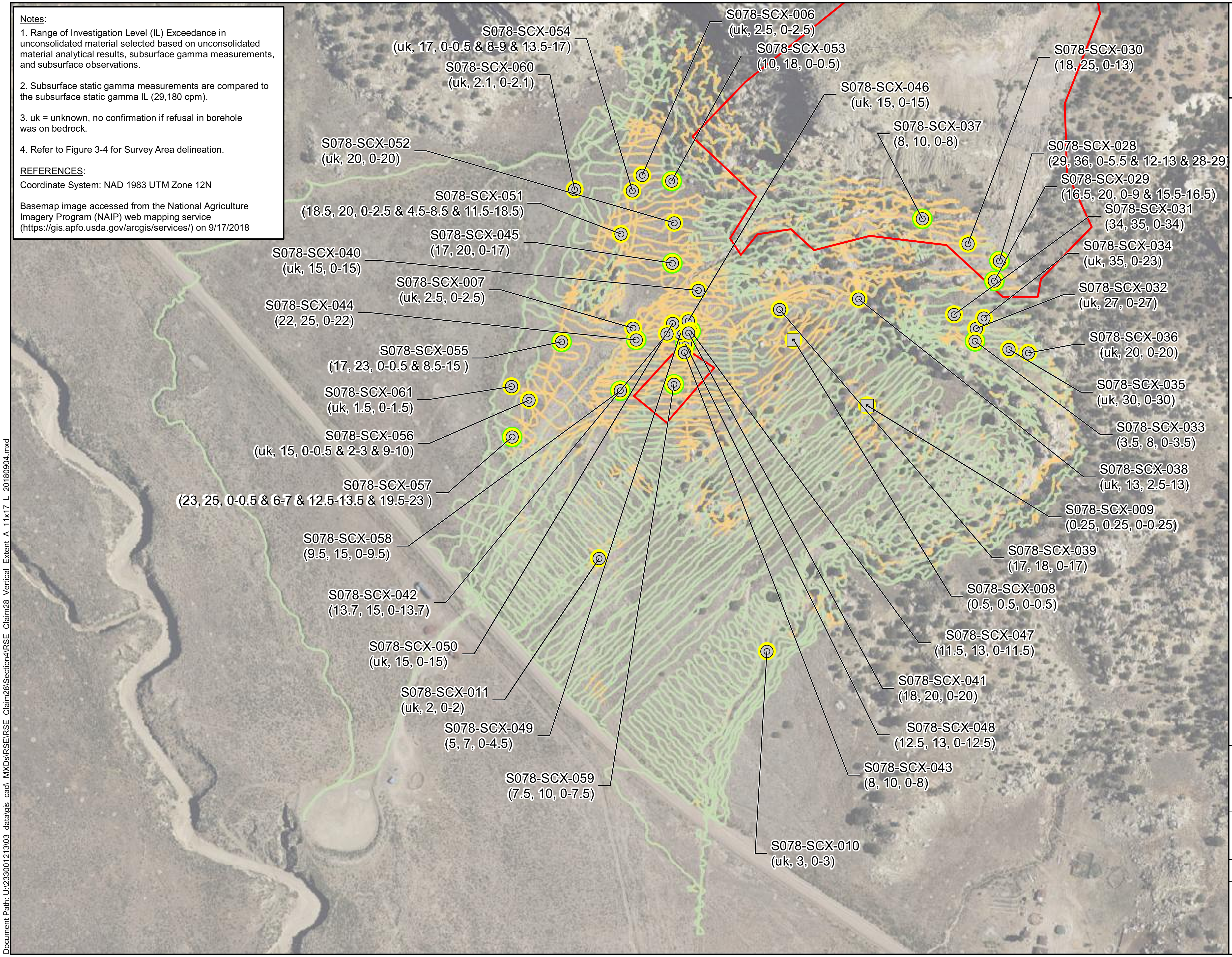
- ● 7,869 - 14,707 (IL Not Exceeded)
- ● 14,708 - 301,035 (IL Exceeded)

TITLE:
Survey Area B
Lateral Extent of Surface and Subsurface IL Exceedances

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018	DOCUMENT NAME: Removal Site Evaluation Report
Stantec	AUTHOR: AJS REVIEWER: CBB
	FIGURE: 4-4c

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Lateral Extent B 11x17 L 20180904.mxd



Notes:

1. Range of Investigation Level (IL) Exceedance in unconsolidated material selected based on unconsolidated material analytical results, subsurface gamma measurements, and subsurface observations.

2. Subsurface static gamma measurements are compared to the subsurface static gamma IL (29,180 cpm).

3. uk = unknown, no confirmation if refusal in borehole was on bedrock.

4. Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

◎ Borehole Surface and Subsurface Sample Location (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material ^{1})

▪ Borehole Location - Surface Samples Only (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material ^{1})

● IL Exceedance in Unconsolidated Material at Location

● IL Exceedance in Bedrock in Borehole

🟥 Claim Boundary

Gamma Survey

Count per Minute (CPM)

● 5,437 - 20,677 (IL Not Exceeded)

● 20,678 - 115,935 (IL Exceeded)

N
W E
S

0 250 500
Feet

TITLE:
Vertical Extent of IL Exceedances in Unconsolidated Material for Survey Area A

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: AJS

REVIEWER: CBB

Stantec

FIGURE: 4-5a

Notes:

1. Range of Investigation Level (IL) Exceedance in unconsolidated material selected based on unconsolidated material analytical results and subsurface observations.

2. A subsurface static gamma IL was not established for Survey Area B.

3. uk = unknown, no confirmation if refusal in borehole was on bedrock.

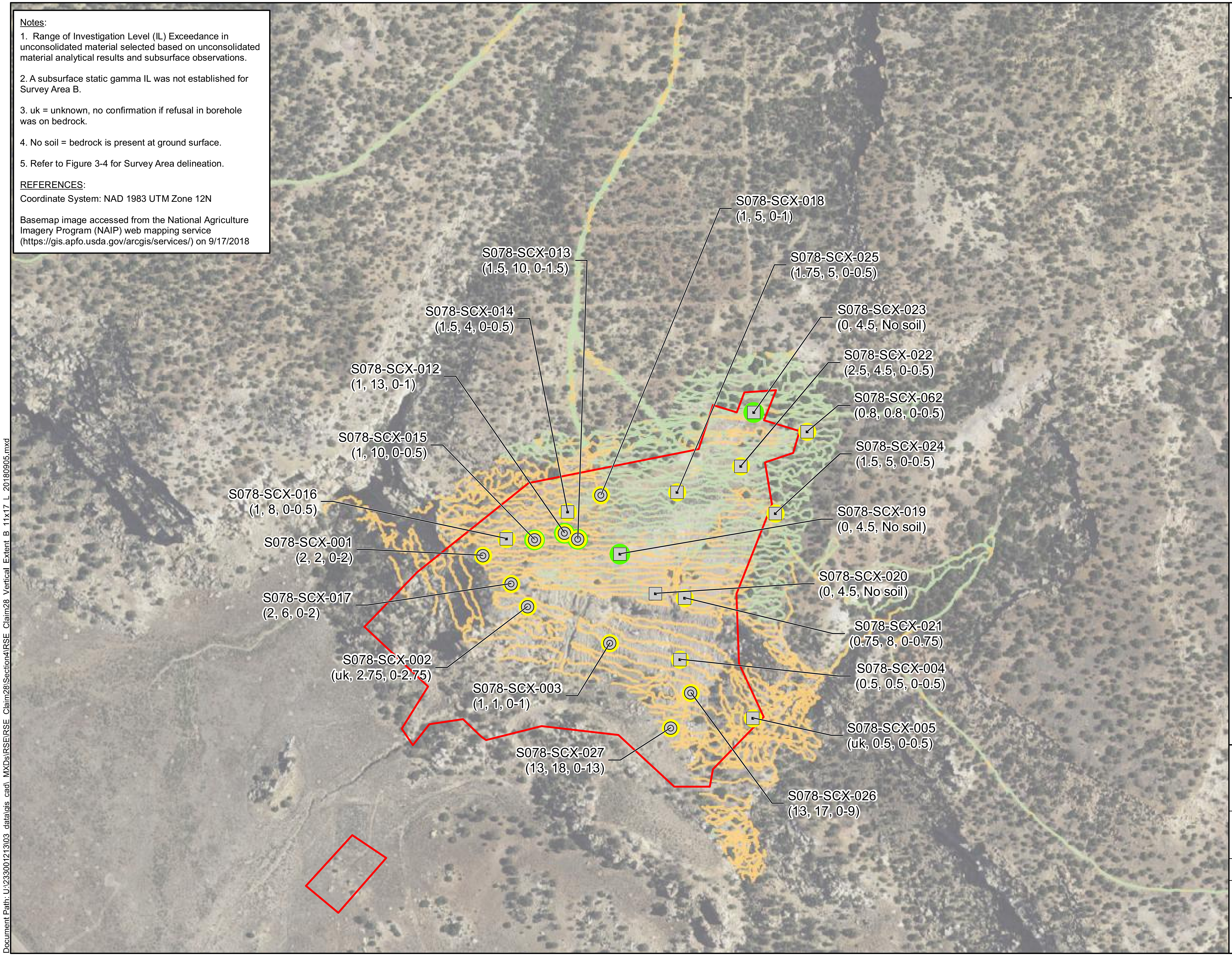
4. No soil = bedrock is present at ground surface.

5. Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Vertical Extent B 11x17 L 20180905.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

◎	Borehole Surface and/or Subsurface Sample Loction (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material [1])
▣	Borehole Location - Surface Samples Only (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material [1])
●	IL Exceedance in Unconsolidated Material at Location
●	IL Exceedance in Bedrock in Borehole
🟥	Claim Boundary

Gamma Survey

Count per Minute (CPM)

●	7,869 - 14,707 (IL Not Exceeded)
●	14,708 - 301,035 (IL Exceeded)

N
W E
S

0 250 500
Feet

TITLE:
Vertical Extent of IL Exceedances in Unconsolidated Material for Survey Area B

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

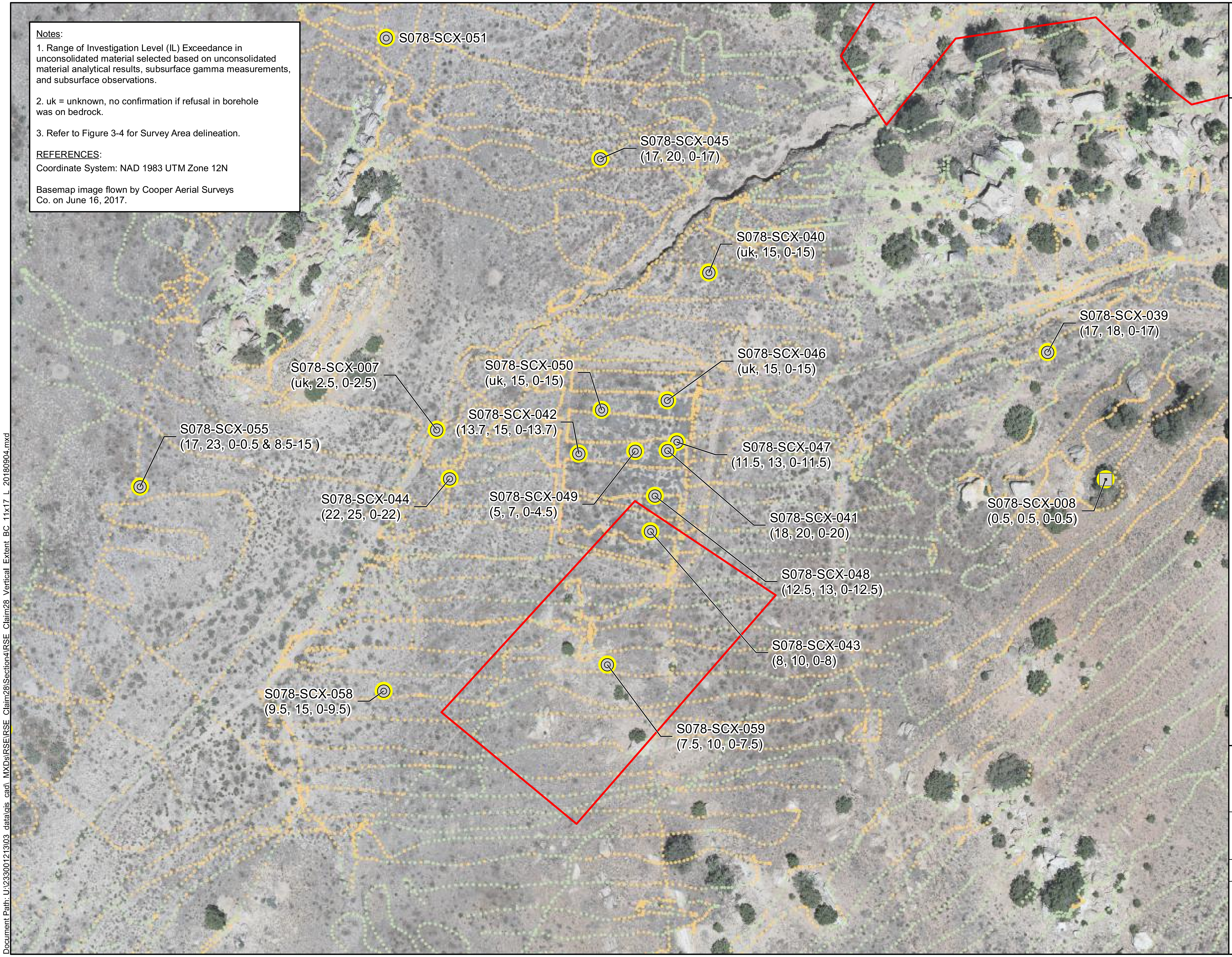
DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-5b



Notes:

1. Range of Investigation Level (IL) Exceedance in unconsolidated material selected based on unconsolidated material analytical results, subsurface gamma measurements, and subsurface observations.

2. uk = unknown, no confirmation if refusal in borehole was on bedrock.

3. Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

◎	Borehole Surface and Subsurface Sample Location (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material [1])
▣	Borehole Location - Surface Samples Only (Depth of Bedrock, Borehole Depth, Depth Range of IL Exceedance in Unconsolidated Material [1])
●	IL Exceedance in Unconsolidated Material at Location
🟥	Claim Boundary

Gamma Survey

Count per Minute (CPM)

●	5,437 - 20,677 (IL Not Exceeded)
●	20,678 - 115,935 (IL Exceeded)

TITLE:

Vertical Extent of IL Exceedances in Unconsolidated Material for Western Mine Waste Burial Pit

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: AJS

REVIEWER: CBB

Stantec

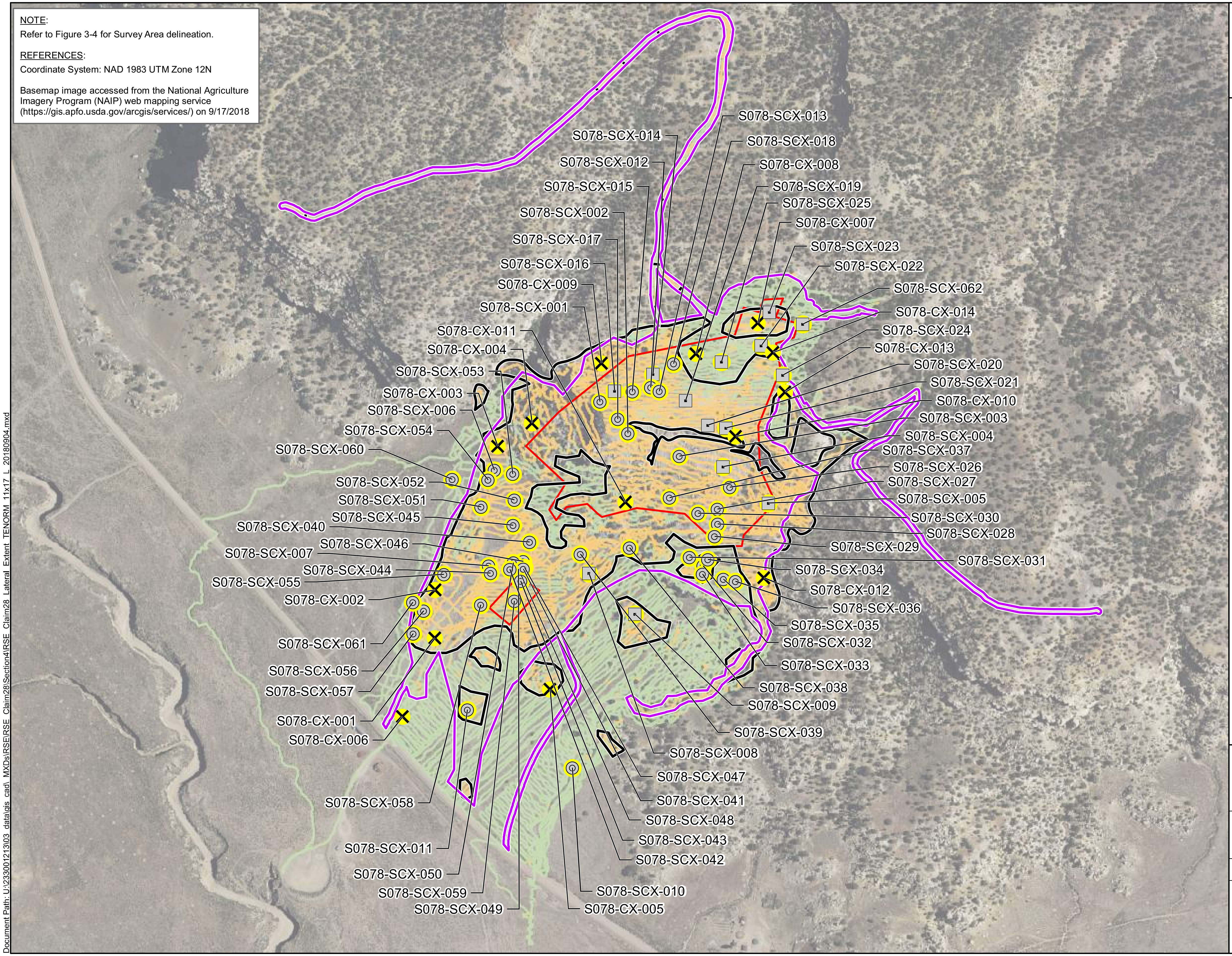
FIGURE: 4-5c

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Vertical Extent BC 11x17 L 20180904.mxd

NOTE:
Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



NAVAJO NATION
AUM Environmental Response Trust-First Phase

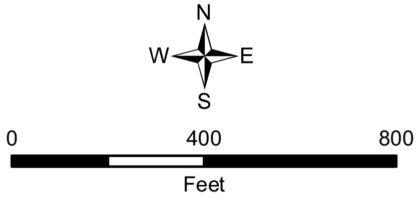
LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
●	IL Exceedance in Unconsolidated Material at Location
▭	TENORM (44.7 acres)
▭	Approximate Area where Surface Gamma IL is Exceeded (35.3 acres)
▭	Claim Boundary

Gamma Survey

Count per Minute (CPM)

●	IL Not Exceeded Survey Area A: 5,437 - 20,677 Survey Area B: 7,869 - 14,707
●	IL Exceeded Survey Area A: 20,678 - 115,935 Survey Area B: 14,708 - 301,035



TITLE:
TENORM Compared to Lateral Extent of IL Exceedances

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

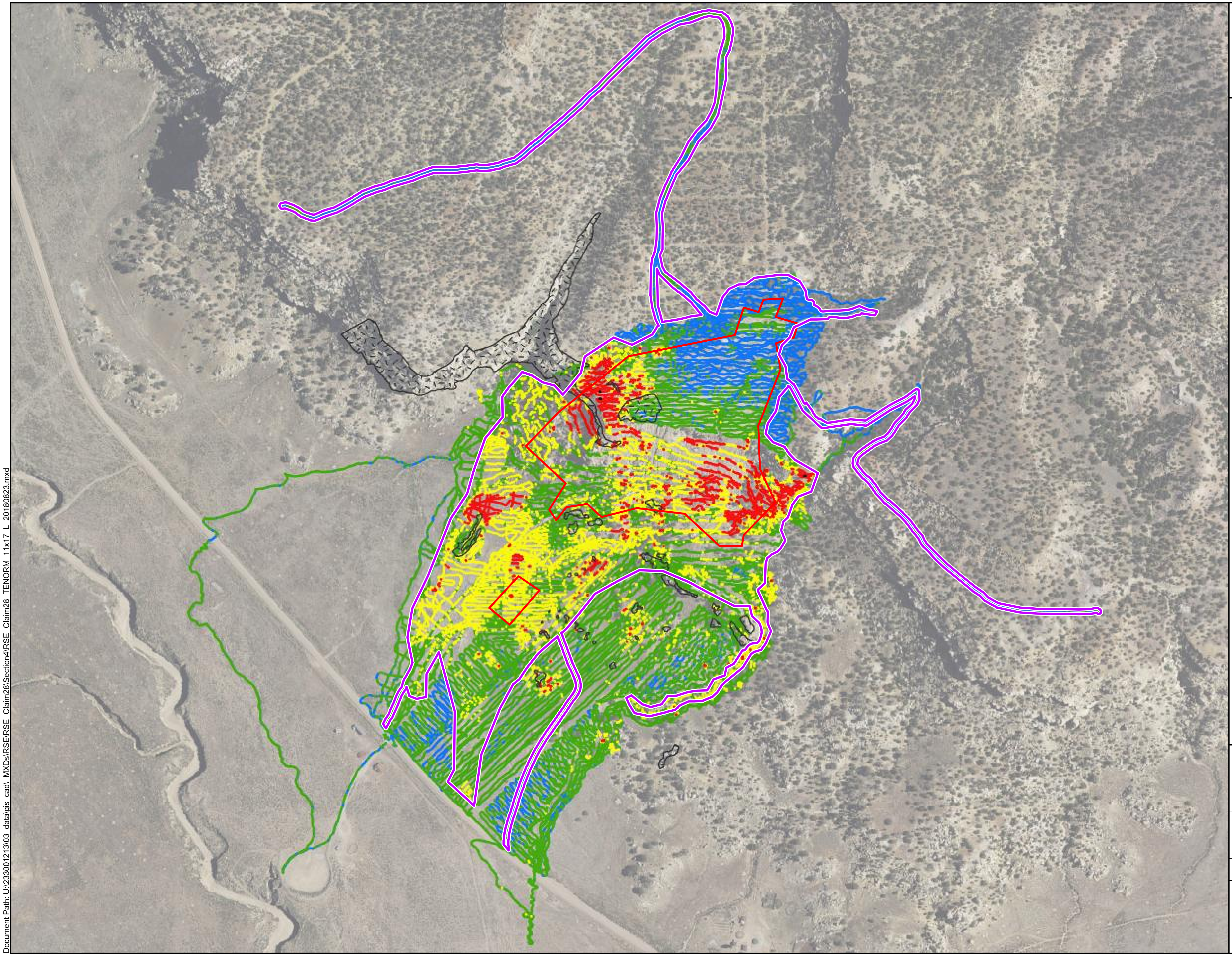
AUTHOR: AJS

REVIEWER: AJS

Stantec

FIGURE: 4-6

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Lateral_Extent_TENORM_11x17_L_20180904.mxd



NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

⬭	TENORM (44.7 acres)
▨	Exposed Bedrock[1]
🟥	Claim Boundary

Gamma Survey

Counts per Minute (CPM)

●	5,437 - 14,707 (Minimum to BG-2 IL)
●	14,708 - 20,677 (>BG-2 IL to BG-1 IL)
●	20,678 - 29,414 (>BG-1 IL to 2x BG-2 IL)
●	29,415 - 147,070 (>2x BG-2 IL to 10x BG-2 IL)
●	147,071 - 301,035 (10x BG-2 IL to Maximum)

NOTE:

1. Portions of the areas delineated as exposed bedrock contain small amounts of colluvium.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/14/2018

N
W E
S

0 400 800
Feet

TITLE:

TENORM Compared to Gamma Radiation Survey Results

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/14/2018

DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: 4-7

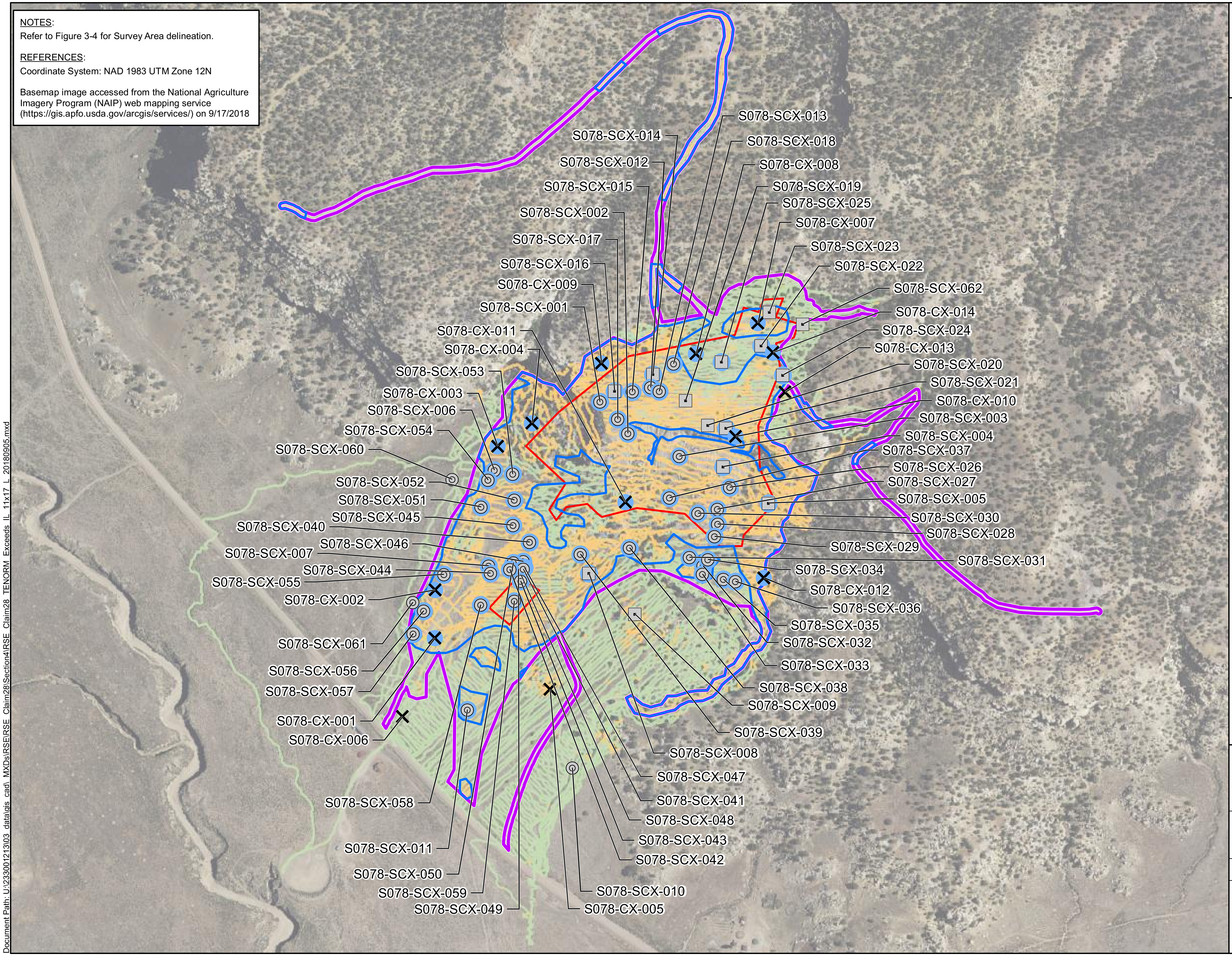
Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 TENORM 11x17 L 20180823.mxd

NAVAJO
NATION
AUM Environmental
Response Trust-First Phase

<u>NOTES</u>:
Refer to Figure 3-4 for Survey Area delineation.

<u>REFERENCES</u>:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



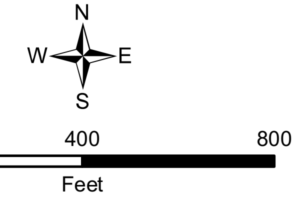
LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
●	TENORM Exceeding IL in Unconsolidated Material at Location
▢	TENORM Area Exceeding Surface Gamma ILs (31.7 acres)
▢	TENORM (44.7 acres)
▢	Claim Boundary

<u>Gamma Survey</u>

Count per Minute (CPM)

	IL Not Exceeded
●	Survey Area A: 5,437 - 20,677 Survey Area B: 7,869 - 14,707
	IL Exceeded
●	Survey Area A: 20,678 - 115,935 Survey Area B: 14,708 - 301,035



TITLE:
TENORM that Exceed ILs

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-8a

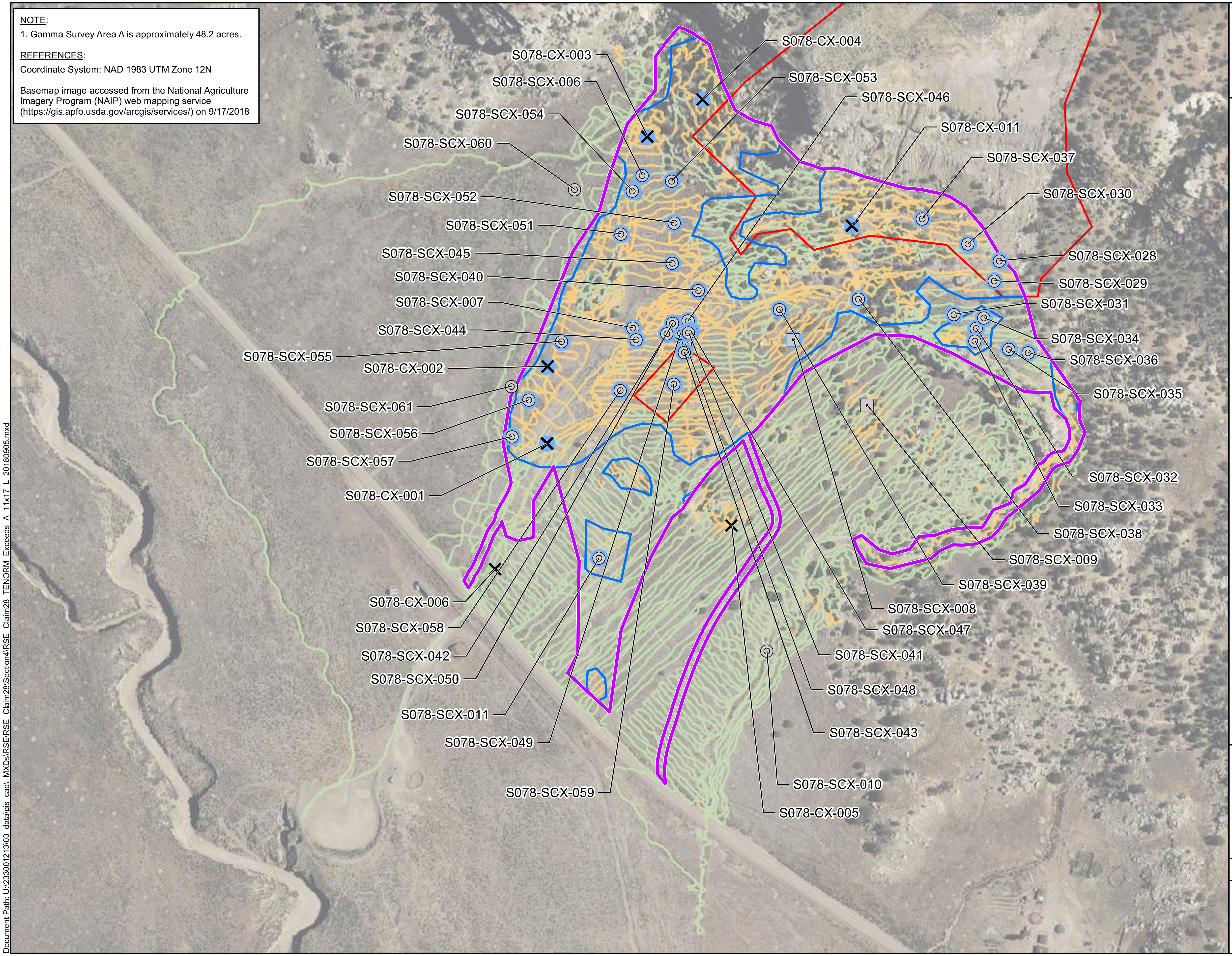
Stantec

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 TENORM Exceeds IL 11x17 L 20180905.mxd

NOTE:
1. Gamma Survey Area A is approximately 48.2 acres.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

✕ Surface Sample Location
◎ Borehole Location - Surface and Subsurface Samples
▣ Borehole Location - Surface Samples Only
● TENORM Exceeding IL in Unconsolidated Material at Location
▢ TENORM Area Exceeding Surface Gamma ILs (16.8 acres)
▢ Area of Survey Area A that is TENORM (23.8 acres)
▢ Claim Boundary

Gamma Survey
Count per Minute (CPM)
● 5,437 - 20,677 (IL Not Exceeded)
● 20,678 - 115,935 (IL Exceeded)

N W E S

0 250 500
Feet

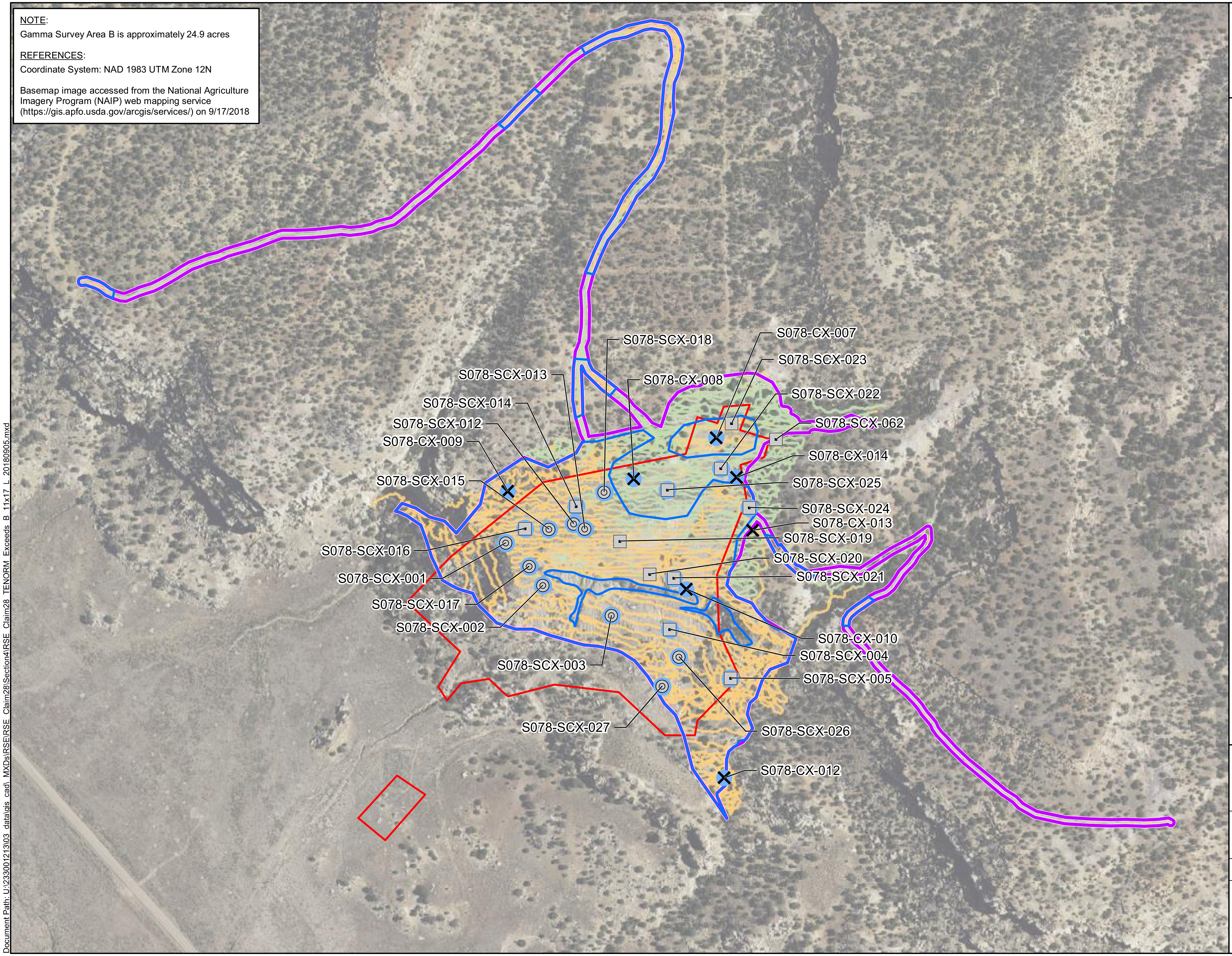
TITLE:
Survey Area A
TENORM that Exceeds ILs

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018
DOCUMENT NAME: Removal Site Evaluation Report
AUTHOR: AJS
REVIEWER: CBB
FIGURE: 4-8b

Stantec

Document Path: U:\233001213\03_data\gis_cad\MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_TENORM_Exceeds_A_11x17_L_20180905.mxd



NOTE:
Gamma Survey Area B is approximately 24.9 acres

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

✕	Surface Sample Location
◎	Borehole Location - Surface and Subsurface Samples
▣	Borehole Location - Surface Samples Only
●	TENORM Exceeding IL in Unconsolidated Material at Location
▢	TENORM Area Exceeding Surface Gamma ILs (14.9 acres)
▢	Area of Survey Area B that is TENORM (20.9 acres)
▢	Claim Boundary

Gamma Survey

Count per Minute (CPM)

●	7,869 - 14,707 (IL Not Exceeded)
●	14,708 - 301,035 (IL Exceeded)

TITLE:
Survey Area B
TENORM that Exceeds ILs

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: AJS

REVIEWER: CBB

Stantec

FIGURE: 4-8c

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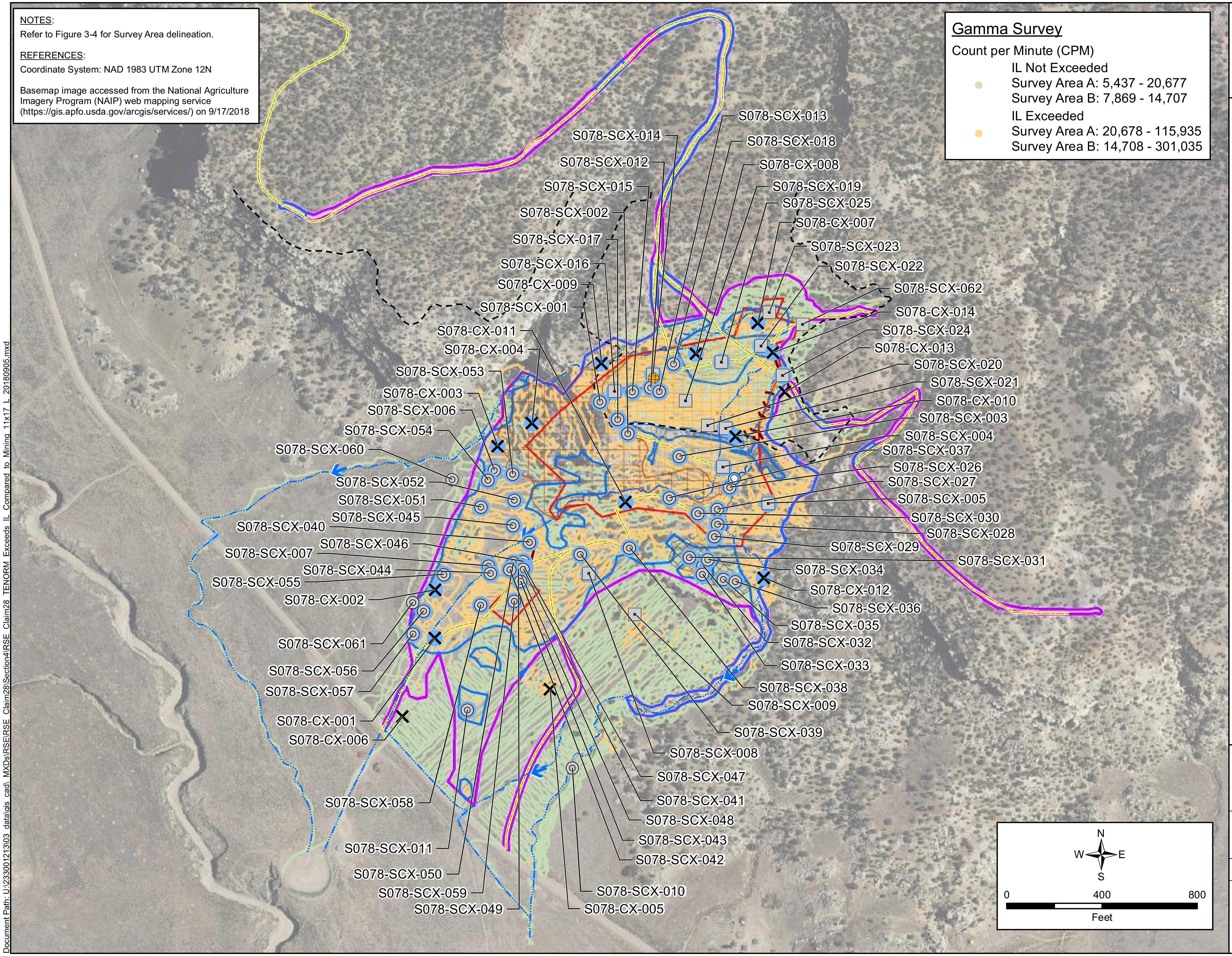


NOTES:
Refer to Figure 3-4 for Survey Area delineation.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/17/2018

Gamma Survey
Count per Minute (CPM)
● IL Not Exceeded
Survey Area A: 5,437 - 20,677
Survey Area B: 7,869 - 14,707
● IL Exceeded
Survey Area A: 20,678 - 115,935
Survey Area B: 14,708 - 301,035

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

- ✕ Surface Sample Location
- ◎ Borehole Location - Surface and Subsurface Samples
- ▣ Borehole Location - Surface Samples Only
- ● TENORM Exceeding IL in Unconsolidated Material at Location
- ⊕ Approximate Location of Historical Pit
- Seep
- ↑ Flow Direction
- Approximate Edge of Mesa
- Berm
- Culvert
- Drainage
- Potential Haul Road
- ▨ Mine Waste Burial Pit
- ⊞ Potential Mine Waste Material
- ⊞ Mining / Reclaimed Disturbed
- ▢ TENORM Area Exceeding Surface Gamma ILs (31.7 acres)
- TENORM (44.7 acres)
- Claim Boundary

TITLE:
TENORM that Exceeds ILs Compared to Mining Related Features

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/17/2018

DOCUMENT NAME: Removal Site Evaluation Report

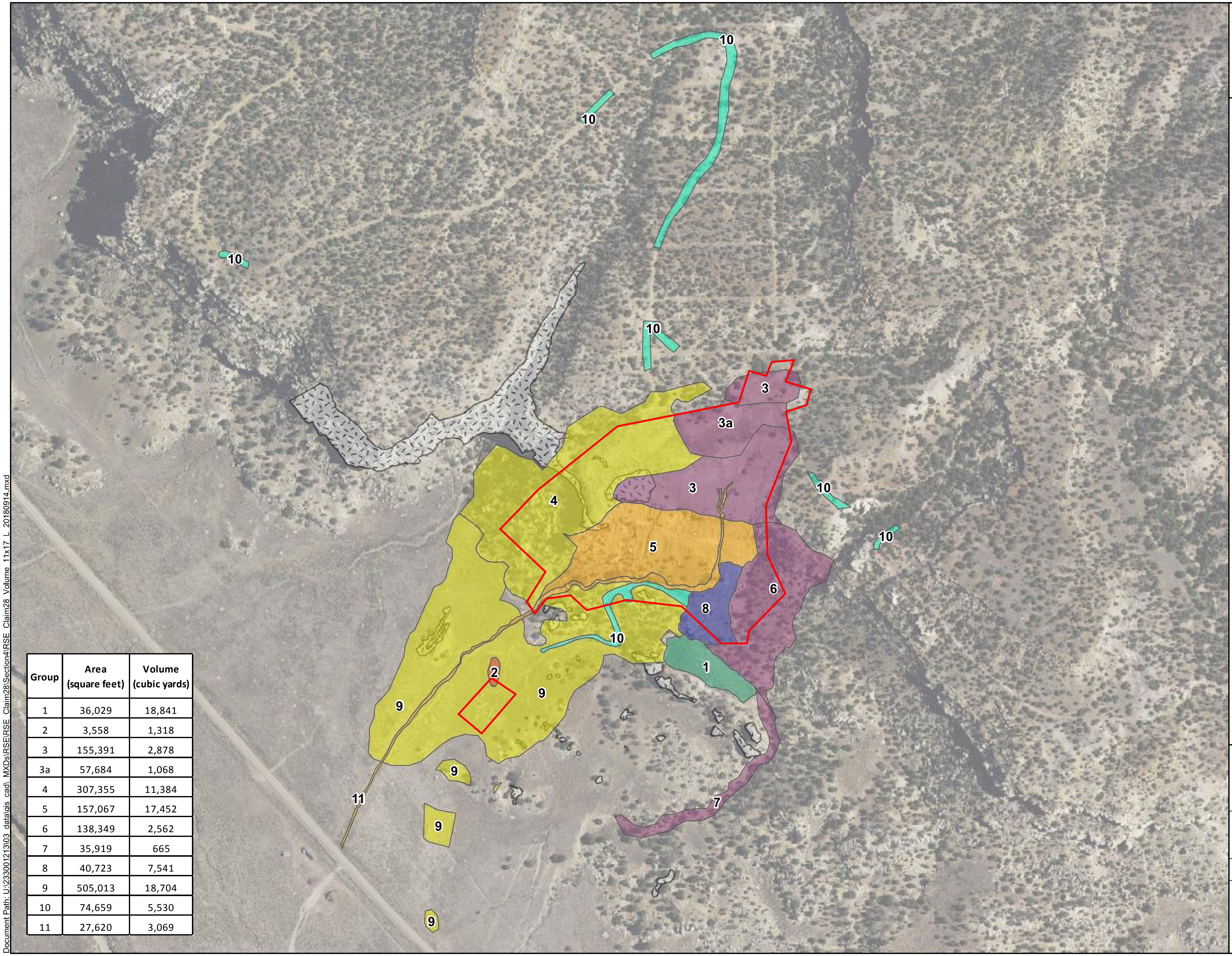
Stantec

AUTHOR: AJS

REVIEWER: CBB

FIGURE: 4-8d

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 TENORM Exceeds IL Compared to Mining 11x17 L 20180905.mxd



Group	Area (square feet)	Volume (cubic yards)
1	36,029	18,841
2	3,558	1,318
3	155,391	2,878
3a	57,684	1,068
4	307,355	11,384
5	157,067	17,452
6	138,349	2,562
7	35,919	665
8	40,723	7,541
9	505,013	18,704
10	74,659	5,530
11	27,620	3,069

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\Section4\RSE Claim28 Volume 11x17 L 20180914.mxd

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

🟥	Claim Boundary
▨	Exposed Bedrock[1]

Average Depth by Group (feet below ground surface)

🟩	Variable[2] - Group 1
🟪	0.5 ft - Groups 3, 3a[3], 6, 7
🟨	1.0 ft - Groups 4, 9
🟩	2.0 ft - Group 10
🟧	3.0 ft - Groups 5, 11
🟦	5.0 ft - Group 8
🟧	10.0 ft - Group 2

NOTES:

1. Portions of the areas delineated as exposed bedrock contain small amounts of colluvium.

2. See Figure 4-9b

3. Group 3a included based on IL exceedance at sample locations.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/14/2018

N
W E
S

0 350 700
Feet

TITLE:
Volume Estimate of
TENORM that Exceeds ILs

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/14/2018

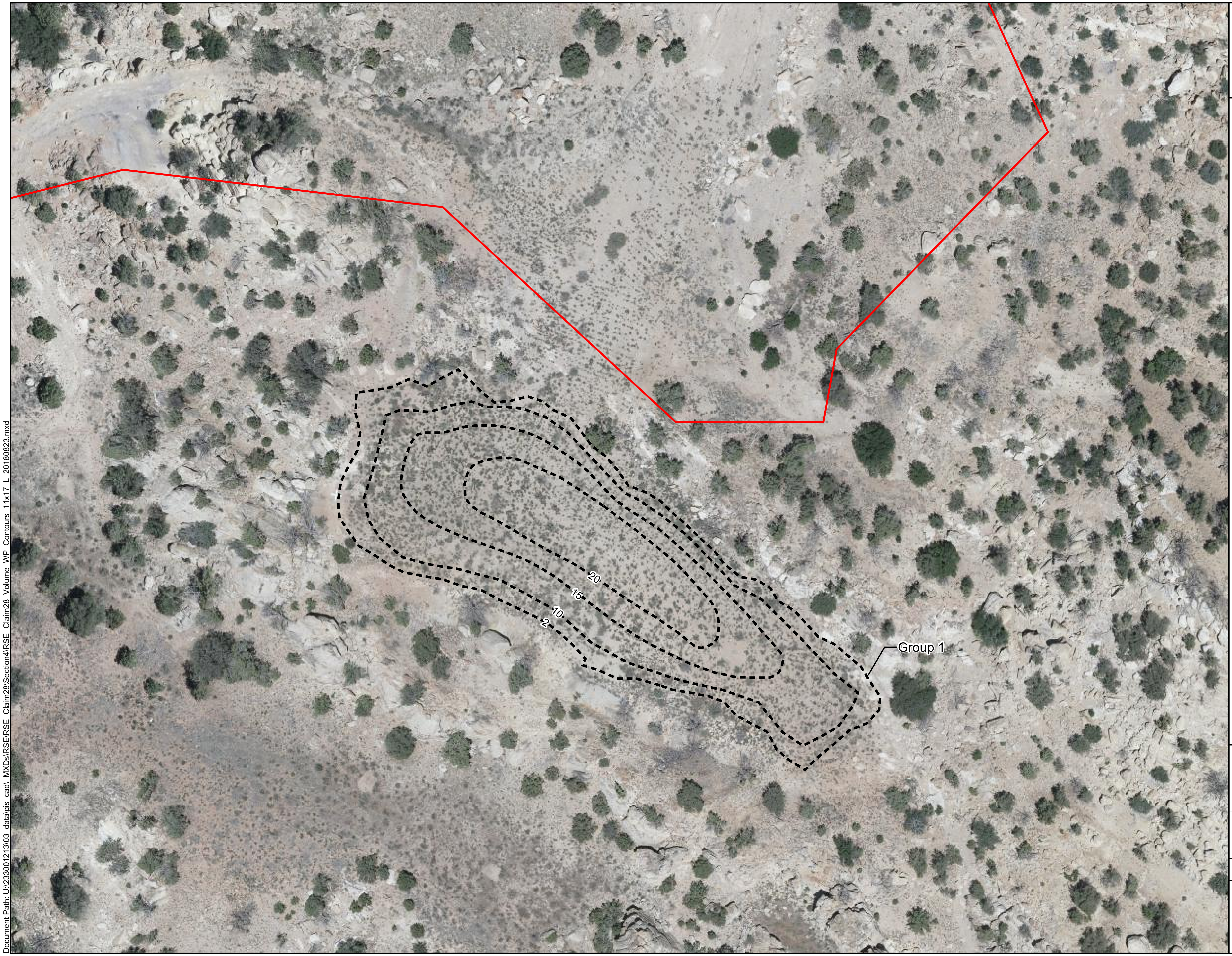
DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: EDZ

REVIEWER: CBB

FIGURE: 4-9a



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

- - - Approximate Burial Pit Contour (thickness in feet)

▭ Claim Boundary

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 60 120
Feet

TITLE:

Group 1 Contours for Volume Estimates

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/23/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: EDZ

REVIEWER: CBB

FIGURE: 4-9b

Stantec

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\Section4\RSE_Claim28_Volume_WP_Contours_11x17_L_20180823.mxd

APPENDICES

Appendix A Subcontractor Reports

A.1 Radiological Characterization of the Claim 28 Abandoned Uranium Mine

A.2 Geophysical Characterization of the Navajo Nation Claim 28 Site

Radiological Characterization of the Claim 28 Abandoned Uranium Mine

September 16, 2018

prepared for:

Stantec Consulting Services Inc.

2130 Resort Drive, Suite 350
Steamboat Springs, CO 80487

prepared by:

ERG

Environmental Restoration Group, Inc.

8809 Washington St. NE
Suite 150
Albuquerque, NM 87113

Contents

Tables

Figures

Appendices

Acronyms

ANSI	American National Standards Institute
AUM	abandoned uranium mine
BG1	Background Reference Area 1
BG2	Background Reference Area 2
cpm	counts per minute
DQOs	data quality objectives
ERG	Environmental Restoration Group, Inc.
ft	foot
GPS	global positioning system
m	meter
MDL	method detection limit
µR/h	microRoentgens per hour
pCi/g	picocuries per gram
R^2	Pearson's Correlation Coefficient
RSE	removal site evaluation
σ	standard deviation
Stantec	Stantec Consulting Services Inc.

Executive Summary

This report addresses the radiological characterization of the Claim 28 abandoned uranium mine (AUM) located in the Tahchee/Blue Gap Chapter of the Navajo Nation near Tachee, Arizona. It documents part of the implementation of the Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan (RSE Work Plan: MWH, 2016). The work was performed by Environmental Restoration Group, Inc. (ERG) of Albuquerque, New Mexico and Stantec Consulting Services Inc. (Stantec) on behalf of the Navajo Nation AUM Environmental Response Trust – First Phase.

This report provides 1) the results of a Global Positioning System (GPS)-based gamma radiation (gamma) survey, 2) comparisons of the gamma count rates at this AUM to exposure rates and concentrations of radium-226 in surface soils, and 3) an assessment of equilibrium in the uranium series. The field activities addressed in this report were conducted on May 5, November 5, 7, 8, 10, and 11, 2016; and March 20 and 21, and April 18, 2017. They included a GPS-based radiological survey of land surfaces over a Survey Area consisting of the mine claim area out to a 100-foot (ft) buffer, roads and drainages within a 0.25-mile radius of the 100-ft buffer, areas where the survey was extended; and correlation studies.

The discussion of the results of soil sampling in this report is limited to concentrations of radium-226 and isotopes of thorium in samples taken from surface soils as part of correlation studies. The objective of the analysis of thorium isotopes was to 1) assess the potential effects of thorium-232 and thorium-228 on the correlation of gamma count rates to concentrations of radium-226 in surface soils; and 2) evaluate thorium-230 and radium-226 activities to assess the status of equilibrium in the uranium decay series. These and additional results for the RSE are addressed in the “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

The findings of the RSE pertaining to these activities are:

- The horizontal extent and magnitude of mining-related materials were delineated sufficiently to support additional characterization of the subsurface.

- Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.

- Two potential Background Reference Areas were established.

- The mean relationship between gamma count rates and concentrations of radium-226 in surface soils (0 to 0.5 ft below ground surface) is described by a linear model:

$$\text{Gamma Count Rate (cpm)} = 1380.1*[\text{radium-226 (pCi/g)}] + 16141.8$$

- The distribution of concentrations of radium-226 in surface soils predicted using this model resembles a lognormal distribution. The values in the Survey Area range from -7.8 to 206.4, with a central tendency (median) of 1.3 pCi/g.

- The thorium series radionuclides do not appear to affect the prediction of concentrations of radium-226 from gamma count rates.

- There is evidence that the uranium series radionuclides are in equilibrium, but not secular equilibrium.

- The relationship between gamma count rates and exposure rates is described by a linear regression model:

  Exposure Rate (microRoentgens per hour [µR/h]) = [Gamma Count Rate (cpm)] x $5\text{x}10^{-4}$ + 7.4537

- The distribution of exposure rates predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 7.5 to 158, with a central tendency (median) of 16.4 µR/h.

1.0 Introduction

This report addresses the radiological characterization of the Claim 28 abandoned uranium mine (AUM) located in the Tahchee/Blue Gap Chapter of the Navajo Nation near Tachee, Arizona. It documents part of the implementation of the Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan (RSE Work Plan: MWH, 2016). The work was performed by Environmental Restoration Group, Inc. (ERG) of Albuquerque, New Mexico and Stantec Consulting Services Inc. (Stantec) on behalf of the Navajo Nation AUM Environmental Response Trust – First Phase.

This report provides 1) the results of a Global Positioning System (GPS)-based gamma radiation (gamma) survey, 2) comparisons of the gamma count rates at this AUM to exposure rates and concentrations of radium-226 in surface soils, and 3) an assessment of equilibrium in the uranium series. The field activities addressed in this report were conducted on May 5, November 5, 7, 8, 10, and 11, 2016; and March 20 and 21, and April 18, 2017. They included a GPS-based radiological survey of land surfaces over a Survey Area consisting of the mine claim area out to a 100-foot (ft) buffer, roads and drainages within a 0.25-mile radius of the 100-ft buffer, areas where the survey was extended; and correlation studies. Section 3.0 of the RSE Workplan provides the data quality objectives (DQOs) for the project.

The discussion of the results of soil sampling in this report is limited to concentrations of radium-226 and isotopes of thorium in samples taken from surface soils, as part of correlation studies. The objective of the analysis of thorium isotopes was to 1) assess the potential effects of thorium-232 and thorium-228 on the correlation of gamma count rates to concentrations of radium-226 in surface soils; and 2) evaluate thorium-230 and radium-226 activities to indicate the status of equilibrium in the uranium decay series. These and additional results for the RSE are addressed in the “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

Figure 1 shows the location of the AUM. Background information that is pertinent to the characterization of this AUM is presented in the “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

2.0 GPS-Based Gamma Surveys

This section addresses the GPS-based surveys conducted in two potential Background Reference Areas and the Survey Area. The survey was extended to bound areas in which elevated count rates were observed. Table 1 lists the detection systems used in the survey. Pursuant to the approved RSE Workplan, detectors were function checked each day to ensure the instruments were stable to the limits prescribed by the work plan. Detector normalization was not performed as it was not addressed by the RSE Workplan. Appendix A presents the completed function check forms and calibration certificates for the instruments. Standard operating procedures (SOPs) are discussed in Section 4.2 of the RSE Workplan and are provided in Appendix E therein.

The 2x2 sodium iodide (NaI) detectors used in this investigation are sensitive to sub-surface radium-226 decay products and other gamma emitting radionuclides. The purpose of the gamma correlation was to estimate radium-226 concentrations in the upper 15 cm of soil. ERG selected correlation plots based on the range of gamma radiation levels observed. If subsurface soil concentrations of gamma emitting radionuclides were variable between correlation locations, this variability would be included in the regression model, and if the magnitude of the effect were sufficiently large, it would result in failure of the DQOs related to the regression analysis.

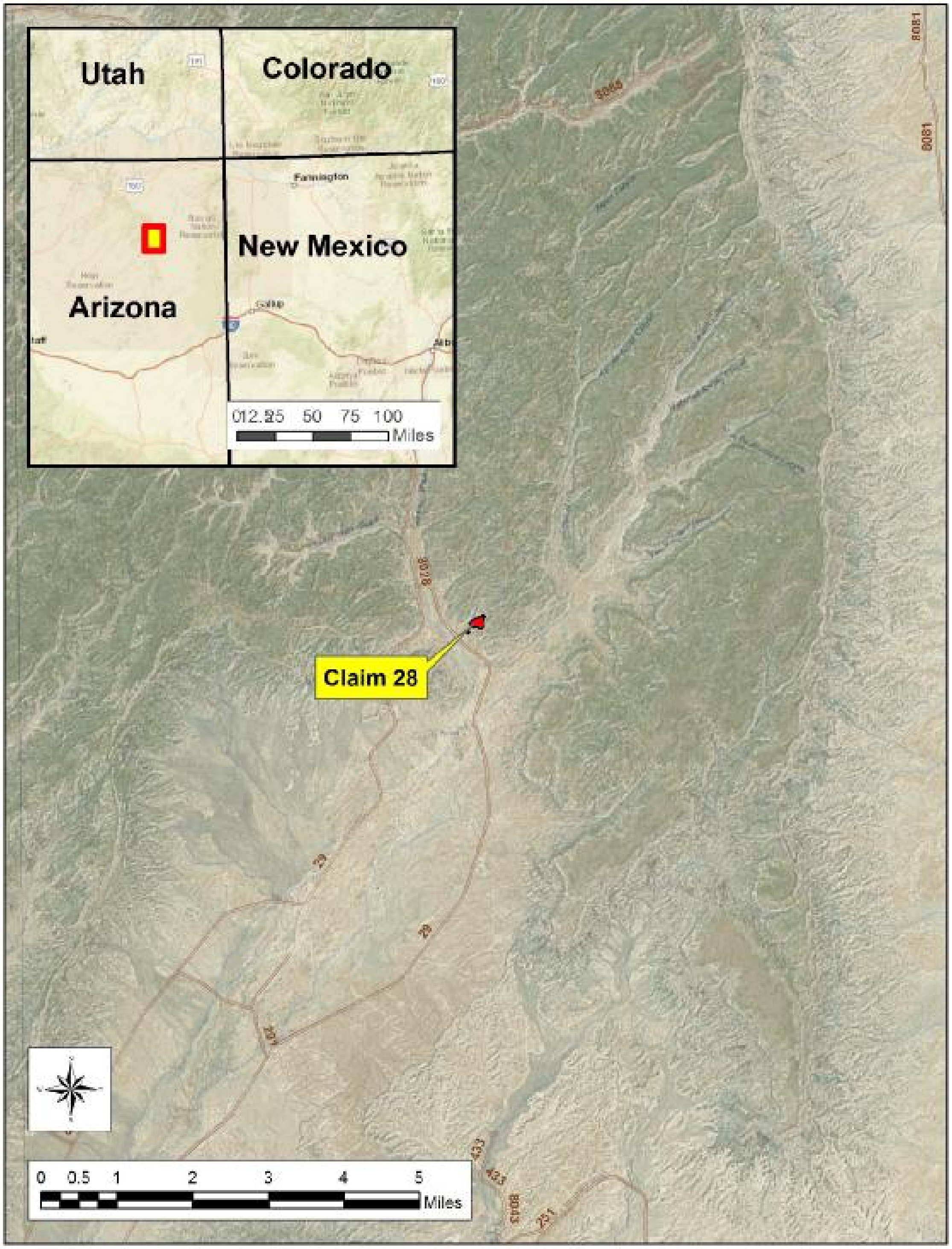


Figure 1. Location of the Claim 28 Abandoned Uranium Mine

Table 1. Detection systems used in the GPS-Based gamma surveys.

Survey Area	Ludlum Model 44-10	Ludlum Model 2221 Ratemeter/Scaler
Potential Background Reference Areas	PR303727[a]	254772[a]
Survey Area	PR150507	282966
	PR154615	138368
	PR295014	196086
	PR303727[a]	254772 [a]
	PR320678	282971

Notes:
[a]Detection system used in the correlation studies described in Sections 3.1 and 3.3.

2.1 Potential Background Reference Areas

Two potential Background Reference Areas were surveyed, the locations and results of which are depicted on Figure 2. BG1 and BG2 in the figure are Background Reference Areas 1 and 2, respectively. Table 2 lists a summary of the gamma count rates, which in:

- BG1 ranged from 15,584 to 22,609 counts per minute (cpm), with a mean and median of 18,165 and 17,880 cpm, respectively.

- BG2 ranged from 10,048 to 16,423 cpm, with a mean and median of 12,709 and 12,518 cpm, respectively.

Figure 3 depicts histograms of the gamma count rates in the potential Background Reference Areas. The red and green lines on the figure are theoretical normal and lognormal distributions, respectively. They are presented to show what could be expected if the distributions were normal or lognormal.

Table 2. Summary statistics for gamma count rates in the potential Background Reference Areas.

	Gamma Count Rate (cpm)					
Potential Background Reference Area	n	Minimum	Maximum	Mean	Median	Standard Deviation
1	237	15,584	22,609	18,165	17,880	1,381
2	338	10,048	16,423	12,709	12,518	1,117

Notes:
cpm = counts per minute

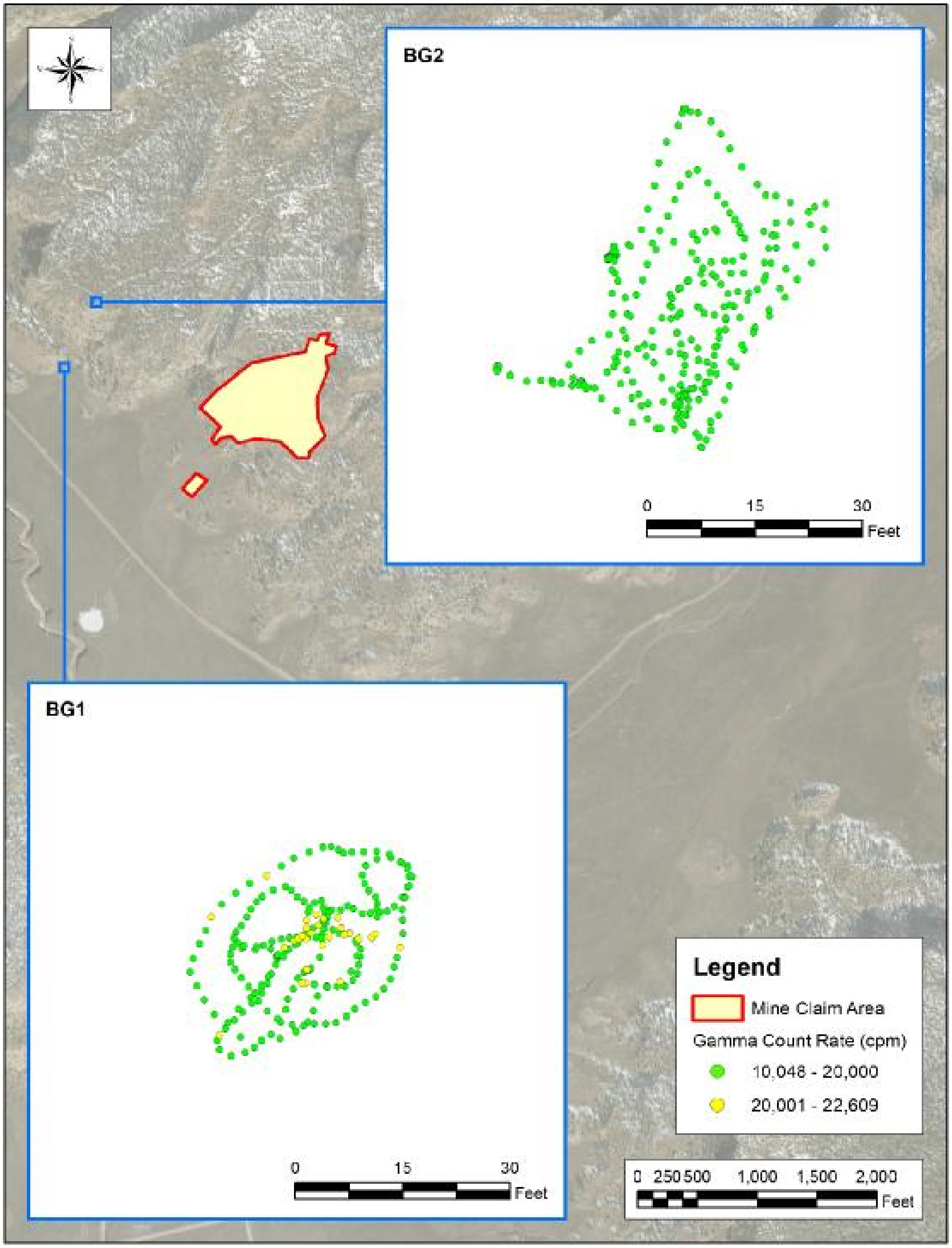
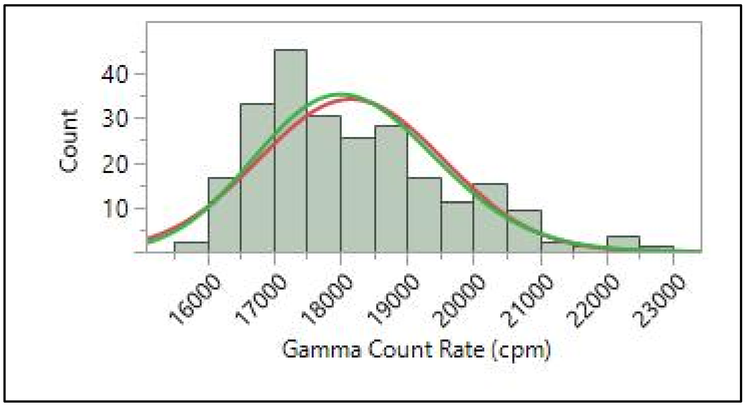
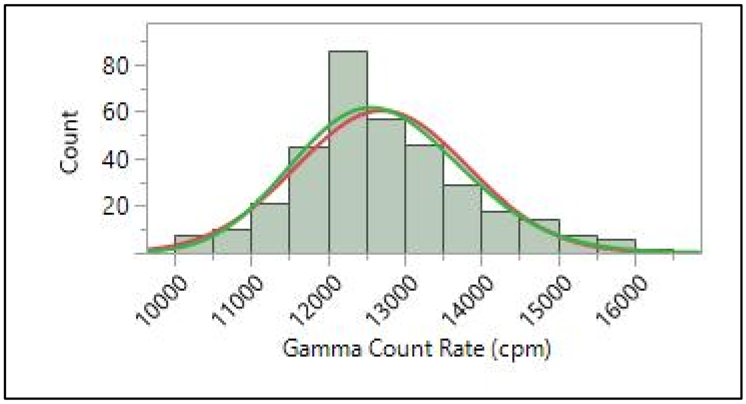


Figure 2. Gamma count rates in the potential Background Reference Areas.



a. Background Reference Area 1



b. Background Reference Area 2

Figure 3. Histograms of gamma count rates in the potential Background Reference Areas.

2.2 Survey Area

The gamma count rates observed in the Survey Area are depicted in Figure 4. Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.

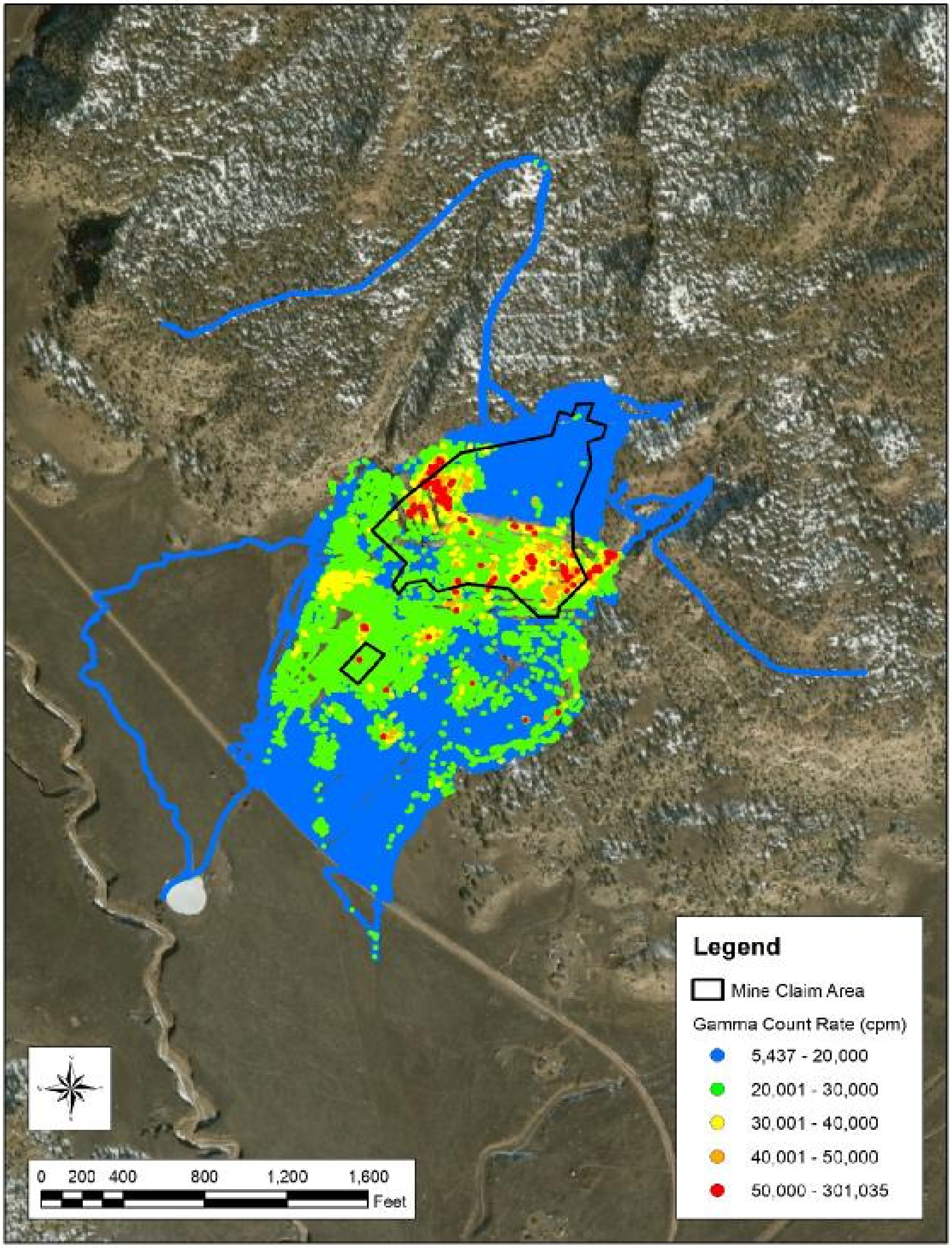


Figure 4. Gamma count rates in the Survey Area.

Figure 5 is a histogram of the gamma count rate measurements made in the Survey Area, including the area surveyed outside the 100-ft buffer. As stated in Section 2.1, the red and green lines on the figure are theoretical normal and lognormal distributions, respectively. They are presented to show what could be expected if the distributions were normal or lognormal. The distribution of the right-tailed set of measurements, evaluated using U.S. Environmental Protection Agency software ProUCL (version 5.1.002), is not defined. The box plot in Figure 6 depicts cutoffs as horizontal bars, from bottom to top, for the following values or percentiles: minimum, 0.5, 2.5, 10, 25, 50, 75, 90, 97.5, 99.5, and maximum. The 25th, 50th, and 75th percentiles (the three horizontal lines of the box inside the box plot) are 15,184, 17,914, and 21,670 cpm, respectively.

Table 3 is a statistical summary of the measurements, which range from 5,437 to 301,035 cpm and have a central tendency (median) of 17,914 cpm.

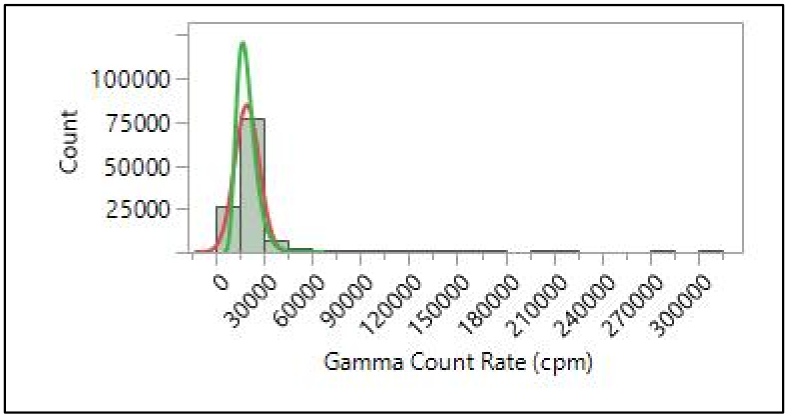


Figure 5. Histogram of gamma count rates in the Survey Area.

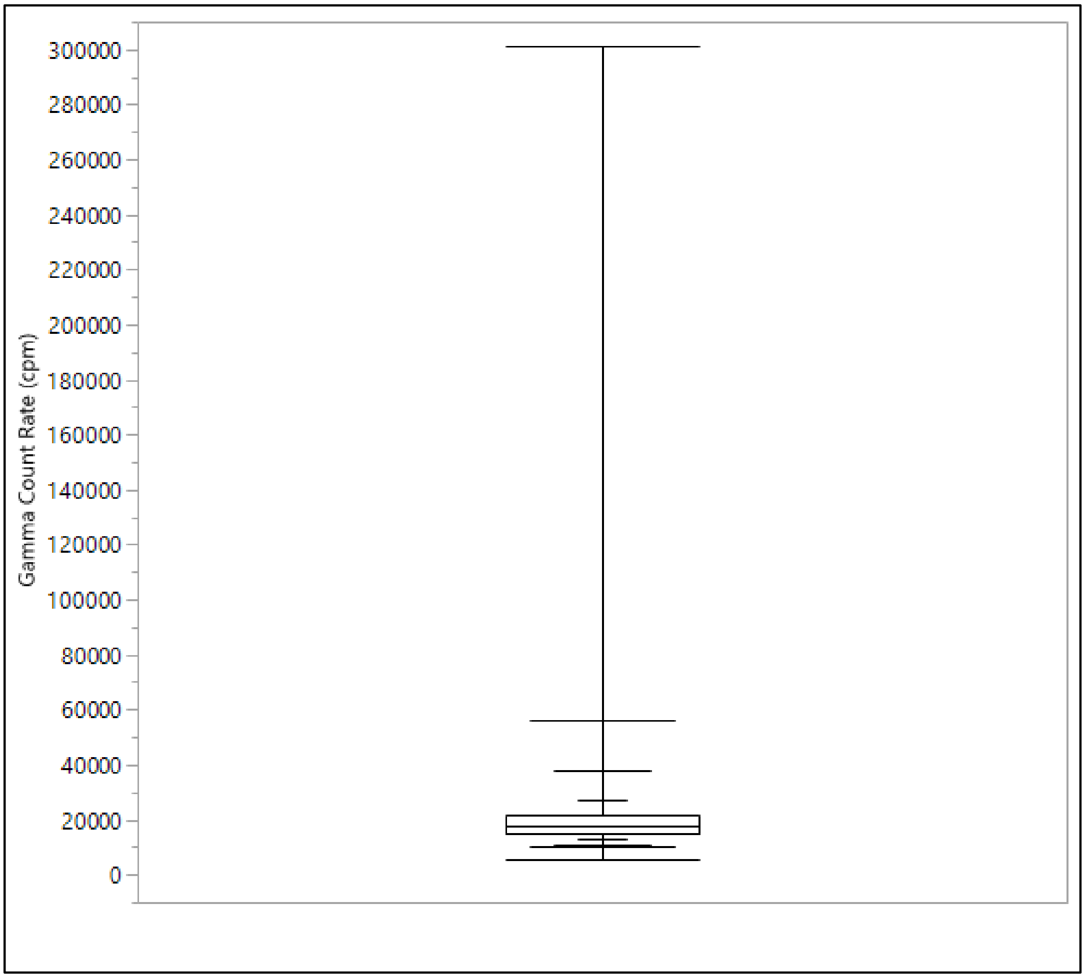


Figure 6. Box plot of gamma count rates in the Survey Area.

Table 3. Summary statistics for gamma count rates in the Survey Area.

Parameter	Gamma Count Rate (cpm)
n	108,660
Minimum	5,437
Maximum	301,035
Mean	19,475
Median	17,914
Standard Deviation	7,672

Notes:
cpm = counts per minute

3.0 Correlation Studies

The following sections address the activities under two types of correlation studies outlined in the RSE Workplan: comparisons of 1) radium-226 concentrations in surface soils and gamma count rates and 2) exposure rates and gamma count rates. GPS-based gamma count rate measurements were made over small areas for the former study. The means of the measurements were used in this case. Static gamma count rate measurements, co-located with exposure rate measurements, were used in the latter study.

3.1 Radium-226 concentrations in surface soils and gamma count rates

On November 11, 2016 field personnel made GPS-based gamma count rates measurements and collected five-point composite samples of surface soils in each of five areas at the AUM. These areas were selected using criteria established in the RSE Workplan. The activities were performed contemporaneously, by area and all on the same day, such that variations in the gamma count rate measurements could be limited largely to those posed by the soils and rocks at the locations. Figure 7 shows the GPS-based gamma count rate measurements in the five areas (labeled with location identifiers).

The soil samples were analyzed by ALS Laboratories in Ft Collins, CO for radium-226 and isotopic thorium. The latter analysis was included to assess the potential effects of thorium series isotopes on the correlation and evaluate thorium-230 and radium-226 activities to indicate the status of equilibrium in the uranium decay series. Table 4 lists the results of the gamma count rate measurements and radium-226 concentrations in the soil samples. The means of the gamma count rate measurements range from 16,151 to 52,335 cpm. The concentrations of radium-226 in the soil samples range from 1.9 to 19.9 picocuries per gram (pCi/g).

Table 5 lists the concentrations of isotopes of thorium (thorium-228, -230, and -232) in the same soil samples.

Laboratory analyses are presented in Appendix D, Laboratory Analytical Data and Data Usability Report, in “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

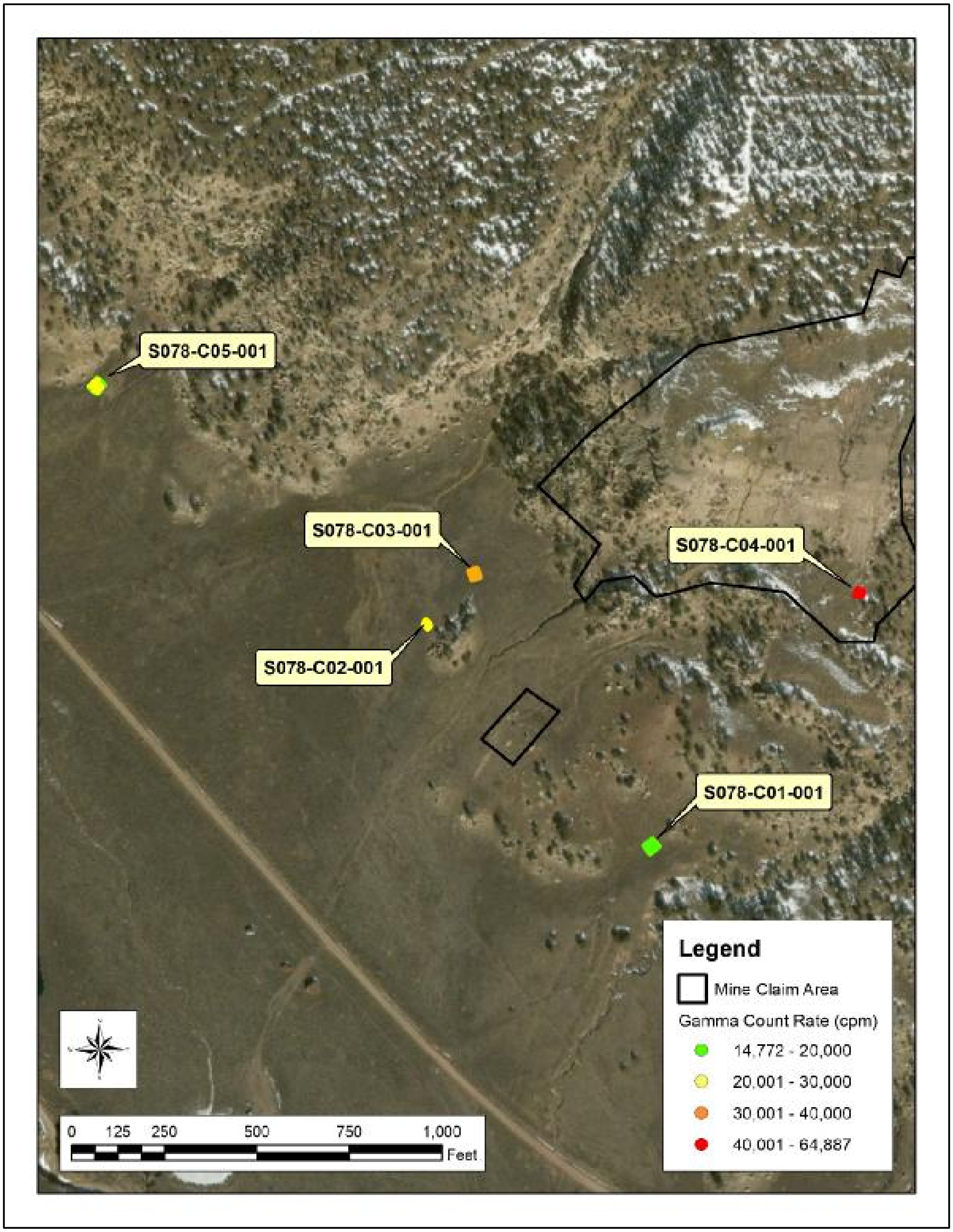


Figure 7. GPS-based gamma count rate measurements made for the correlation study.

Table 4. Gamma count rates and associated concentrations of radium-226 in samples of surface soils obtained in the correlation study.

		Gamma Count Rate (cpm)				Ra-226 (pCi/g)		
Location	**Area (m^2)**	**Mean**	**Minimum**	**Maximum**	**σ**	**Result**	**Error ±2σ**	**MDC**
S078-C01-001	113.2	16,151	14,772	19,419	763	1.9	0.34	0.39
S078-C02-001	42.5	24,027	20,120	28,985	1,866	2.69	0.47	0.56
S078-C03-001	71.7	33,222	30,071	37,554	1,459	19.1	2.4	0.6
S078-C04-001	41.4	52,335	35,196	64,887	6,923	19.9	2.5	0.7
S078-C05-001	111.4	18,846	16,056	22,113	1,136	2.69	0.46	0.51

Notes:
[a]Result is the average of primary and duplicate sample results.
cpm = counts per minute
MDC = minimum detectable concentration
m^2 =square meters
pCi/g = picocuries per gram
σ = standard deviation

Table 5. Concentrations of isotopes of thorium in samples of surface soils obtained in the correlation study.

	Thorium-228 (pCi/g)			Thorium-230 (pCi/g)			Thorium-232 (pCi/g)		
Sample ID	**Result**	**Error ± 2 σ**	**MDC**	**Result**	**Error ± 2 σ**	**MDC**	**Result**	**Error ± 2 σ**	**MDC**
S078-C01-001	0.66	0.13	0.04	1.42	0.25	0.07	0.75	0.14	0.02
S078-C02-001	1	0.18	0.04	1.94	0.33	0.07	0.99	0.18	0.02
S078-C03-001	1.38	0.23	0.04	11.7	1.8	0.1	1.26	0.21	0.02
S078-C04-001	1.48	0.25	0.05	12.3	1.9	0.1	1.41	0.24	0.02
S078-C05-001	1.16	0.2	0.04	1.88	0.31	0.07	1.15	0.2	0.02

Notes:
MDC = minimum detectable concentration
pCi/g = picocuries per gram
σ = standard deviation

A model was made of the results in Table 4, predicting the concentrations of radium-226 in surface soils from the mean gamma count rate in each area. A linear function, shown in Figure 8, was used to predict this relationship resulting in adjusted R^2 value of 0.7. This linear relationship is described by the equation:

$$\text{Gamma Count Rate (cpm)} = 1380.1*[\text{radium-226 (pCi/g)}] + 16141.8$$

The root mean square error and p-value for the model are 2.6 x10^4 and 0.047, respectively; these parameters are not data quality objectives (DQOs) and are included only as information. The R^2 value for this model does not meet the project DQO of 0.8. The model could be improved with additional correlation data collected in the future.

This equation was used to convert the gamma count rate measurements observed in the gamma surveys to predicted concentrations of radium-226. Table 6 presents summary statistics for the predicted concentrations of radium-226 in the Survey Area. The range of the predicted concentrations of radium-226 in the Survey Area is -7.8 to 206.4 pCi/g, with a mean and median of 2.4 and 1.3 pCi/g, respectively. While the gamma correlation equation can be used to convert gamma count rates to concentrations of Ra-226 in soil, the resulting radium concentrations are highly uncertain estimates, as the wide prediction interval bands illustrated in Figure 8 demonstrate. Users of the regression equation should be aware of the limitations of the dataset and be cautious when estimating radium-226 concentrations.

Soil concentrations of potassium-40 (K-40) were not expected to be spatially variable within the site, and therefore this radionuclide was not separately accounted for in the RSE Workplan. If K-40 concentrations did vary, this variability would be included in the regression model and, if the magnitude of the effect were sufficiently large, would result in failure of DQOs related to the regression analysis.

A multivariate linear regression (MLR) was used to evaluate the influence of thorium-232 and thorium-228, isotopes in the thorium series, on the average gamma count rate in the correlation locations. The MLR model was first run using radium-226, thorium-232, and thorium-228 as predictors of gamma count rate. The model failed to produce results because thorium-232 and thorium-228 are colinear. The MLR model was subsequently run without thorium-228. For the second model, the p-values for radium-226 and thorium-232 were both greater than 0.05 (0.38 and 0.59 respectively) and therefore not significant predictors of gamma count rate collectively. Thorium-232 and radium-226 were then each modelled individually as a predictor of gamma count rate. The p-value for thorium-232 coefficient was 0.08 with an adjusted R^2 of 0.6. The thorium-232 coefficient is not significant and the R^2 value does not meet the project DQO. Subsequently it is concluded that thorium-232 and thorium-228 concentrations in soil are not significant predictors of gamma count rate. The p-value for radium-226 was significant as described above, although the R^2 value did not meet project DQOs.

The depletion of radon-222 in surface soil due to environmental factors is assumed to be relatively constant across the correlation locations (i.e., the loss is a fixed fraction of the available source). Provided this is the case, any loss of radon-222 in surface soil is unimportant and accounted for within the statistical model. If the loss is not a consistent fraction at each correlation locations, it is one of many potential correlation confounders that are all linked to the spatial heterogeneous of the environmental conditions, and especially the spatial heterogeneous of the soil matrix.

The presence of heterogeneous concentrations of gamma emitting radionuclides in sub-surface soil can affect the gamma correlation model. If subsurface soil concentrations of gamma emitting radionuclides were variable between correlation locations, this variability would be included in the regression model, and if the magnitude of the effect were sufficiently large, it would result in failure of the DQOs related to the regression analysis.

Figure 9 shows the predicted concentrations of radium-226, the spatial and numerical distribution of which mirror those depicted in Figure 4.

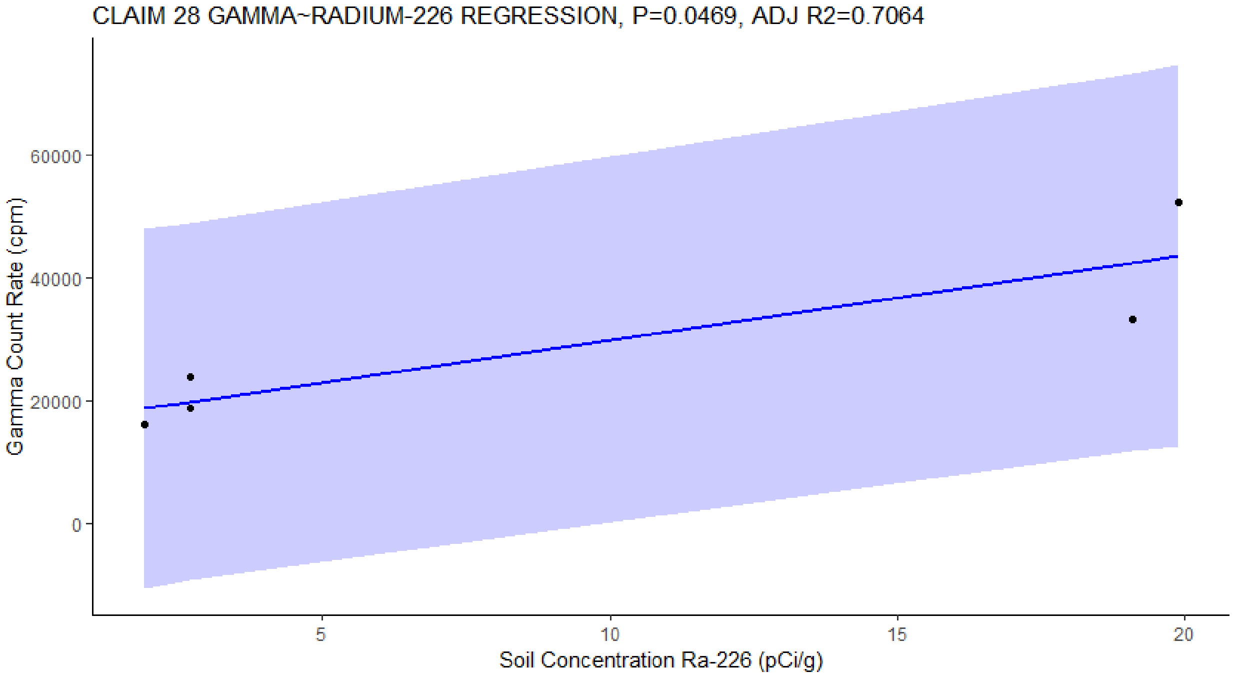


Figure 8. Correlation of gamma count rates and concentrations of radium-226 in surface soils.

Table 6. Predicted concentrations of radium-226 in the Survey Area.

Parameter	Radium-226 (pCi/g)
n	108,660
Minimum	-7.8
Maximum	206.4
Mean	2.4
Median	1.3
Standard Deviation	6.1

Notes:
pCi/g = picocuries per gram

3.2 Equilibrium in the uranium series

Secular equilibrium is a condition that occurs when the half-life of a decay-product nuclide is significantly shorter than that of its parent nuclide. After a period of ingrowth equal to approximately seven times the half-life of the decay product, the two nuclides effectively decay with the half-life of the parent. When two radionuclides are in secular equilibrium, their activities are equal.

Equilibrium, for the purpose of this report, is defined as a condition whereby a parent nuclide and its decay product are present in the environment at a fixed ratio, but this ratio – for whatever reason – is not a one-to-one relationship indicative of secular equilibrium. Most commonly, an equilibrium condition results from an environmental process which chemically selects for and transports one nuclide (parent or decay product) away from the other nuclide. Because a consistent fraction of one nuclide has been removed, the two nuclides are present at a fixed ratio other than one-to-one.

Determination of secular equilibrium for an AUM can be an important part of the risk assessment process, as the assumed fraction of radium-226 decay products present in the environment greatly influences a hypothetical receptor's radiation dose and mortality risk. However, it is also acceptable and conservative to assume secular equilibrium between radium-226 and its decay products for the purpose of risk assessment, and therefore to avoid the need to conclusively determine the secular equilibrium status of an AUM. Thus, an inconclusive result regarding secular equilibrium is not a study data gap, as the risk assessment phase may still proceed, provided that conservative assumptions are included regarding equilibrium concentrations of radium-226 decay products.

Regardless, the RSE Workplan specified that an evaluation of secular equilibrium would be made at each of the 16 Trust AUMs, and so a robust statistical examination of secular equilibrium status for radium-226 and its decay products at each AUM was conducted. Evaluation of secular equilibrium for each mine site proceeded as follows:

1. Construction of a figure that depicts soil concentrations of thorium-230 plotted against soil concentrations of radium-226.
2. Simple linear regression is performed on the dataset; the p-value and the adjusted R^2 are recorded. The resulting linear model and the 95% UCL bands are plotted on the figure generated in step 1.
3. The line y=x is added to the figure generated in step 2 (this line represents a perfect 1:1 ratio between Th-230 to Ra-226, indicative of secular equilibrium).
4. An examination of the model and the figure is made sequentially:
    a. If the p-value for the regression slope is insignificant (i.e., $p > 0.05$) or the adjusted R^2 does not meet the study's data quality objective (Adjusted $R^2 > 0.8$), ERG concludes that there is insufficient evidence to conclude that radium-226 and thorium-230 are in equilibrium (secular or otherwise).

    b. If the p-value for the regression slope is significant (i.e., $p < 0.05$) and the adjusted R^2 meets the DQO (Adjusted $R^2 > 0.8$) there are two possible conditions, which are evaluated via visual examination of the figure generated in step 3.

        i. If the y=x line falls fully within the bounds of the 95% UCL bands on the regression, ERG concludes that there is evidence that radium-226 and thorium-230 are in secular equilibrium at the site.

        ii. If the y=x line falls partially or completely outside the bounds of the 95% UCL bands on the regression, ERG concludes that there is evidence that radium-226 and thorium-230 are in equilibrium, but not secular equilibrium at the site.

Based on this method, ERG concludes there is evidence that thorium-230 and radium-226 are in equilibrium, but not secular equilibrium (Figure 9).

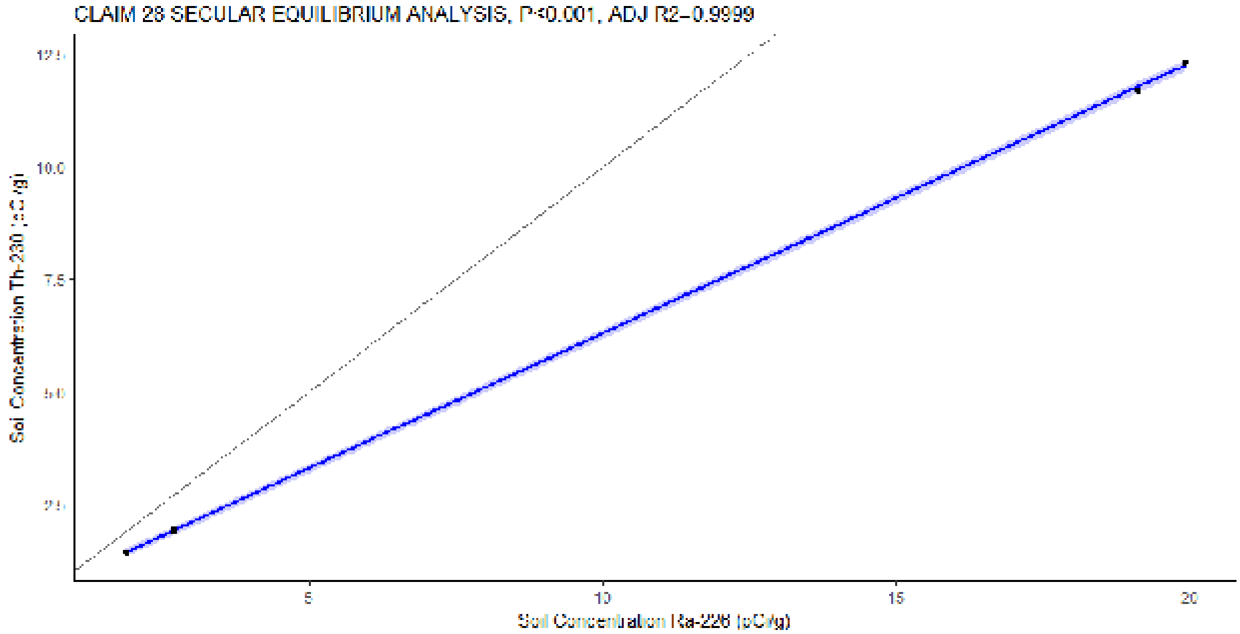


Figure 9. Evaluation of secular equilibrium in the uranium decay series.

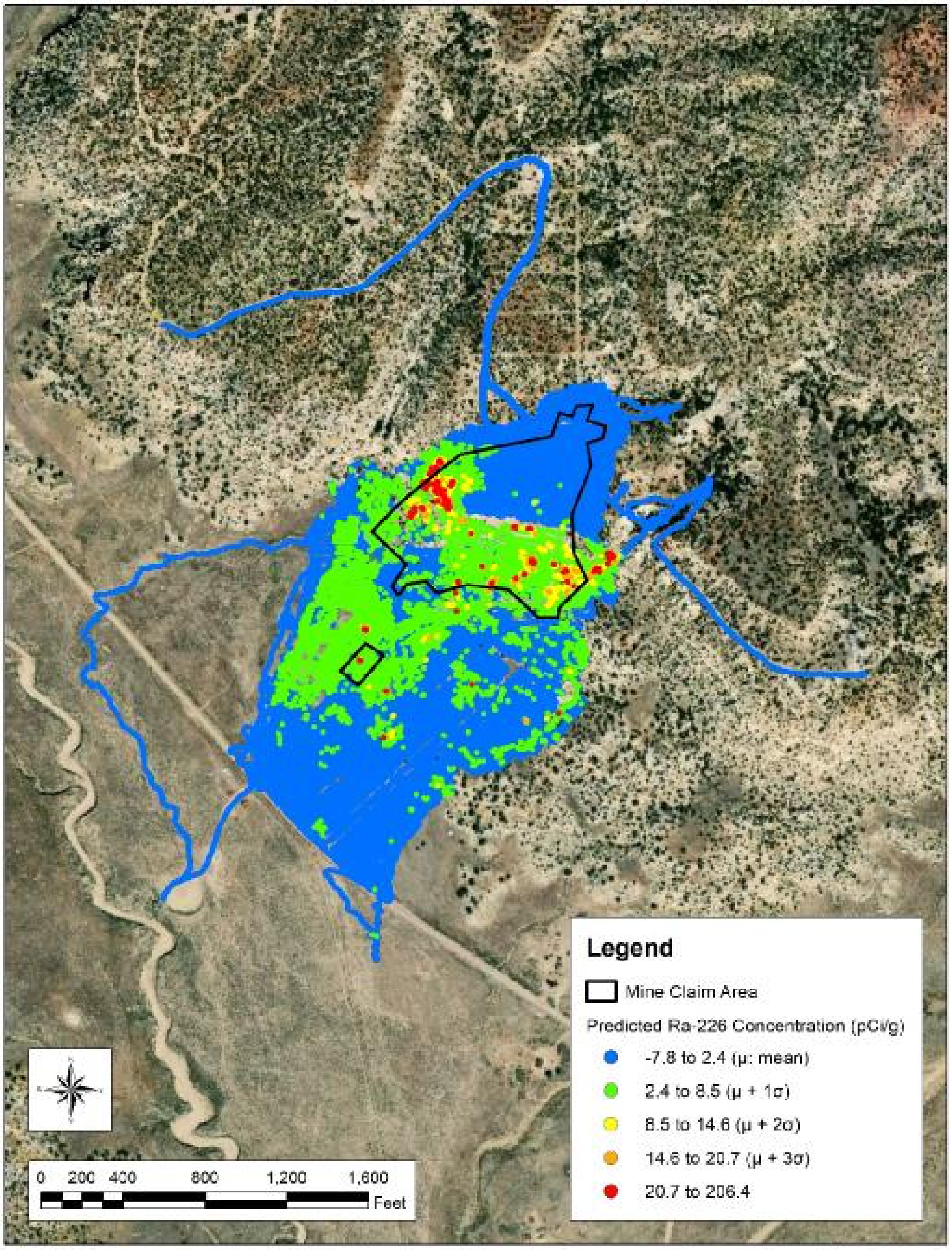


Figure 10. Predicted concentrations of radium-226 in the Survey Area.

3.3 Exposure rates and gamma count rates

On October 11, 2016 field personnel made co-located one-minute static count rate and exposure rate measurements at the five locations within the Survey Area, representing the range of gamma count rates obtained in the GPS-based gamma survey. Figure 7 shows the locations of the co-located measurements, which were made in the centers of the areas.

The gamma count rate and exposure rate measurements were made at 0.5 meters (m) and 1 m above the ground surface, respectively. The gamma count rate measurements were made using one of the sodium iodide detection systems used in the GPS-based gamma survey of the AUM (Serial Number PR303727/254772). The exposure rate measurements were made using a Reuter Stokes Model RSS-131 (Serial Number 07J00KM1) high pressure ionization chamber (HPIC) at six-second intervals for about 10 minutes. The exposure rates used in the comparison was the mean of these measurements, less those occurring in initial instrument spikes. The HPIC was in current calibration and function checked before and after use. Calibration forms for the HPIC are provided in Appendix A. Table 7 presents the results for the two types of measurements made at each of the five locations. Appendix B presents the individual (one second) exposure rate measurements.

The best predictive relationship between the measurements is linear with an R^2 of 0.9947 indicating a strong, positive correlation. The root mean square error and p-value for the model are 0.659598 and 0.0002, respectively; these parameters are not DQOs and are included only as information.

The following equation is the linear regression (shown in Figure 10) between the mean exposure rate and gamma count rate results in Table 7 that was generated using MS Excel:

$$\text{Exposure Rate (microRoentgens per hour [μR/h])} = 5\text{x}10^{-4} \text{ x Gamma Count Rate (cpm)} + 7.4537$$

Figure 11 presents the exposure rates predicted from the gamma count rate measurements, the spatial and numerical distribution of which mirror those depicted in Figure 4.

Table 8 and 9 present summary statistics for the predicted exposure rates in the two Background Reference Areas and AUM, respectively.

The range of predicted exposure rates at:

- BG1 is 15.2 to 18.8 µR/h, with a mean and median of 16.5 and 16.4 µR/h, respectively
- BG2 is 12.5 to 15.7 µR/h, with a mean and median of 13.8 and 13.7 µR/h, respectively

The range of predicted exposure rates in the Survey Area is 10.2 to 158 µR/h, with a mean and median of 17.2 and 16.4 µR/h, respectively.

Table 7. Co-located gamma count rate and exposure rate measurements.

Location	Gamma Count Rate (cpm)	Exposure Rate (µR/h)
S078-C01-001	16,092	15.3
S078-C02-001	25,299	20
S078-C03-001	33,606	25.3
S078-C04-001	53,767	35.2
S078-C05-001	18,734	17.9

Notes:
cpm = counts per minute
µR/h = microRoentgens per hour

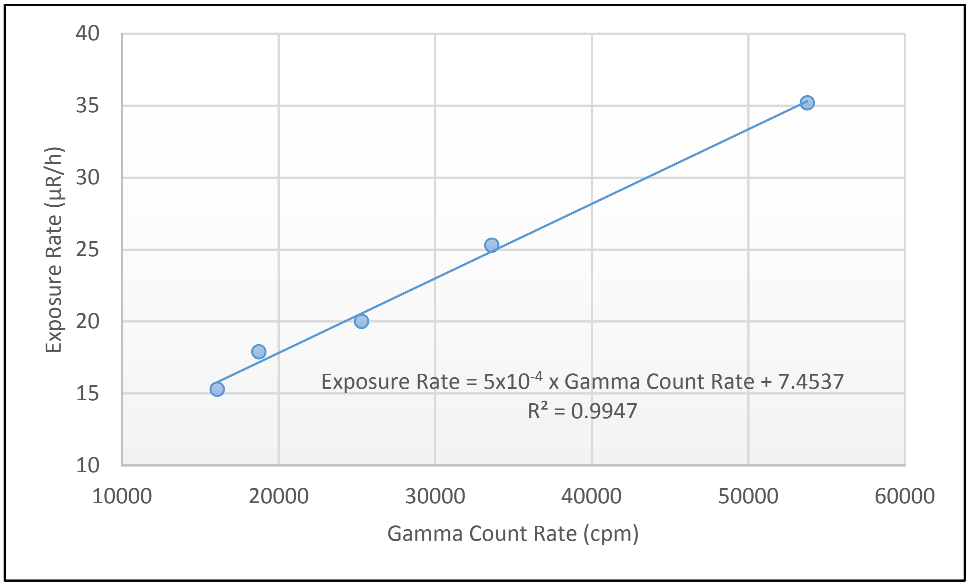


Figure 11. Correlation of gamma count rates and exposure rates.

Table 8. Predicted exposure rates in the potential Background Reference Areas.

Potential Background Reference Area	BG1	BG2
Parameter	**Exposure Rate (µR/h)**	
n	237	338
Minimum	15.2	12.5
Maximum	18.8	15.7
Mean	16.5	13.8
Median	16.4	13.7
Standard Deviation	0.7	0.6

Notes:
BG1 = Background Reference Area 1
BG2 = Background Reference Area 2
µR/h = microRoentgens per hour

Table 9. Predicted exposure rates in the Survey Area.

Parameter	Exposure Rate (µR/h)
n	108,660
Minimum	10.2
Maximum	158
Mean	17.2
Median	16.4
Standard Deviation	3.8

Notes:
µR/h = microRoentgens per hour

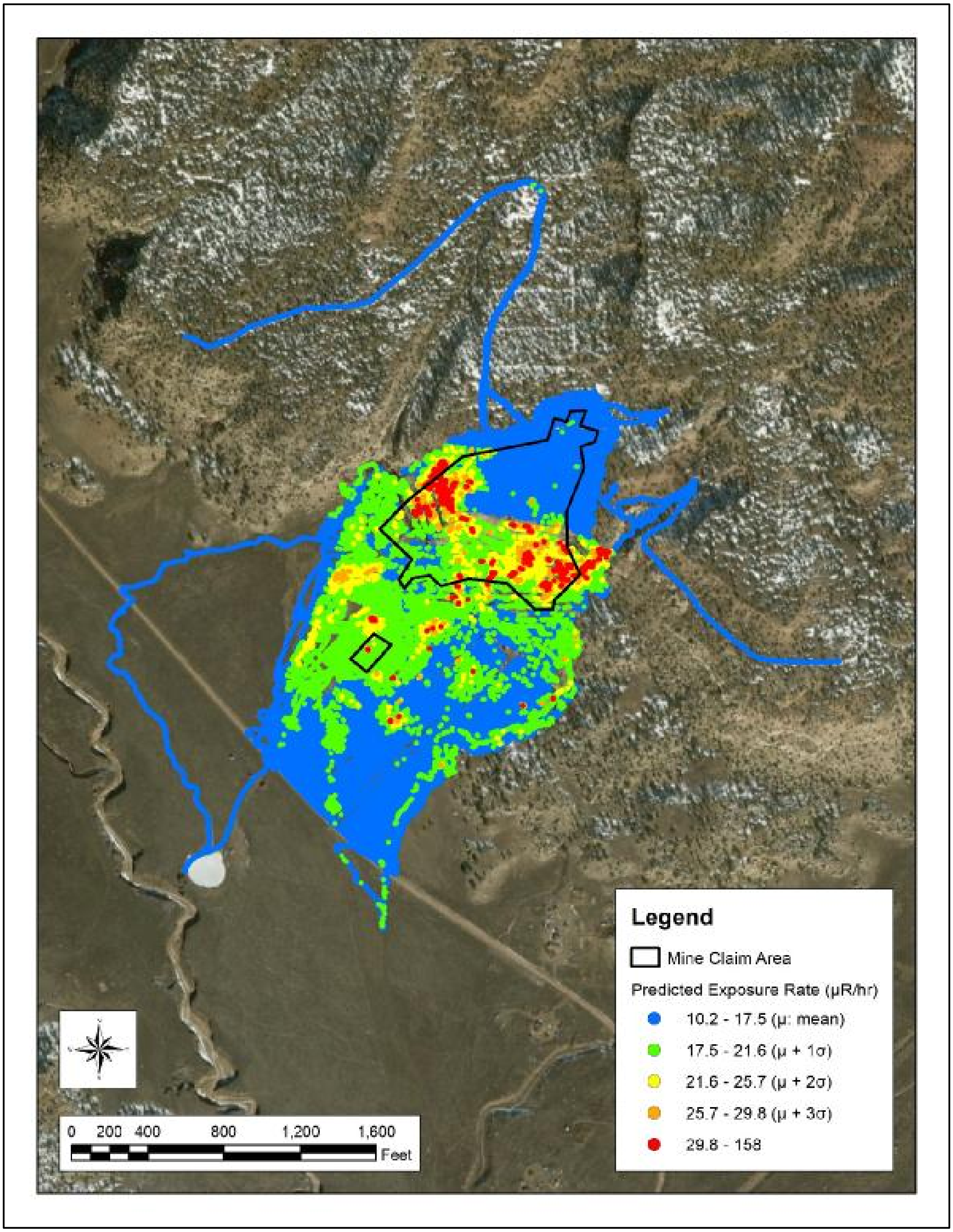


Figure 12. Predicted exposure rates in the Survey Area.

4.0 Deviations from the RSE Work Plan

The RSE Work Plan specifies that the comparison of gamma count rates and radium concentrations in surface soils was to occur in 900 square foot areas. Field personnel adjusted the areas as necessary, to minimize the variability of gamma count rates observed, particularly where the spatial distribution of waste rock was heterogeneous.

5.0 Conclusions

The findings of the RSE pertaining to these activities are:

- The horizontal extent and magnitude of mining-related materials were delineated sufficiently to support additional characterization of the subsurface.

- Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.

- Two potential Background Reference Areas were established.

- The relationship between gamma count rates and concentrations of radium-226 in surface soils (0 to 0.5 ft below ground surface) is described by a linear model:

  Gamma Count Rate (cpm) = 1380.1*[radium-226 (pCi/g)] + 16141.8

- The distribution of concentrations of radium-226 in surface soils predicted using this model resembles a lognormal distribution. The values in the Survey Area range from -7.8 to 206.4, with a central tendency (median) of 1.3 pCi/g.

- The thorium series radionuclides do not affect the prediction of concentrations of radium-226 from gamma count rates.

- There is evidence the uranium series radionuclides are in equilibrium, but not secular equilibrium.

- The relationship between gamma count rates and exposure rates is described by a linear regression model:

  Exposure Rate (µR/h) = Gamma Count Rate (cpm) x 5×10^{-4} + 7.4537

The distribution of exposure rates predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 7.5 to 158, with a central tendency (median) of 16.4 µR/h.

- Further work is recommended to support a robust gamma correlation.

6.0 References

MWH, 2016. Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan, October 24, 2016.

Stantec, 2018. Claim 28 Removal Site Evaluation Report, January 2018.

Appendix A Instrument calibration and completed function check forms

ERG

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:	254772
Detector:	Manufacturer: Ludlum	Model Number:	44-10	Serial Number:	PR303727

☑ 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)
Source Distance: ☐ Contact ☑ 6 inches ☐ Other:
Source Geometry ☑ Side ☐ Below ☐ Other:

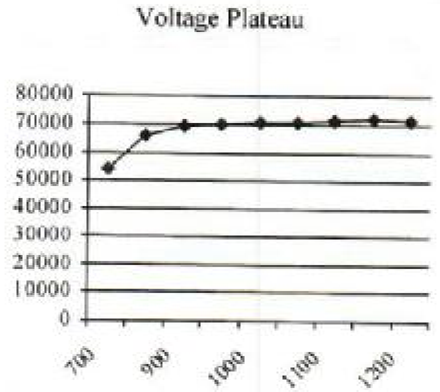
Threshold: 10 mV
Window:

Barometric Pressure: 24.6 inches Hg
Temperature: 73 °F
Relative Humidity: 20 %

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Coun
x 1000	400	400	400	398773	400
x 1000	100	100	100		100
x 100	400	400	400	39887	400
x 100	100	100	100		100
x 10	400	400	400	3988	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	53957	
800	65946	
900	69049	
950	69687	
1000	70240	9925
1050	70288	
1100	71224	
1150	71563	
1200	71161	



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

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: 1-20-16 Calibration Due 1-20-17

Reviewed By: Date: 1/20/16

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A – 1997

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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: 254772

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR303727

✓ 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:
Source Geometry: ✓ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

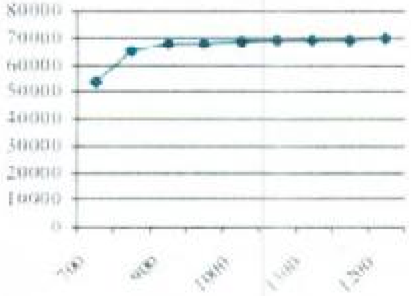
Barometric Pressure: 24.75 inches Hg
Temperature: 74 °F
Relative Humidity: 20 %

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	398857	400
x 1000	100	100	100		100
x 100	400	400	400	39913	400
x 100	100	100	100		100
x 10	400	400	400	3992	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	53620	
800	64979	
900	67955	
950	67795	
1000	68536	9542
1050	69153	
1100	69331	
1150	69346	
1200	69492	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

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: 87490128
✓ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Calibration Date: 7-8-16
Calibration Due: 7-8-17

Reviewed By:
Date: 7/20/16

ERG Form ITC. 101.A

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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: 196086

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR295014

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

HV Check (+/- 2.5%): ✓ 500 V ✓ 1000 V ✓ 1500 V
Cable Length: 39-inch ✓ 72-inch Other:

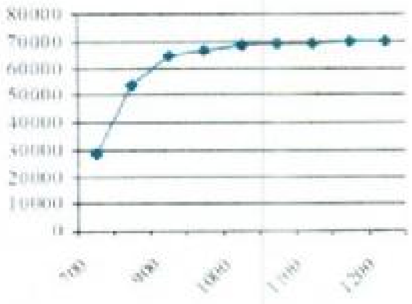
Source Distance: Contact ✓ 6 inches Other:
Source Geometry: ✓ Side Below Other:
Threshold: 10 mV
Window:
Barometric Pressure: 24.78 inches Hg
Temperature: 74 °F
Relative Humidity: 20 %

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	399802	400
x 1000	100	100	100		100
x 100	400	400	400	39989	400
x 100	100	100	100		100
x 10	400	400	400	3999	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	28456	
800	53330	
900	64430	
950	66209	
1000	68333	
1050	69077	
1100	69121	8924
1150	69973	
1200	70155	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1100

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: 87490128
✓ Gamma Source: Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
Other Source:

Calibrated By:
Calibration Date: 7 [illegible] 16
Calibration Due: 7 [illegible] 17

Reviewed By:
Date: 7/20/16

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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: 138368

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR154615

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed

☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry: ☑ Side ☐ Below ☐ Other:

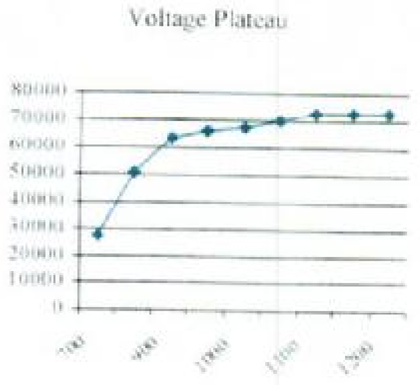
Threshold: 10 mV
Window:

Barometric Pressure: 24.78 inches Hg
Temperature: 74 °F
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	398436	400
x 1000	100	100	100		100
x 100	400	400	400	39845	400
x 100	100	100	100		100
x 10	400	400	400	3984	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	26998	
800	51037	
900	63340	
950	65550	
1000	67410	
1050	70113	
1100	72217	
1150	72561	9216
1200	72337	



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Reference Instruments and/or Sources:

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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: 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Calibration Date: 7-6-16
Calibration Due: 7-6-17

Reviewed By:
Date: 7/20/16

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Calibration and Voltage Plateau

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Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	282966
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR150507

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

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 60"

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

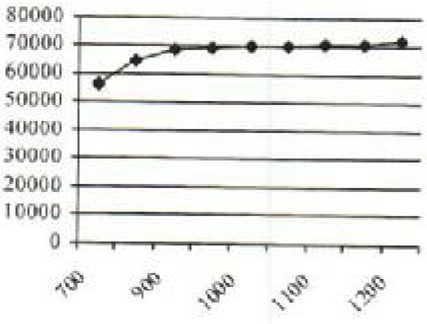
Barometric Pressure: 24.89 inches Hg
Temperature: 73 °F
Relative Humidity: 20 %

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	398753	400
x 1000	100	100	100		100
x 100	400	400	400	39879	400
x 100	100	100	100		100
x 10	400	400	400	3989	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	56463	
800	64304	
900	68534	
950	69331	
1000	69868	9696
1050	70054	
1100	70609	
1150	70681	
1200	71955	

Voltage Plateau



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Reference Instruments and/or Sources:

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☐ 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: ☐ 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Calibration Date: 10-31-16
Calibration Due: 10-31-17

Reviewed By:
Date: 10/31/16

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

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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:	254772
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR303727

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed

☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

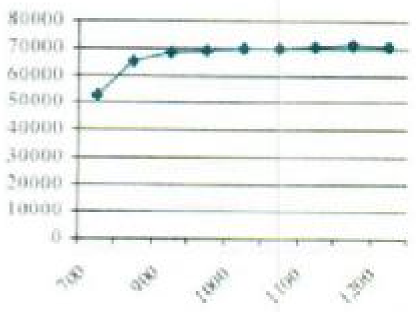
Barometric Pressure: 24.24 inches Hg
Temperature: 78 °F
Relative Humidity: 20 %

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	399859	400
x 1000	100	100	100		100
x 100	400	400	400	39991	400
x 100	100	100	100		100
x 10	400	400	400	4001	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	52821	
800	65213	
900	68644	
950	69245	
1000	69492	9111
1050	69792	
1100	70472	
1150	71183	
1200	70571	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1000

Reference Instruments and/or Sources:

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☐ 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: ☐ 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: 2/28/17 ~~2 March 17~~ gsH
Calibration Due: 2/28/18 ~~2 March~~ 18 gsH

Date: 3-1-17

ERG Form ITC, 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

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: 196086

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR295014

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed

☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

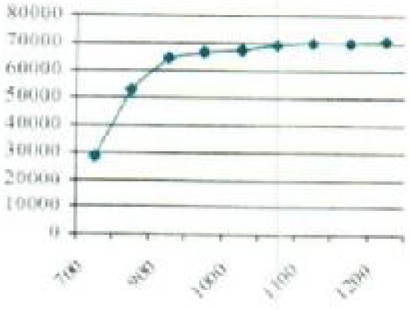
Barometric Pressure: 24.27 inches Hg
Temperature: 78 °F
Relative Humidity: 20 %

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	399386	400
x 1000	100	100	100		100
x 100	400	400	400	39949	400
x 100	100	100	100		100
x 10	400	400	400	3995	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	28235	
800	52834	
900	64481	
950	66468	
1000	67321	
1050	69009	
1100	69981	9079
1150	69564	
1200	70538	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1100

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: ☐ 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: ~~1 March 17~~ 2/28/17 Calibration Due: ~~1 March 18~~ 2/28/18

Date: 3/1-17

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

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: 282971

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR320678

☑ 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:

Barometric Pressure: 24.63 inches Hg

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:

Threshold: 10 mV

Temperature: 75 °F

Source Geometry: ☑ Side ☐ Below ☐ Other:

Window:

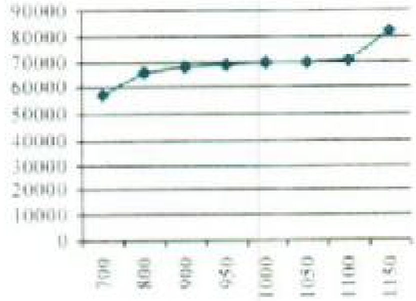
Relative Humidity: 20 %

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	399936	400
x 1000	100	100	100		100
x 100	400	400	400	39984	400
x 100	100	100	100		100
x 10	400	400	400	3998	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	57641	
800	65850	
900	68414	
950	68639	
1000	69410	9773
1050	69358	
1100	70301	
1150	81822	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number: ☐ 87490128

☐ Alpha Source: Th-230 sn: 4098-03 @ 12,800dpm/6,520 cpm (1/4/1

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

☐ Beta Source: Tc-99 sn: 4099-03 @ 17,700dpm/11,100cpm (1/4/12

☐ Other Source:

Calibrated By:

Calibration Date: 3-13-17

Calibration Due: 3-13-18

Reviewed By:

Date: 14 March 2017

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A-1997

K&S Associates, Inc.
1926 Elm Tree Drive
Nashville, Tennessee 37210-3718
Phone 800-522-2325 Fax 615-871-0856

ACCREDITED
CALIBRATION CERT #1866.01

CALIBRATION REPORT

SUBMITTED BY: ERG
8809 Washington Street Northeast
Suite 150
Albuquerque, NM 87113

INSTRUMENT: Reuter Stokes RSS-131, #07J00KM1

REPORT NUMBER: 161866
TEST NUMBER(S) M161588
REPORT DATE: June 29, 2016

The CALIBRATION COEFFICIENTS contained in this report were obtained by intercomparison with instruments calibrated by, or directly traceable to, the National Institute of Standards and Technology (NIST). K• S Associates, Inc. is licensed by the State of Tennessee (R-19075-G97, R-19136-B00) to perform calibrations, and is recognized by the Health Physics Society (HPS) as an ACCREDITED INSTRUMENT CALIBRATION LABORATORY. As part of the accreditation K • S participates in a measurement assurance program conducted by the HPS and NIST. K • S also certifies that the calibration was performed using quality policies, methods and procedures that meet or exceed the requirements of ISO/IEC 17025:2005.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined in accordance with the laboratory's terms of accreditation unless stated otherwise in this report

The CALIBRATION COEFFICIENTS stated herein are valid under the conditions specified. It is the instrument user's responsibility to perform the appropriate constancy tests prior to shipment and after return from calibration. It is also the responsibility of the user to assure that the interpretation of the information in this report is consistent with that intended by K • S Associates, Inc.

K&S Associates, Inc
Nashville, Tennessee 37210-3718

ACCREDITED

CALIBRATION CERTIFICATE

Calibration Date: 6/27/2016 Report Number: 161866 Test Number: M161588

K&S certifies that the environmental radiation monitor identified below has been calibrated for radiation measurement using collimated radiation sources whose output has been calibrated with instruments calibrated by or directly traceable to the National Institute of Standards and Technology. K&S is accredited by the American Association for Laboratory Accreditation to perform environmental level calibrations and further certifies that the calibration was performed using accredited policies and procedures (SI 25) that meet or exceed the requirements of ISO/IEC 17025:2005.

Sensor Type: 100 mR/h

Serial Number: 07J00KM1

Average Calibration Coefficient for the range of 0.012 mR/h – 0.220 mR/h*:
1.02 mR/"mR" reading
(Measured at 4 points)

Calibration Coefficient for the 50.0 mR/h point*:
1.12 mR/"mR" reading

Calibration Coefficient for the 80.0 mR/h point*:
1.10 mR/"mR" reading

Found RAC: 2.169e-8

*Multiply the reading in **mR/h** by the Calibration Coefficient to obtain true **mR/h**.

Calibrated By: Richard Hardison Richard Hardison
Title: Calibration Technician

Reviewed By: Angela Roy [illegible]
Title: Calibration Physicist

Log: M-53 Page: 73

K&S Associates, Inc
Nashville, Tennessee 37210-3718

ACCREDITED
CALIBRATION CERT #1866.01

AS FOUND DATA
Reuter-Stokes Chamber Calibration

June 27, 2016 *Test Number M161588*

CHAMBER:

Mfgr: Reuter Stokes
Model: RSS-131
Serial: 07J00KM1

SUBMITTED BY:

ERG

Albuquerque, NM

ORIENTATION/CONDITIONS:

Serial number away from source

"True" background exposure rate of 6.7 uR/h, instrument reading was 0.0076 mR/h

ATMOSPHERIC COMMUNICATION: SEALED

POLARIZING POTENTIAL 401V

LEAKAGE: negligible

BEAM QUALITY BEAM		EXPOSURE RATE		CALIBRATION COEFFICIENT	UNCERT	LOG
CsEn220	(11mCi)	0.22mR/h	N_x=	1.00 mR/h/rdg	11%	M-53 73
CsEn80	(11mCi)	0.08mR/h	N_x=	1.03 mR/h/rdg	11%	
CsEnv12	(1mCi)	0.012mR/h	N_x=	1.01 mR/h/rdg	11%	
CsEnv15	(1mCi)	0.015mR/h	N_x=	1.02 mR/h/rdg	11%	
Cs199m	(20 Ci)	50mR/h	N_x=	1.12 mR/h/rdg	8%	
Cs252m	(20 Ci)	80mR/h	N_x=	1.10 mR/h/rdg	8%	

Comments Batt: 6.1V, Temp: 24.6 deg C. K&S Environment: Temp:21 deg C , RH 59%, Press: 752 mmHg;
Report Number: 161866
Refer to Appendix I of this report for details on PIC ionization chamber calibrations. Procedure: SI 25
RAC Found: 2.169e-8

Calibrated By Richard Hardison
Richard Hardison
Title: Calibration Technician

Reviewed By:
Title: Calibration Physicist

Checked By: **Prepared By:** REH

Form RSS

①

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	7-9-17 NW 1-20-17 STET 1-9-17 NW

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	7-9-17 NW 1-20-17 STET 7-9-17

Comments:
NNEET

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-2-16	0821	5.7	1008	99	45344	6195	39149	NW	Charles keith
11-2-16	1721	5.6	1002	99	44348	5346	39002	NW	Goulding's in SUV
11-3-16	1037	5.7	1007	100	43600	5834	37766	NW	Charles keith
11-3-16	1848	5.7	1003	100	46842	7821	39021	NW	Chinle Holiday Inn SUV
11-4-16	0845	5.7	1007	100	48258	8617	39641	NW	Occurrence B
11-4-16	1255	5.5	1003	99	46329	8608	37721	NW	Occurrence B
11-5-16	1108	5.6	1006	99	47858	9264	38594	NW	Claim 28
11-5-16	1527	5.6	1006	99	45039	7398	37641	NW	Chinle lot in SUV
11-7-16	0905	5.7	1008	100	48193	9249	38944	NW	Claim 28
11-7-16	1836	5.6	1003	99	46785	6986	39797	NW	Chinle lot in SUV
11-8-16	0800	5.6	1009	99	47951	9183	38768	NW	Claim 28
11-8-16	1637	5.5	1003	100	45094	6916	38178	NW	Chinle lot

Reviewed by:

Review Date: 11/29/16

ERG Form ITC.201.A

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	7-5-17

DETECTOR	
Manufacturer:	Ludlum
Model:	49-10
Serial No.:	PR303727
Cal. Due Date:	7-5-17

Comments:

NNERT

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-9-16	0729	5.6	1009	100	47673	8821	38852	NW	Occurrence B
11-9-16	1415	5.4	1002	99	46465	7541	38924	NW	Chinle lot
11-10-16	0820	5.6	1011	100	47628	9750	37878	NW	Claim 28
11-10-16	1632	5.4	1002	99	50634	8930	41704	NW	Claim 28 (2nd location)
11-11-16	0816	5.5	1010	100	49034	9824	39210	NW	Claim 28
11-11-16	1555	5.4	1002	99	48985	8643	40342	NW	Occurrence B
11-12-16	0819	5.5	1009	100	49296	9054	40242	NW	Hoskie Tso
11-12-16	1340	5.3	1002	99	49800	8556	41244	NW	Hoskie Tso
11-14-16	0818	5.5	1012	100	47737	9609	38128	NW	Hoskie Tso
11-14-16	1637	5.3	1002	99	47714	9150	38564	NW	Hoskie Tso (2nd location)
11-16-16	0809	5.4	1011	100	49413	12340	37073	NW	Standing Rock
11-16-16	1510	5.3	1003	99	49649	11268	38381	NW	Gallup lot

Reviewed by:

Review Date: 11/29/16

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR295014
Cal. Due Date:	7-9-17

Comments:

NNEAT

Source: Cs-137

Activity: 5.12 uCi

Source Date: 6-6-94

Distance to Source: 6 Inches

Serial No.: 333-94

Emission Rate: NA cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-1-16	0744	5.3	1107	100	43406	4729	38677	NW	Charles Keith
11-1-16	1718	5.2	1102	99	44319	5332	38987	NW	Goulding's in SUV
11-2-16	0818	5.2	1108	100	43456	5555	37901	NW	Charles Keith
11-2-16	1703	5.1	1101	100	43874	5111	38763	NW	Gouldings in SUV
a 11-3-16	1050	6.2	1107	100	45017	5399	39618	NW	Charles Keith
* 11-3-16	1845	6.2	1104	99	47896	7562	40334	NW	Chinle Holiday Inn SUV
11-4-16	0856	6.2	1109	100	47119	8387	38732	NW	Occurrence B
11-4-16	1147	6.1	1105	100	46025	7972	38053	NW	Occurrence B
11-5-16	1112	6.1	1107	100	47483	8555	38928	NW	Claim 28
11-5-16	1524	6.1	1107	99	46828	7017	39811	NW	Chinle lot in SUV
11-7-16	0822	6.1	1108	100	46784	8794	37990	NW	Claim 28
11-7-16	1829	5.9	1104	99	46382	6448	39934	NW	Chinle lot

a. Changed batteries

Reviewed by: MH

Review Date: 11/29/16

②

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR295014
Cal. Due Date:	7-9-17

Comments:
NNERT

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-8-16	0805	6.0	1109	100	49571	9246	40325	NW	Claim 28
11-8-16	1641	5.8	1104	100	45893	6864	39029	NW	Chinle lot
11-9-16	0724	5.8	1110	101	46451	8453	37998	NW	Occurrence 8
11-9-16	1925	5.8	1104	100	47096	6903	40193	NW	Chinle lot
11-10-16	0826	5.8	1109	100	47011	9425	37586	NW	Claim 28
11-10-16	1628	5.7	1103	100	48672	8509	40163	NW	Claim 28 (2nd location)
11-12-16	0834	5.7	1109	101	47413	9188	38275	NW	Hoskie Tsu
11-12-16	1347	5.6	1101	101	48929	8265	40664	NW	Hoskie Tsu
11-14-16	1218	5.7	1105	100	48870	8074	40796	NW	Hoskie Ts.
11-14-16	1639	5.7	1105	100	47696	9068	38628	NW	Hoskie Tso (2nd locatn.)
11-15-16	0834	5.7	1110	101	50555	9150 ~~9195~~ NW	41405	NW	Hoskie Tsu
11-15-16	1142	5.5	1101	100	48004	8598	39406	NW	Hoskie Tsu

Reviewed by:

Review Date: 11/29/16

③

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	138638
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR154615
Cal. Due Date:	7-9-17

Comments:
NNERT

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-4-16	1143	5.2	1131	110	46332	8240	38092	NW	Occurrence B
11-5-16	1117	5.4	1135	113	46611	8815	37796	NW	Claim 28
11-5-16	1519	5.2	1127	104	46761	7064	39697	NW	Chinle lot
11-7-16	0815	5.3	1130	107	49792	8843	40949	NW	Claim 28
11-7-16	1821	5.2	1120	100	47318	6436	40882	NW	Chinle lot
11-16-16	0821	5.4	1158	132	50609	11976	38633	NW	Standing Rock
11-16-16	1507	5.2	1125	106	49562	10942	38620	NW	Gallup lot

NW 12-6-16

Reviewed by: MM

Review Date: 11/29/16

ERG Form ITC.201.A

④

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	282966
Cal. Due Date:	10-31-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR150507
Cal. Due Date:	10-31-17

Comments:
NNERT

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference point,
11-2-16	0832	6.0	1007	100	43939	6161	37778	NW	Charles Keith
11-2-16	1711	6.0	1003	101	44857	5744	39113	NW	Goulding's in SUV
11-4-16	0904	6.0	1008	101	47156	8938	38218	NW	Occurrence B
11-4-16	1152	5.9	1007	101	46787	8341	38446	NW	Occurrence B
11-5-16	1121	6.0	1007	101	47567	9195	38372	NW	Claim 28
11-5-16	1531	5.9	1007	101	46740	7360	39380	NW	Chinle lot in SUV
11-7-16	0810	6.0	1010	104	49757	9136	40621	NW	Claim 28
11-7-16	1832	5.8	1003	100	45791	6809	38982	NW	Chinle lot
11-8-16	0810	5.8	1009	100	49552	9855	39697	NW	Claim 28
11-8-16	1634	5.7	1003	100	48686	7133	41553	NW	Chinle lot
11-10-16	0812	5.8	1012	101	48023	9818	38205	NW	Claim 28
11-10-16	1635	5.7	1003	101	46906	9042	37864	NW	Claim 28 (2nd location)

Reviewed by: ______________

Review Date: 11/29/16

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	2-28-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 303727
Cal. Due Date:	2-28-18

Comments:
NNERT

Source: Cs-137

Serial No.: 544-96

Activity: 4 uCi

Emission Rate: N/A cpm/emissions

Source Date: 4-18-96

Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
3-16-17	1322	6.2	947	100	40116	7260	32856	NW	Cameron Trading Post lot
3-16-17	1555	6.1	942	99	38643	5986	32657	NW	Boyd Tisi
3-17-17	0812	6.2	951	100	40087	7965	32122	NW	Cameron Trading Post lot
3-17-17	1328	6.1	943	100	42203	10206	31997	NW	Boyd Tisi ~200 ft from B64
3-18-17	0750	6.1	944	100	38598	6950	31648	NW	Harvey Blackwater
3-18-17	1505	6.0	941	100	35954	5035	30919	NW	Mitten No. 3
3-19-17	0651	6.1	949	99	36982	4952	32030	NW	Goulding's lot
3-19-17	1217	5.9	945	99	36802	5103	31699	NW	Charles Keith south of claim
3-20-17	0855	6.0	950	100	40829	8989	31840	NW	Claim 28
3-20-17	1555	5.9	943	100	37489	5569	32280	NW	Chinle parking lot
3-21-17	0635	5.9	950	100	38433	5735	32698	NW	Chinle lot
3-21-17	1657	5.9	946	100	36797	4997	31800	NW	Goulding's lot

Reviewed by: MM

Review Date: 10/17/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	2-28-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 295014
Cal. Due Date:	2-28-18

Comments:

NNEAT

Source: Cs-137

Serial No.: 544-96

Activity: 4 uCi

Emission Rate: NA cpm/emissions

Source Date: 4-18-96

Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
3-20-17	0905	5.7	1003	101	40471	8507	31964	NW	Claim 28
3-20-17	1547	5.6	996	101	36470	5494	30976	NW	Chinle lot
3-21-17	0641	5.7	1004	101	37904	5597	32307	NW	Chinle lot
3-21-17	1654	5.6	999	101	36212	4929	31283	NW	Goulding's lot
3-22-17	0702	5.6	1001	101	35714	5119	30595	NW	Goulding's lot
3-22-17	1437	5.4	995	101	35087	4539	30548	NW	Charles Keith shooting range
3-23-17	0907	5.6	1004	101	36031	4879	31152	NW	NA-0928
3-23-17	1922	5.5	1004	101	41793	9955	31838	NW	Gallup lot
3-24-17	0810	5.5	1007	101	35608	4282	31326	NW	Eunice Becenti
3-24-17	1735	5.5	1000	101	41923	10785	31138	NW	Gallup lot
3-27-17	0833	5.5	1005	101	36943	4282	32661	NW	Eunice Becenti
3-27-17	1235	5.4	1000	101	35141	4013	31128	NW	Eunice Becenti

Reviewed by: MW

Review Date: 10/9/17

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ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	2-28-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	2-28-17

Comments:

NWERT

Source: Cs-137

Serial No.: 544-96

Activity: 4 uCi

Emission Rate: NA cpm/emissions

Source Date: 4-18-96

Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4.11.17	0920	5.7	1000	101	36807	5626	31181	NW	NA-0928
4.11.17	1607	5.1	994	100	35724	5073	30651	NW	NA-0904 upper
4.14.17	0910	5.3	999	100	37554	5361	32193	NW	NA-0928
4.14.17	1050	5.3	997	100	37119	5165	31954	NW	NA-0928
4.17.17	0926	5.6	1000	101	37381	5937	31444	NW	NA-0928
4.17.17	1314	5.5	993	100	37712	5579	32133	NW	Barton 3
4.18.17	1400	5.6	997	100	40901	8541	32360	NW	Claim 28
4.18.17	1633	5.5	996	100	38299	8808	29491	NW	Claim 28
					4.19.17				

Reviewed by:

Review Date: 11/08/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	282971
Cal. Due Date:	3-13-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR320178
Cal. Due Date:	3-13-18

Comments:

NNEAT

Source: Cs-137

Activity: 4 uCi

Source Date: 4-18-96

Distance to Source: 6 inches

Serial No.: 544-96

Emission Rate: NA cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4-17-17	1312	5.9	1044	100	38272	6004	32268	NW	Barton 3
4-18-17	1356	5.9	1049	100	41042	8945	32097	NW	Claim 28
4-18-17	1636	5.8	1047	100	40713	9418	31295	NW	Claim 28
4-19-17	0821	5.9	1049	101	40983	9954	31029	NW	Claim 28
4-19-17	1350	5.7	1047	100	40955	9152	31803	NW	Claim 28
4-20-17	0919	5.8	1051	100	41485	9593	31892	NW	Claim 28
4-20-17	1315	5.7	1046	100	40970	9549	31421	NW	Claim 28

4-24-17

Reviewed by:

Review Date: 10/4/17

ERG Form ITC.201.A

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	2-28-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 295014
Cal. Due Date:	2-28-17

Comments:

NNERT

Source: Cs-137
Activity: 4 uCi
Source Date: 4-18-96
Distance to Source: 6 inches
Serial No.: 544-96
Emission Rate: NA cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4-11-17	0932	5.5	1100	100 mv	36776	5404		NW	NA-0928
4-11-17	1601	5.4	1094	100	36796	5031		NW	NA-0904 (upper)
4-12-17	0850	5.4	1100	101	37067	5050		NW	NA-0928
4-12-17	1510	5.3	1092	100	36453	5524		NW	NA-0904
4-13-17	0855	5.4	1101	101	36895	5793		NW	NA-0928
4-12-17	1648	5.3	1092	100	38916	5572		NW	NA-0904
4-15-17	0840	5.4	1100	101	37457	5291		NW	NA-0928
4-13-17	1612	5.2	1090	100	38092	6045		NW	Barton 3
4-17-17	0921	5.4	1101	101	38591	5561		NW	NA-0928
4-17-17	1317	5.3	1090	100	37050	5496		NW	Barton 3
4-18-17	1354	5.4	1098	101	40983	8497		NW	Claim 28
4-18-17	1642	5.2	1091	101	39900	8193		NW	Claim 28

Reviewed by:

Review Date: 10/9/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	GE
Model:	RS3-131
Serial No.:	07J00KM1
Cal. Due Date:	6-29-17

DETECTOR	
Manufacturer:	SAME AS METER
Model:	
Serial No.:	
Cal. Due Date:	

Comments:
NNERT

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: Contact-housing

Date	Time	Battery	High Voltage	Threshhold	Source Counts μR/h	BKG Counts μR/h	Net Counts	Initials	Note(s): Project reference points
10-26-16	0525	~6.4	~400	NA	~27.8	~10.5	~17.3	NW	Best Western room - Flagstaff
10-26-16	2010	~6.3	~400	NA	~26	~9.5	~16.5	NW	Gouldings room ~~Best Western room - Flagstaff~~
10-27-16	0720	~6.2	~400	NA	~26.7	~10.0	~16.7	NW	Gouldings room
10-27-16	1710	~6.2	~400	NA	~27.0	~10.8	~16.2	NW	Gouldings room
10-31-16	0609	~6.3	~400	NA	~27.0	~10	~16	NW	Gouldings room
10-31-16	1520	~6.3	~400	NA	~26	~10	~16	NW	Gouldings room
11-3-16	0700	~6.2	~400	NA	~26.5	~10.5	~16	NW	Gouldings room
11-3-16	1924	~6.1	~400	NA	~28.8	~12.5	~16.3	NW	Holiday Inn Chinle-room
11-9-16	0615	~6.3	~400	NA	~30	~12.8	~17.2	NW	Holiday Inn-Chinle room
11-9-16	1430	~6.2	~400	NA	~29.5	~12.5	~17	NW	Holiday Inn Chinle-room
11-11-16	0610	~6.4	~400	NA	~31.5	~13.5	~18	NW	Holiday Inn Chinle-room
11-11-16	1825	~6.2	~400	NA	~28	~11	~17	NW	Holiday Inn Chinle-room

Reviewed by:

Review Date: 11-29-16

Appendix B Exposure Rate Measurements

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 10:30	0.0545	Correlation Location 1
11/11/2016 10:30	0.0958	Correlation Location 1
11/11/2016 10:30	0.0842	Correlation Location 1
11/11/2016 10:30	0.0585	Correlation Location 1
11/11/2016 10:30	0.0394	Correlation Location 1
11/11/2016 10:31	0.0279	Correlation Location 1
11/11/2016 10:31	0.0215	Correlation Location 1
11/11/2016 10:31	0.0182	Correlation Location 1
11/11/2016 10:31	0.0165	Correlation Location 1
11/11/2016 10:31	0.0154	Correlation Location 1
11/11/2016 10:31	0.0148	Correlation Location 1
11/11/2016 10:31	0.015	Correlation Location 1
11/11/2016 10:31	0.0156	Correlation Location 1
11/11/2016 10:31	0.0155	Correlation Location 1
11/11/2016 10:31	0.0154	Correlation Location 1
11/11/2016 10:32	0.015	Correlation Location 1
11/11/2016 10:32	0.0149	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0144	Correlation Location 1
11/11/2016 10:32	0.015	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:33	0.0155	Correlation Location 1
11/11/2016 10:33	0.0152	Correlation Location 1
11/11/2016 10:33	0.0149	Correlation Location 1
11/11/2016 10:33	0.0148	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0156	Correlation Location 1
11/11/2016 10:33	0.0155	Correlation Location 1
11/11/2016 10:33	0.0154	Correlation Location 1
11/11/2016 10:34	0.0158	Correlation Location 1
11/11/2016 10:34	0.0161	Correlation Location 1
11/11/2016 10:34	0.0156	Correlation Location 1
11/11/2016 10:34	0.0151	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0151	Correlation Location 1
11/11/2016 10:34	0.015	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:35	0.0153	Correlation Location 1
11/11/2016 10:35	0.0154	Correlation Location 1
11/11/2016 10:35	0.0155	Correlation Location 1
11/11/2016 10:35	0.0155	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:35	0.0164	Correlation Location 1
11/11/2016 10:35	0.0162	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:35	0.0156	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0152	Correlation Location 1
11/11/2016 10:36	0.0154	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0153	Correlation Location 1
11/11/2016 10:36	0.0152	Correlation Location 1
11/11/2016 10:36	0.0155	Correlation Location 1
11/11/2016 10:36	0.0158	Correlation Location 1
11/11/2016 10:36	0.0158	Correlation Location 1
11/11/2016 10:37	0.0154	Correlation Location 1
11/11/2016 10:37	0.0155	Correlation Location 1
11/11/2016 10:37	0.0156	Correlation Location 1
11/11/2016 10:37	0.0158	Correlation Location 1
11/11/2016 10:37	0.0161	Correlation Location 1
11/11/2016 10:37	0.0162	Correlation Location 1
11/11/2016 10:37	0.0163	Correlation Location 1
11/11/2016 10:37	0.016	Correlation Location 1
11/11/2016 10:37	0.0156	Correlation Location 1
11/11/2016 10:37	0.0153	Correlation Location 1
11/11/2016 10:38	0.015	Correlation Location 1
11/11/2016 10:38	0.0147	Correlation Location 1
11/11/2016 10:38	0.0148	Correlation Location 1
11/11/2016 10:38	0.0145	Correlation Location 1
11/11/2016 10:38	0.0142	Correlation Location 1
11/11/2016 10:38	0.0142	Correlation Location 1
11/11/2016 10:38	0.0146	Correlation Location 1
11/11/2016 10:38	0.0151	Correlation Location 1
11/11/2016 10:38	0.0151	Correlation Location 1
11/11/2016 10:38	0.0149	Correlation Location 1
11/11/2016 10:39	0.0149	Correlation Location 1
11/11/2016 10:39	0.015	Correlation Location 1
11/11/2016 10:39	0.0151	Correlation Location 1
11/11/2016 10:39	0.015	Correlation Location 1
11/11/2016 10:39	0.0147	Correlation Location 1
11/11/2016 10:39	0.0151	Correlation Location 1
11/11/2016 10:39	0.0154	Correlation Location 1
11/11/2016 10:39	0.0156	Correlation Location 1
11/11/2016 10:39	0.0158	Correlation Location 1
11/11/2016 10:39	0.0158	Correlation Location 1
11/11/2016 10:40	0.0156	Correlation Location 1
11/11/2016 10:40	0.0153	Correlation Location 1
11/11/2016 10:40	0.0146	Correlation Location 1
11/11/2016 10:40	0.0144	Correlation Location 1
11/11/2016 10:40	0.0149	Correlation Location 1
11/11/2016 10:40	0.0153	Correlation Location 1
11/11/2016 10:40	0.0155	Correlation Location 1
11/11/2016 10:40	0.016	Correlation Location 1
11/11/2016 10:40	0.0158	Correlation Location 1
11/11/2016 10:40	0.0155	Correlation Location 1
11/11/2016 10:41	0.0151	Correlation Location 1
11/11/2016 10:41	0.0154	Correlation Location 1
11/11/2016 10:41	0.0153	Correlation Location 1
11/11/2016 11:14	0.0556	Correlation Location 2
11/11/2016 11:14	0.0983	Correlation Location 2
11/11/2016 11:15	0.0879	Correlation Location 2
11/11/2016 11:15	0.0626	Correlation Location 2

Claim 28 Exposure Rate Measurements for Correlation

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 11:15	0.0433	Correlation Location 2
11/11/2016 11:15	0.0317	Correlation Location 2
11/11/2016 11:15	0.0258	Correlation Location 2
11/11/2016 11:15	0.0229	Correlation Location 2
11/11/2016 11:15	0.0211	Correlation Location 2
11/11/2016 11:15	0.0201	Correlation Location 2
11/11/2016 11:15	0.0198	Correlation Location 2
11/11/2016 11:15	0.0197	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0199	Correlation Location 2
11/11/2016 11:16	0.0198	Correlation Location 2
11/11/2016 11:16	0.0197	Correlation Location 2
11/11/2016 11:16	0.02	Correlation Location 2
11/11/2016 11:17	0.0202	Correlation Location 2
11/11/2016 11:17	0.02	Correlation Location 2
11/11/2016 11:17	0.0196	Correlation Location 2
11/11/2016 11:17	0.0197	Correlation Location 2
11/11/2016 11:17	0.0197	Correlation Location 2
11/11/2016 11:17	0.0192	Correlation Location 2
11/11/2016 11:17	0.0194	Correlation Location 2
11/11/2016 11:17	0.02	Correlation Location 2
11/11/2016 11:17	0.0205	Correlation Location 2
11/11/2016 11:17	0.0205	Correlation Location 2
11/11/2016 11:18	0.0202	Correlation Location 2
11/11/2016 11:18	0.0201	Correlation Location 2
11/11/2016 11:18	0.0207	Correlation Location 2
11/11/2016 11:18	0.0208	Correlation Location 2
11/11/2016 11:18	0.0204	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.0198	Correlation Location 2
11/11/2016 11:18	0.0196	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0194	Correlation Location 2
11/11/2016 11:19	0.019	Correlation Location 2
11/11/2016 11:19	0.019	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.02	Correlation Location 2
11/11/2016 11:20	0.0196	Correlation Location 2
11/11/2016 11:20	0.019	Correlation Location 2
11/11/2016 11:20	0.0192	Correlation Location 2
11/11/2016 11:20	0.0194	Correlation Location 2
11/11/2016 11:20	0.0197	Correlation Location 2
11/11/2016 11:20	0.02	Correlation Location 2
11/11/2016 11:20	0.0202	Correlation Location 2
11/11/2016 11:20	0.0201	Correlation Location 2
11/11/2016 11:20	0.0199	Correlation Location 2
11/11/2016 11:20	0.02	Correlation Location 2
11/11/2016 11:21	0.0202	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.02	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.0198	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.02	Correlation Location 2
11/11/2016 11:22	0.02	Correlation Location 2
11/11/2016 11:22	0.02	Correlation Location 2
11/11/2016 11:22	0.0196	Correlation Location 2
11/11/2016 11:22	0.0194	Correlation Location 2
11/11/2016 11:22	0.0198	Correlation Location 2
11/11/2016 11:22	0.0204	Correlation Location 2
11/11/2016 11:22	0.0207	Correlation Location 2
11/11/2016 11:22	0.0207	Correlation Location 2
11/11/2016 11:22	0.0209	Correlation Location 2
11/11/2016 11:22	0.0208	Correlation Location 2
11/11/2016 11:23	0.0208	Correlation Location 2
11/11/2016 11:23	0.0209	Correlation Location 2
11/11/2016 11:23	0.0211	Correlation Location 2
11/11/2016 11:23	0.0207	Correlation Location 2
11/11/2016 11:23	0.0202	Correlation Location 2
11/11/2016 11:23	0.0201	Correlation Location 2
11/11/2016 11:23	0.0204	Correlation Location 2
11/11/2016 11:23	0.021	Correlation Location 2
11/11/2016 11:23	0.0215	Correlation Location 2
11/11/2016 11:23	0.0213	Correlation Location 2
11/11/2016 11:24	0.0213	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:24	0.02	Correlation Location 2
11/11/2016 11:24	0.0198	Correlation Location 2
11/11/2016 11:24	0.0198	Correlation Location 2
11/11/2016 11:24	0.0201	Correlation Location 2
11/11/2016 11:24	0.0211	Correlation Location 2
11/11/2016 11:24	0.0211	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:25	0.0208	Correlation Location 2
11/11/2016 11:25	0.0206	Correlation Location 2
11/11/2016 11:25	0.02	Correlation Location 2
11/11/2016 11:25	0.0201	Correlation Location 2
11/11/2016 11:25	0.0201	Correlation Location 2
11/11/2016 11:25	0.0199	Correlation Location 2
11/11/2016 11:25	0.0199	Correlation Location 2
11/11/2016 11:55	0.0566	Correlation Location 3
11/11/2016 11:56	0.1014	Correlation Location 3
11/11/2016 11:56	0.0929	Correlation Location 3
11/11/2016 11:56	0.068	Correlation Location 3
11/11/2016 11:56	0.0491	Correlation Location 3
11/11/2016 11:56	0.0377	Correlation Location 3
11/11/2016 11:56	0.0319	Correlation Location 3
11/11/2016 11:56	0.0289	Correlation Location 3
11/11/2016 11:56	0.027	Correlation Location 3

Claim 28 Exposure Rate Measurements for Correlation

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 11:56	0.0256	Correlation Location 3
11/11/2016 11:56	0.0253	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0244	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0253	Correlation Location 3
11/11/2016 11:57	0.0256	Correlation Location 3
11/11/2016 11:58	0.0258	Correlation Location 3
11/11/2016 11:58	0.0259	Correlation Location 3
11/11/2016 11:58	0.0255	Correlation Location 3
11/11/2016 11:58	0.0249	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:58	0.0252	Correlation Location 3
11/11/2016 11:58	0.0255	Correlation Location 3
11/11/2016 11:58	0.0251	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:59	0.0245	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0247	Correlation Location 3
11/11/2016 11:59	0.0251	Correlation Location 3
11/11/2016 11:59	0.0252	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0245	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0252	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 12:00	0.0249	Correlation Location 3
11/11/2016 12:00	0.0249	Correlation Location 3
11/11/2016 12:00	0.0245	Correlation Location 3
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11/11/2016 14:03	0.018	Correlation Location 5
11/11/2016 14:03	0.0179	Correlation Location 5
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11/11/2016 14:04	0.0182	Correlation Location 5
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11/11/2016 14:05	0.0173	Correlation Location 5
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11/11/2016 14:05	0.0172	Correlation Location 5
11/11/2016 14:05	0.017	Correlation Location 5

Appendix C Technical Memo - Statistical Analysis of the Navajo Trustee Mines Dataset: Multivariate Linear Regression for Evaluation of Gamma Correlation with Ra-226 and Evaluation of Secular Equilibrium Between Ra-226 and Th-230

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Memo

To: Kirsty Woods, Program Director, Stantec

From: Liz Ruedig, PhD, CHP, and Mike Schierman, CHP, Environmental Restoration Group

Date: 7/31/2018

Re: Statistical Analysis of the Navajo Trustee Mines Dataset: Multivariate Linear Regression for Evaluation of Gamma Correlation with Ra-226 and Evaluation of Secular Equilibrium Between Ra-226 and Th-230

Multivariate Linear Regression for Evaluation of Gamma Count Rate with Ra-226 Concentrations in Surface Soil

Due to a large number of reviewer comments at the sixteen Navajo Trust Abandoned Uranium Mines (AUMs) concerning the influence of gamma-emitting radionuclides not within the uranium-238 decay series on the correlation between dynamic gamma count rate and soil concentration of radium-226, Environmental Restoration Group has performed multivariate linear regression (MLR), relating gamma count rate to multiple soil radionuclides simultaneously. MLR models the influence of a set of predictor variables (in this case, soil concentrations of several gamma-emitting radionuclides, or surrogates for these radionuclides) on a single response variable (in this case, dynamic gamma count rate), accounting for the influence of each predictor variable upon the response variable independently of the other predictor variables within the set.

In a MLR, it is possible to distinguish from a large set of variables the subset that significantly predicts a response variable. This is done by evaluating potential models on a number of criteria:

1. **The multi-collinearity of predictor variables.**

   Predictor variables that are linearly related to each other (i.e., variables y and x, where y may also be mathematically expressed as some multiple of x) produce a condition known as multicollinearity, where the matrix math used to solve the multivariate linear regression becomes irreducible. A physical example of multicollinearity occurs when modelling the influence of two radionuclides in equilibrium with each other (e.g., Th-230 and Ra-226) on a single response variable (e.g., gamma count rate). In order to compute a mathematical solution to the regression model, one of the multicollinear variables must be removed from the regression matrix. The multicollinear variables are identifiable by a large variance inflation factor (VIF), typically greater than 7, but in cases of near-perfect multicollinearity, often much greater than this value (e.g., > 100).

   It is also possible to identify multicollinear predictor variables by regressing two suspect variables upon each other. A high degree of correlation (i.e., $p < 0.05$ and high adjusted R^2) between the two variables suggests that the predictor variables are multicollinear, and that one variable should be eliminated from the multivariate regression prior to analysis.

2. **The p-value of predictor variables**

   For a variable to be considered a significant predictor of the response variable, the p-value of its slope (as calculated in an ANOVA table) must be significant (i.e., $p < 0.05$). In a MLR, the adjusted R^2 value for individual predictor variables is not indicative of overall model quality.

For the Navajo Trust AUMs there are three potential gamma-contributing radionuclides (defined as radionuclides that emit gamma radiation, or whose short-lived decay products emit gamma radiation) present in soil: thorium-232, radium-226 and, thorium-228. Thorium-230, which does not emit gamma radiation, was excluded as a potentially significant gamma-contributing radionuclide.

A MLR model: gamma = radium-226 + thorium-228 + thorium-232 was run for each AUM. For 15 of the 16 mines, thorium-232 and thorium-228 were multicollinear. On this basis, thorium-228 was excluded from the MLR. No multicollinearity was detected at Barton 3. However, none of the predictor variables was a significant predictor of gamma count rate ($p > 0.05$) for the complete model. As such, analysis for all 16 AUMs proceeded by removing thorium-228 from the set of predictor variables and running a new MLR model: gamma = radium-226 + thorium-232. None of the 16 models exhibited multicollinearity with the reduced model. After accounting for the effect of radium-226, thorium-232 was not a significant predictor of gamma count rate at any of the 16 AUMs. Radium-226 was a significant predictor ($p < 0.05$) of gamma count rate (after accounting for the influence of thorium-232 and thorium-228) at some of the AUMs (six of 16 AUMs).

Since neither predictor variable (thorium-232 or radium-226) was unambiguously a predictor in the MLR, two univariate regression models were performed as a final step: gamma = radium-226 and gamma = thorium-232. Thorium-232 was a significant predictor of gamma count rate ($p < 0.05$) only at Standing Rock, which is not unexpected given the geological conditions at this AUM. At all other sites, thorium-232 (and thorium-228 by association) were not significant predictors of gamma count rate ($p > 0.05$). By way of contrast, radium-226 was a significant predictor of the gamma count rate ($p < 0.05$) at 13 of the 16 AUMs. At three AUMs (Mitten, NA-0928, and Tsosie 1) none of the measured radionuclides significantly predicted the gamma count rate. Additionally, the adjusted R^2 values for the correlation models at the three AUMs, plus Claim 28, fail to meet the specified data quality objective (DQO) of greater than 0.8.

The failure to construct statistically defensible correlation models at four AUMs has been identified as a data gap in the relevant AUM report. The unsatisfactory correlation result at these locations is likely due to the small number of correlation locations, or environmental conditions at the AUMs (e.g., spatial heterogeneity in radionuclide concentration in soil, topographic features influencing gamma count rate, etc.), or some combination thereof.

Note that while the statistical measures (i.e., conformance with the study DQO of $R^2 > 0.8$) associated with these regressions can be improved by fitting a power curve to the data, and reporting unadjusted R^2 values, with only five data points at each AUM, ERG does not believe that any statistical correlation model is sufficiently robust to make meaningful inferences concerning soil radium-226 concentration from the gamma scanning data. ERG believes that linear functions – not power curves – best mimic the conceptual model for the physical processes governing the observed data. Fitting any other function in an effort to achieve the study DQO for R^2 is not a statistically rigorous approach, and improving R^2 does not commensurately improve a statistical model's predictive ability. Figure *1* compares the result of fitting a linear versus a power function to the available correlation data for one AUM (Hoskie Tso); the other AUM results are similar.

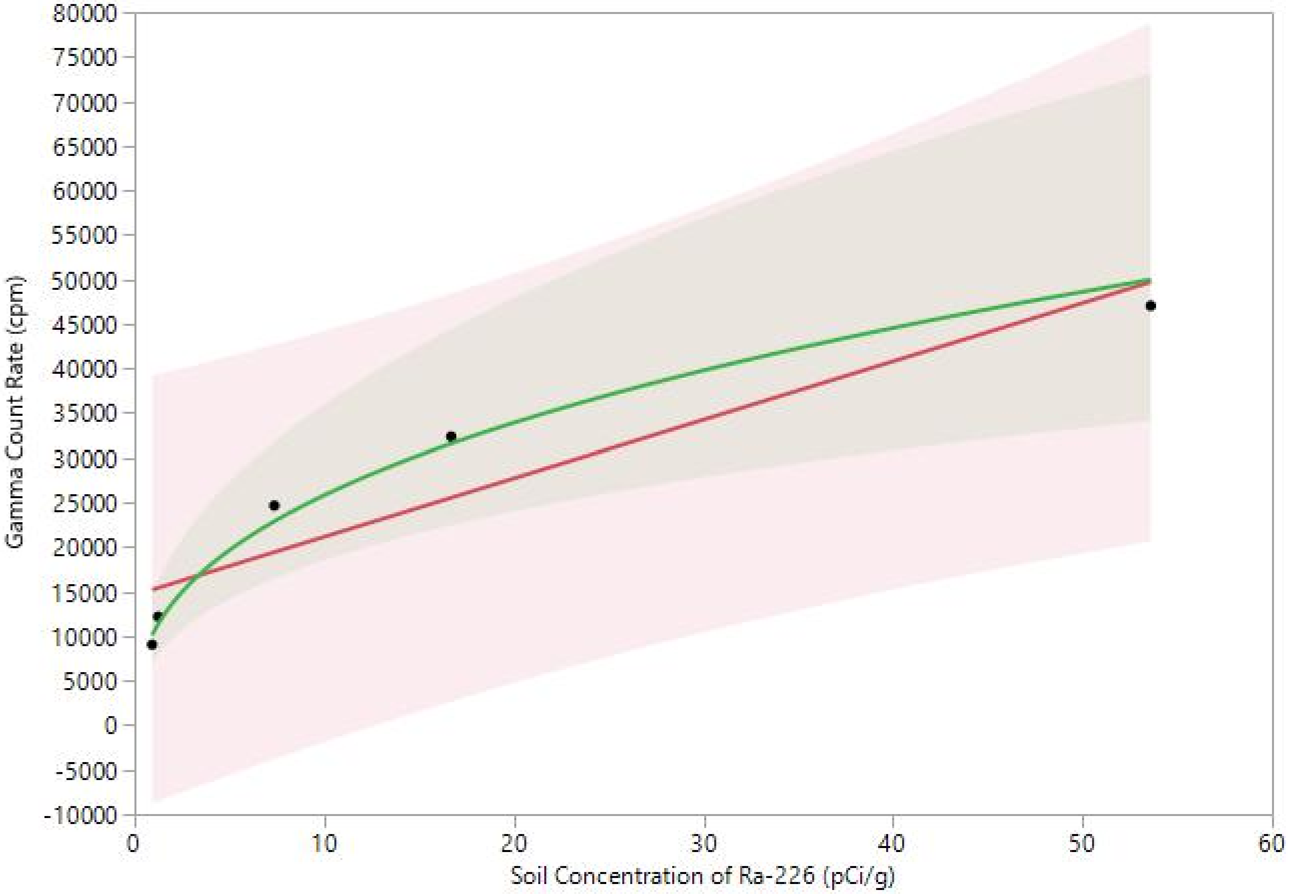

Figure 1. Regression models (linear versus power curve) for gamma count rate regressed on radium-226 showing 95% UPLs (upper prediction limits). Both models meet the study DQO for adjusted R^2 (greater than 0.8). Gamma count rate is not an especially strong predictor of soil concentration of radium-226 for either function.

ERG has updated the individual AUM reports with linear correlation functions and reported the more robust measures of statistical performance described in this memo.

Evaluation of Secular Equilibrium Between Ra-226 and Th-230

Secular equilibrium is a condition that occurs when the half-life of a decay-product nuclide is significantly shorter than that of its parent nuclide. After a period of ingrowth equal to approximately seven times the half-life of the decay product, the two nuclides effectively decay with the half-life of the parent. When two radionuclides are in secular equilibrium, their activities are equal.

Equilibrium, for the purpose of this report, is defined as a condition whereby a parent nuclide and its decay product are present in the environment at a fixed ratio, but this ratio – for whatever reason – is not a one-to-one relationship indicative of secular equilibrium. Most commonly, an equilibrium condition results from an environmental process which chemically selects for and transports one nuclide (parent or decay product) away from the other nuclide. Because a consistent fraction of one nuclide has been removed, the two nuclides are present at a fixed ratio other than one-to-one.

Determination of secular equilibrium for an AUM can be an important part of the risk assessment process, as the assumed fraction of radium-226 decay products present in the environment greatly influences a hypothetical receptor's radiation dose and mortality risk. However, it is also acceptable and conservative to assume secular equilibrium between radium-226 and its decay products for the purpose of risk assessment, and therefore to avoid the need to conclusively determine the secular equilibrium status of an AUM. Thus, an inconclusive result regarding secular equilibrium is not a study data gap, as the risk assessment phase may still proceed, provided that conservative assumptions are included regarding equilibrium concentrations of radium-226 decay products.

Regardless, the Navajo Nation AUM Environmental Response Trust RSE workplan specified that an evaluation of secular equilibrium would be made at each of the 16 Trust AUMs, and so a robust statistical examination of secular equilibrium status for radium-226 and its decay products at each AUM was conducted. One method of evaluating equilibrium between Ra-226 and Th-230 is to calculate the ratio (φ) between the two nuclides for each soil sample location, i.e.,

$$\varphi = \frac{\left[{}^{226}Ra\right]}{\left[{}^{230}Th\right]}$$

When φ is unity, the two nuclides may be said to be in secular equilibrium. Sometimes, φ is averaged over a number of locations, and if the average is unity, the population of measurement locations is said to be in secular equilibrium. Similarly, if φ is consistently some number other than one, it may be concluded that the measured population is in equilibrium. This approach does not account for the statistical uncertainty associated with making inferences across a population, nor the bias introduced into the measurement by averaging a potentially large number of ratios. It is also difficult to establish defensible cutoffs for whether Ra-226 and Th-230 are in secular equilibrium at a particular site using a ratio approach, as there is no objective basis for concluding, e.g., that φ must be between 0.8 and 1.2 (versus any other range of values for φ) for secular equilibrium to occur.

Due to a large number of reviewer comments concerning secular equilibrium within the RSE reports, Environmental Restoration Group opted to re-evaluate equilibrium at each mine site using a more robust statistical method: simple linear regression. This was done after confirming the methods to analyze Ra-226 (EPA Method 901.1) and Th-230 (alpha spectroscopy following sample digestion with hydrofluoric acid) are both total-activity methods with comparable results (L. Steere, ALS personal email communication, July 25, 2018). Evaluation of secular equilibrium for each mine site proceeded as follows:

1. Construction of a figure that depicts soil concentrations of Th-230 plotted against soil concentrations of Ra-226.

2. Simple linear regression is performed on the dataset; the p-value and the adjusted R^2 are recorded. The resulting linear model and the 95% UCL (upper confidence limit) bands are plotted on the figure generated in step 1.

3. The line y=x is added to the figure generated in step 2 (this line represents a perfect 1:1 ratio between Th-230 to Ra-226, indicative of secular equilibrium).

4. An examination of the model and the figure is made sequentially:

    a. If the p-value for the regression slope is insignificant (i.e., $p > 0.05$) or the adjusted R^2 does not meet the study's data quality objective (Adjusted $R^2 > 0.8$), ERG concludes that there is insufficient evidence to conclude that Ra-226 and Th-230 are in equilibrium (secular or otherwise) therefore, it is listed as inconclusive (no equilibrium). Figure *2* depicts the regression result for an AUM (Mitten) that failed to meet the p-value and adjusted R^2 criteria.

    b. If the p-value for the regression slope is significant (i.e., $p < 0.05$) and the adjusted R^2 meets the DQO (Adjusted $R^2 > 0.8$) there are two possible conditions, which are evaluated via visual examination of the figure generated in step 3.

        i. If the y=x line falls fully within the bounds of the 95% UCL bands on the regression, ERG concludes that there is evidence that Ra-226 and Th-230 are in secular equilibrium at the site. Figure *3* depicts the regression result for an AUM (Harvey Blackwater) where there is evidence that Ra-226 and Th-230 are in secular equilibrium.

        ii. If the y=x line falls partially or completely outside the bounds of the 95% UCL bands on the regression, ERG concludes that there is evidence that Ra-226 and Th-230 are in equilibrium, but not secular equilibrium at the site. Figure *4* depicts the regression result for an AUM (Alongo Mines) where there is evidence that Ra-226 and Th-230 are in equilibrium, but not secular equilibrium.

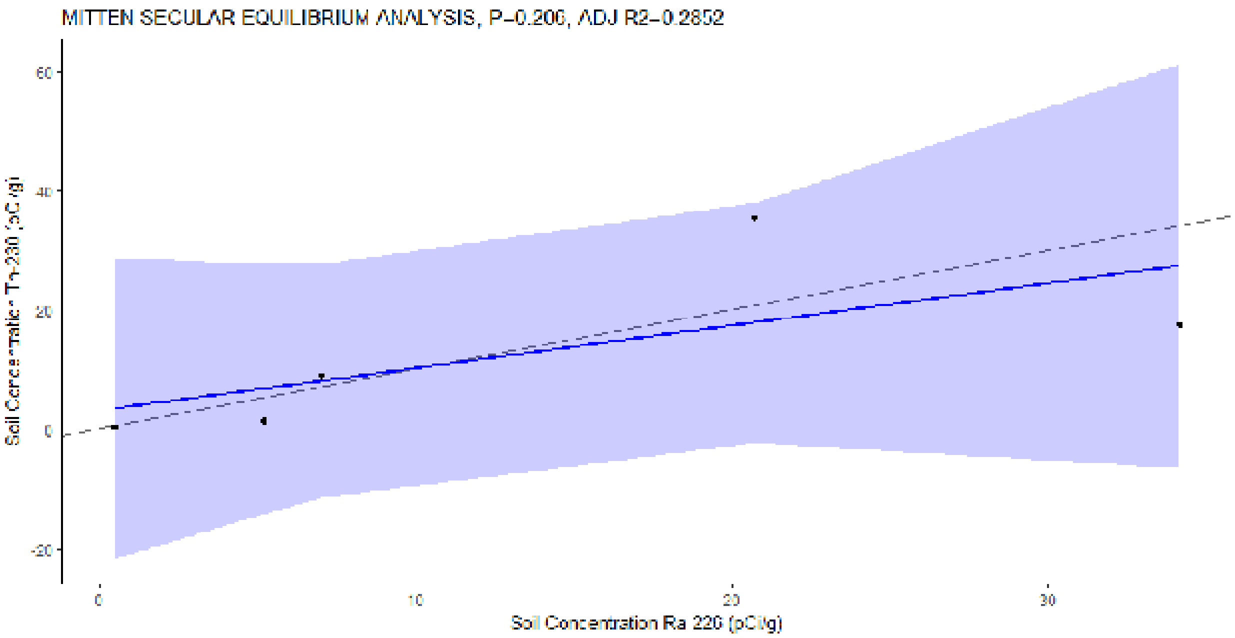

Figure 2. Result for Mitten secular equilibrium analysis, showing failure to meet p-value and adjusted R^2 criteria, i.e., the data are poorly correlated.

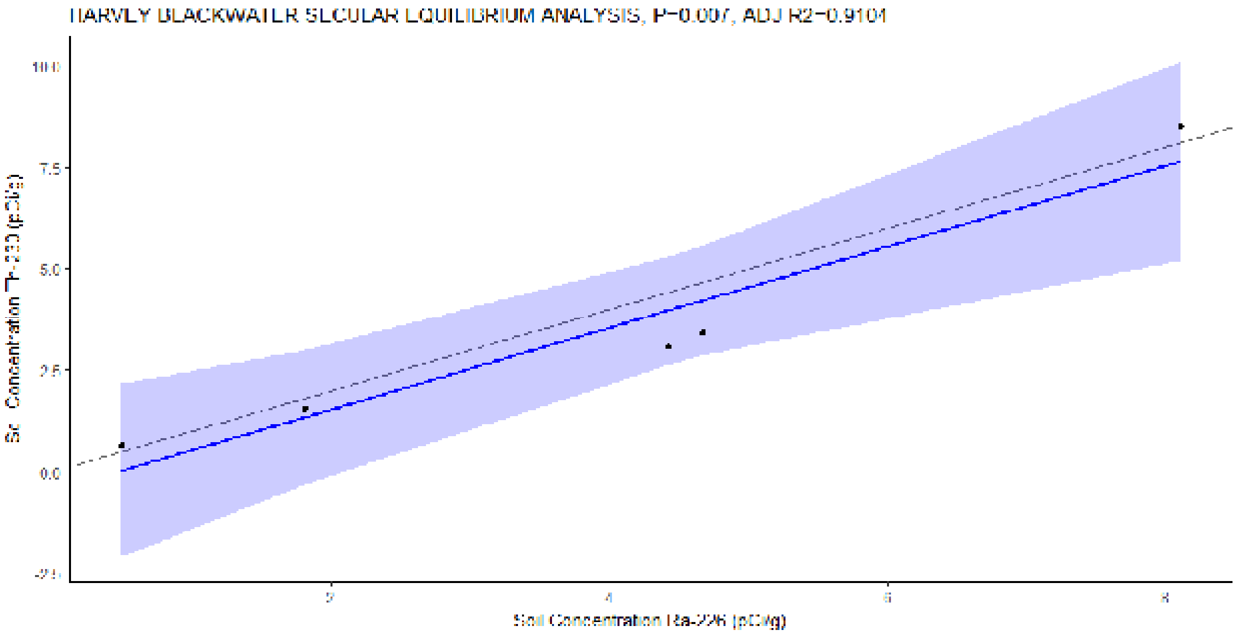

Figure 3. Result for Harvey Blackwater secular equilibrium analysis, showing excellent correlation between the data and the y=x line, i.e., Th-230 and Ra-226 are in secular equilibrium.

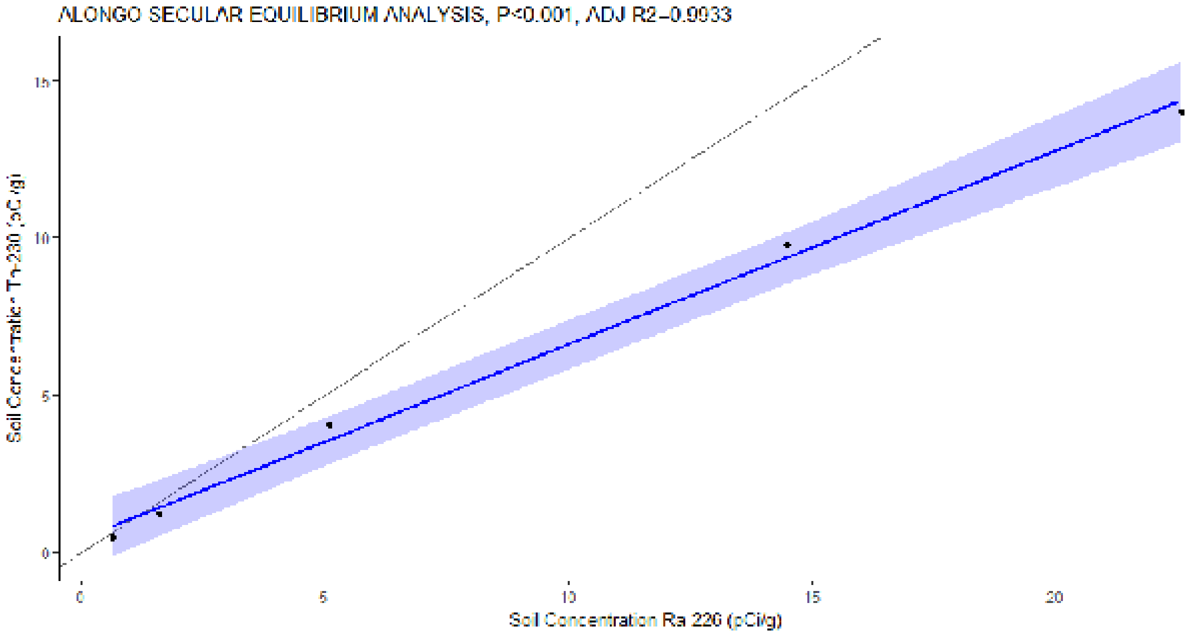

Figure 4. Result for Alongo Mines secular equilibrium analysis, showing excellent correlation between the data, but poor agreement with the y=x line, i.e., Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

ERG tested for secular equilibrium at each of the 16 Navajo AUMs using the process described above. The results are summarized in Table 1 and in the RSE report for each AUM, respectively. ERG concluded that the data provide evidence that that Ra-226 and Th-230 are in secular equilibrium in soils at two mines (Harvey Blackwater and NA-0928). At one mine (Mitten) there was insufficient evidence to draw any conclusions regarding equilibrium. At the remaining sites, there is evidence that Ra-226 and Th-230 are in equilibrium.

Table 1. Results of secular equilibrium analysis for each of the 16 Navajo Trust AUMs.

Mine	p-value	Adjusted R^2	Conclusion
Alongo Mine	<0.001	0.99	Equilibrium
Barton 3	<0.001	0.98	Equilibrium
Boyd Tisi	<0.001	0.99	Equilibrium
Charles Keith	<0.001	0.99	Equilibrium
Claim 28	<0.001	0.99	Equilibrium
Eunice Becenti	<0.001	0.99	Equilibrium
Harvey Blackwater	0.008	0.91	Secular Equilibrium
Hoskie Tso	<0.001	0.99	Equilibrium
Mitten	0.2	0.29	No Equilibrium
NA-0904	0.001	0.98	Equilibrium
NA-0928	0.002	0.97	Secular Equilibrium
Oak 124-125	<0.001	0.99	Equilibrium
Occurrence B	<0.001	0.98	Equilibrium
Section 26	0.002	0.96	Equilibrium
Standing Rock	0.008	0.91	Equilibrium
Tsosie 1	0.02	0.86	Equilibrium

Appendix D Draft Report - Radiological Characterization of the Claim 28 Abandoned Uranium Mine

Radiological Characterization of the Claim 28 Abandoned Uranium Mine

Draft

February 19, 2018

prepared for:

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Acronyms

ANSI	American National Standards Institute
AUM	abandoned uranium mine
BG1	Background Reference Area 1
BG2	Background Reference Area 2
cpm	counts per minute
DQOs	data quality objectives
ERG	Environmental Restoration Group, Inc.
ft	foot
GPS	global positioning system
m	meter
MDL	method detection limit
µR/h	microRoentgens per hour
pCi/g	picocuries per gram
R^2	Pearson's Correlation Coefficient
RSE	removal site evaluation
σ	standard deviation
Stantec	Stantec Consulting Services Inc.

Executive Summary

This report addresses the radiological characterization of the Claim 28 abandoned uranium mine (AUM) located in the Tachee/Blue Gap Chapter of the Navajo Nation near Tahchee, Arizona. It documents part of the implementation of the Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan (RSE Work Plan: MWH, 2016). The work was performed by Environmental Restoration Group, Inc. of Albuquerque, New Mexico and Stantec Consulting Services Inc. (Stantec) on behalf of the Navajo Nation AUM Environmental Response Trust – First Phase.

This report provides 1) the results of a Global Positioning System (GPS)-based gamma radiation (gamma) survey, 2) comparisons of the gamma count rates at this AUM to exposure rates and concentrations of radium-226 in surface soils, and 3) an assessment of equilibrium in the uranium series. The field activities addressed in this report were conducted on May 5, November 5, 7, 8, 10, and 11, 2016; and March 20 and 21, and April 18, 2017. They included a GPS-based radiological survey of land surfaces over a Survey Area consisting of the mine claim area out to a 100-foot (ft) buffer, roads and drainages within a 0.25-mile radius of the 100-ft buffer, areas where the survey was extended; and correlation studies.

The discussion of the results of soil sampling in this report is limited to concentrations of radium-226 and isotopes of thorium in samples taken from surface soils, as part of correlation studies. The objective of the analysis of thorium isotopes was to 1) assess the potential effects of thorium-232 and thorium-228 on the correlation of gamma count rates to concentrations of radium-226 in surface soils; and 2) evaluate thorium-230 and radium-226 activities to indicate the status of equilibrium in the uranium decay series. These and additional results for the RSE are addressed in “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

The findings of the RSE pertaining to these activities are:

- The horizontal extent and magnitude of mining-related materials were delineated sufficiently to support additional characterization of the subsurface.
- Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.
- Two potential Background Reference Areas were established.
- The relationship between gamma count rates and concentrations of radium-226 in surface soils (0 to 0.5 ft below ground surface) is described by a power regression model:

$$\text{Radium-226 Concentration (picocuries per gram [pCi/g])} = 8\text{x}10^{-10}\,(\text{Gamma Count Rate in counts per minute [cpm]})^{2.2279}$$

- The distribution of concentrations of radium-226 in surface soils predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 0.2 to 1,285, with a central tendency (median) of 2.4 pCi/g.

- The thorium series radionuclides do not appear to affect the prediction of concentrations of radium-226 from gamma count rates.

- The uranium series radionuclides appear not to be in secular equilibrium.

- The relationship between gamma count rates and exposure rates is described by a linear regression model:

  Exposure Rate (microRoentgens per hour [µR/h]) = Gamma Count Rate (cpm) x $5x10^{-4}$ + 7.4537

- The distribution of exposure rates predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 7.5 to 158, with a central tendency (median) of 16.4 µR/h.

1.0 Introduction

This report addresses the radiological characterization of the Claim 28 abandoned uranium mine (AUM) located in the Tachee/Blue Gap Chapter of the Navajo Nation near Tahchee, Arizona. It documents part of the implementation of the Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan (RSE Work Plan: MWH, 2016). The work was performed by Environmental Restoration Group, Inc. of Albuquerque, New Mexico and Stantec Consulting Services Inc. (Stantec) on behalf of the Navajo Nation AUM Environmental Response Trust – First Phase.

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The discussion of the results of soil sampling in this report is limited to concentrations of radium-226 and isotopes of thorium in samples taken from surface soils, as part of correlation studies. The objective of the analysis of thorium isotopes was to 1) assess the potential effects of thorium-232 and thorium-228 on the correlation of gamma count rates to concentrations of radium-226 in surface soils; and 2) evaluate thorium-230 and radium-226 activities to indicate the status of equilibrium in the uranium decay series. These and additional results for the RSE are addressed in "Claim 28 Removal Site Evaluation Report" (Stantec, 2018).

Figure 1 shows the location of the AUM. Background information that is pertinent to the characterization of this AUM is presented in "Claim 28 Removal Site Evaluation Report" (Stantec, 2018).

2.0 GPS-Based Gamma Surveys

This section addresses the GPS-based surveys conducted in two potential Background Reference Areas and the Survey Area. The survey was extended to bound areas in which elevated count rates were observed. Table 1 lists the detection systems used in the survey, which were function-checked before and after each day of use and within calibration, in accordance with American National Standards Institute (ANSI) Standard N232A (ANSI, 1997). Appendix A presents the completed function check forms and calibration certificates for the instruments.

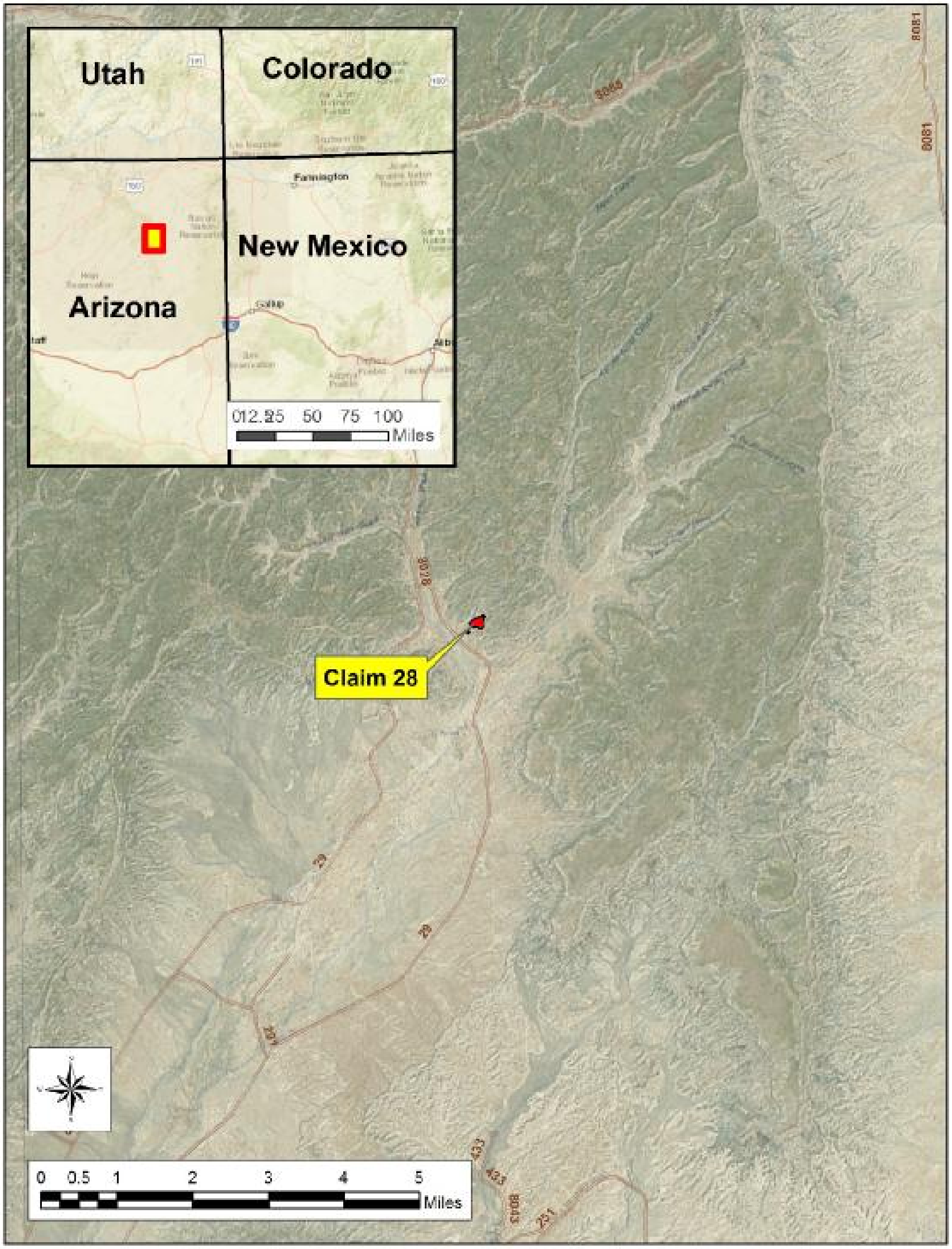


Figure 1. Location of the Claim 28 Abandoned Uranium Mine

Table 1. Detection systems used in the GPS-Based gamma surveys.

Survey Area	Ludlum Model 44-10	Ludlum Model 2221 Ratemeter/Scaler
Potential Background Reference Areas	PR303727[a]	254772[a]
Survey Area	PR150507	282966
	PR154615	138368
	PR295014	196086
	PR303727[a]	254772 [a]
	PR320678	282971

Notes:
[a]Detection system used in the correlation studies described in Sections 3.1 and 3.3.

2.1 Potential Background Reference Areas

Two potential Background Reference Areas were surveyed, the locations and results of which are depicted on Figure 2. BG1 and BG2 in the figure are Background Reference Areas 1 and 2, respectively. Table 2 lists a summary of the gamma count rates, which in:

- BG1 ranged from 15,584 to 22,609 counts per minute (cpm), with a mean and median of 18,165 and 17,880 cpm, respectively.

- BG1 ranged from 10,048 to 16,423 cpm, with a mean and median of 12,709 and 12,518 cpm, respectively.

Figure 3 depicts histograms of the gamma count rates in the potential Background Reference Areas. The red and green lines on the figure are theoretical normal and lognormal distributions, respectively. They are presented to show what could be expected if the distributions were normal or lognormal.

Table 2. Summary statistics for gamma count rates in the potential Background Reference Areas.

	Gamma Count Rate (cpm)					
Potential Background Reference Area	n	Minimum	Maximum	Mean	Median	Standard Deviation
1	237	15,584	22,609	18,165	17,880	1,381
2	338	10,048	16,423	12,709	12,518	1,117

Notes:
cpm = counts per minute

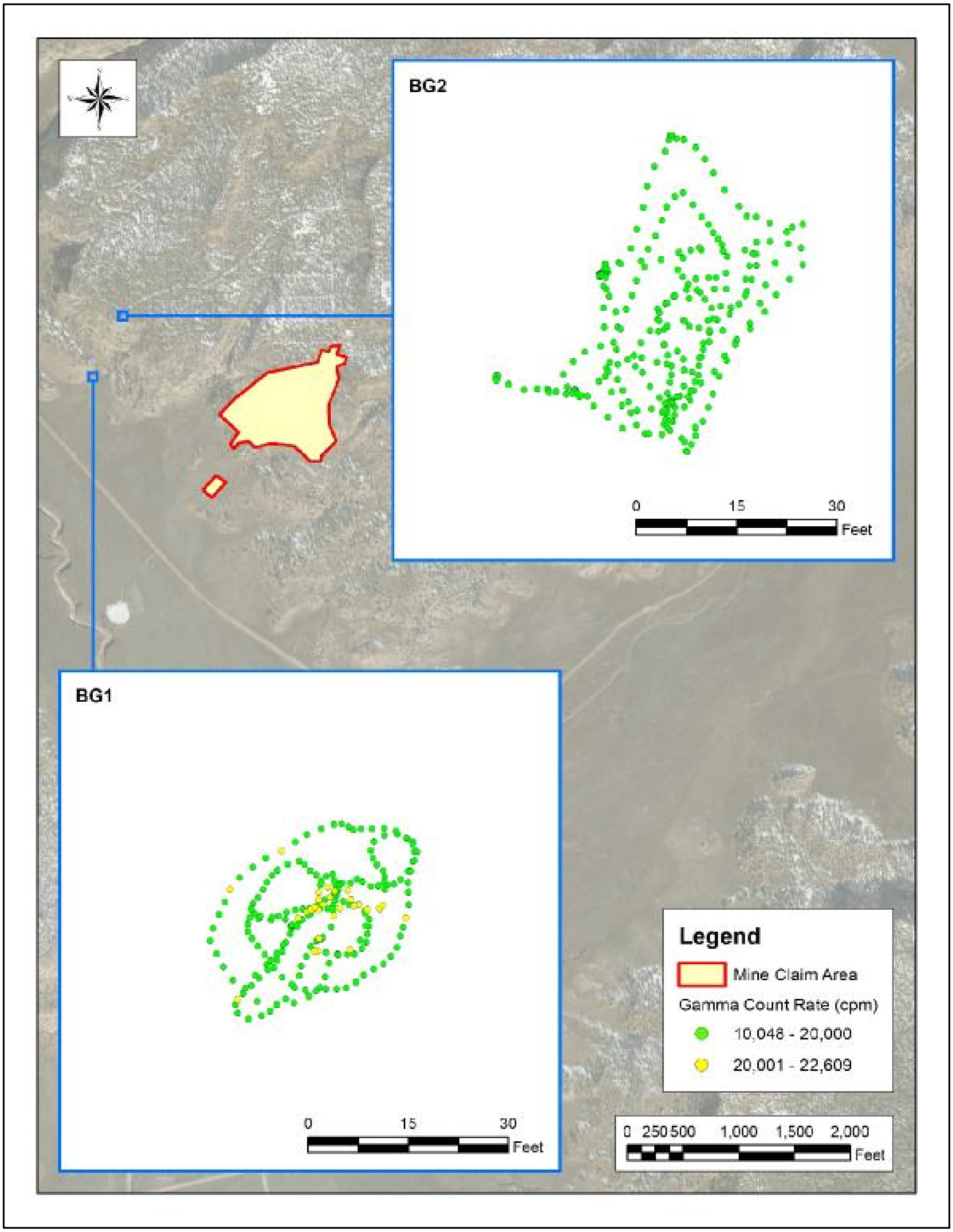
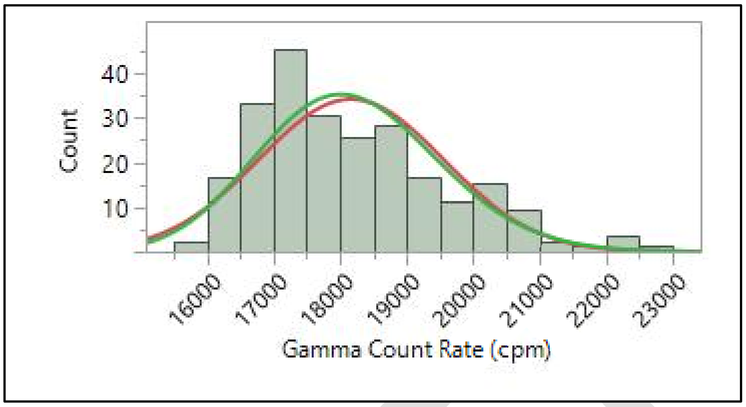
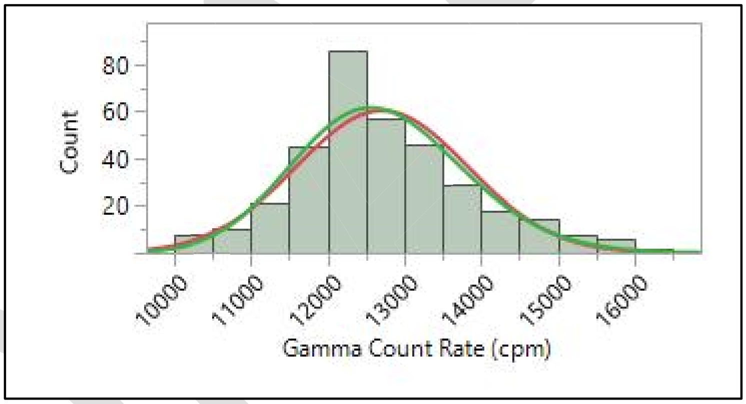


Figure 2. Gamma count rates in the potential Background Reference Areas.



a. Background Reference Area 1



b. Background Reference Area 2

Figure 3. Histograms of gamma count rates in the potential Background Reference Areas.

2.2 Survey Area

The gamma count rates observed in the Survey Area are depicted in Figure 4. Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.

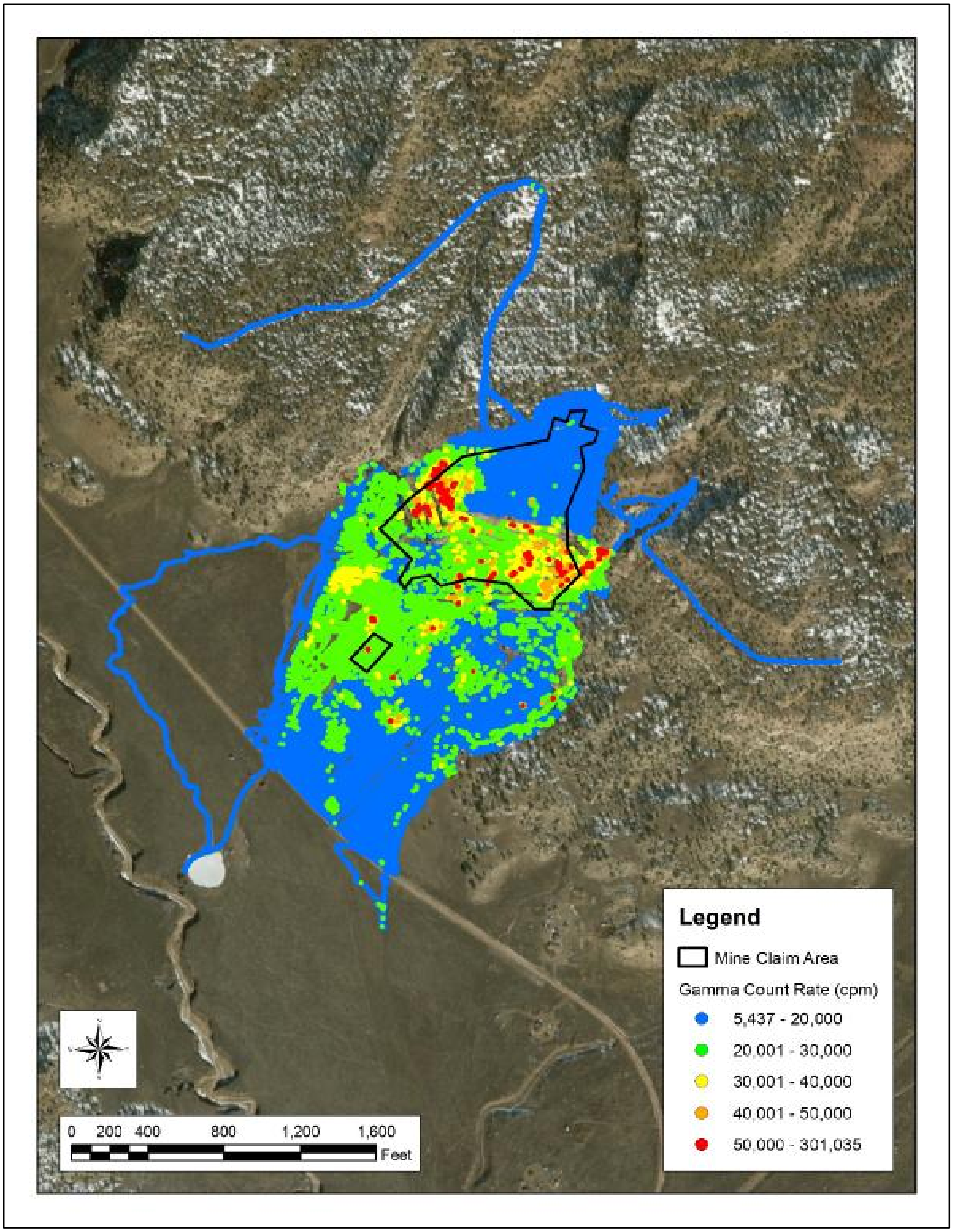


Figure 4. Gamma count rates in the Survey Area.

Figure 5 is a histogram of the gamma count rate measurements made in the Survey Area, including the area surveyed outside the 100-ft buffer. As stated in Section 2.1, the red and green lines on the figure are theoretical normal and lognormal distributions, respectively. They are presented to show what could be expected if the distributions were normal or lognormal. The distribution of the right-tailed set of measurements, evaluated using U.S. Environmental Protection Agency software ProUCL (version 5.1.002), is not defined; i.e., neither normal or logarithmic. The box plot in Figure 6 depicts cutoffs as horizontal bars, from bottom to top, for the following values or percentiles: minimum, 0.5, 2.5, 10, 25, 50, 75, 90, 97.5, 99.5, and maximum. The 25th, 50th, and 75th percentiles (the three horizontal lines of the box inside the box plot) are 15,184, 17,914, and 21,670 cpm, respectively.

Table 3 is a statistical summary of the measurements, which range from 5,437 to 301,035 cpm and have a central tendency (median) of 17,914 cpm.

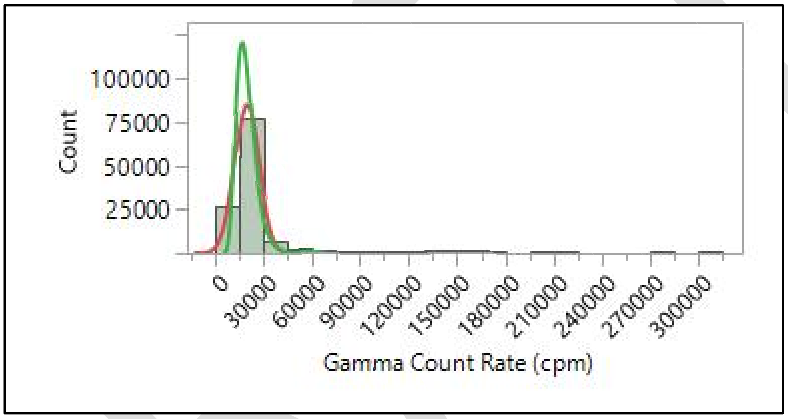


Figure 5. Histogram of gamma count rates in the Survey Area.

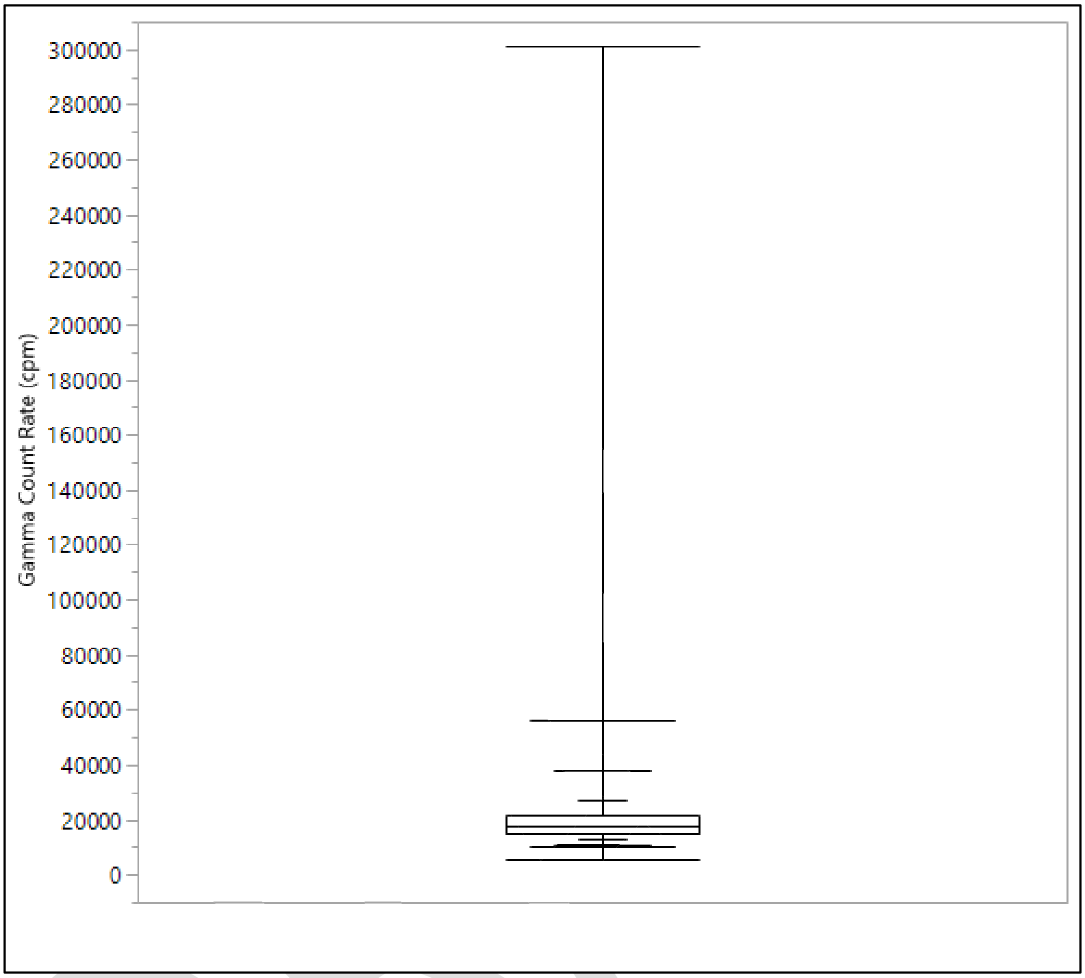


Figure 6. Box plot of gamma count rates in the Survey Area.

Table 3. Summary statistics for gamma count rates in the Survey Area.

Parameter	**Gamma Count Rate (cpm)**
n	108,660
Minimum	5,437
Maximum	301,035
Mean	19,475
Median	17,914
Standard Deviation	7,672

Notes:
cpm = counts per minute

3.0 Correlation Studies

The following sections address the activities under two types of correlation studies outlined in the RSE Work Plan: comparisons of 1) radium-226 concentrations in surface soils and gamma count rates and 2) exposure rates and gamma count rates. GPS-based gamma count rate measurements were made over small areas for the former study. The means of the measurements were used in this case. Static gamma count rate measurements, co-located with exposure rate measurements, were used in the latter study.

3.1 Radium-226 concentrations in surface soils and gamma count rates

On November 11, 2016 field personnel made GPS-based gamma count rates measurements and collected five-point composite samples of surface soils in each of five areas at the AUM. The activities were performed contemporaneously, by area and all on the same day, such that variations in the gamma count rate measurements could be limited largely to those posed by the soils and rocks at the locations. Figure 7 shows the GPS-based gamma count rate measurements in the five areas (labeled with location identifiers).

The soil samples were analyzed by ALS Laboratories in Ft Collins, CO for radium-226 and isotopic thorium. The latter analysis was included to assess the potential effects of thorium series isotopes on the correlation and evaluate thorium-230 and radium-226 activities to indicate the status of equilibrium in the uranium decay series. Table 4 lists the results of the gamma count rate measurements and radium-226 concentrations in the soil samples. The means of the gamma count rate measurements range from 16,151 to 52,335 cpm. The concentrations of radium-226 in the soil samples range from 2 to 19.9 picocuries per gram (pCi/g).

Table 5 lists the concentrations of isotopes of thorium (thorium-228, -230, and -232) in the same soil samples.

Laboratory analyses are presented in Appendix D, Laboratory Analytical Data and Data Usability Report, in “Claim 28 Removal Site Evaluation Report” (Stantec, 2018).

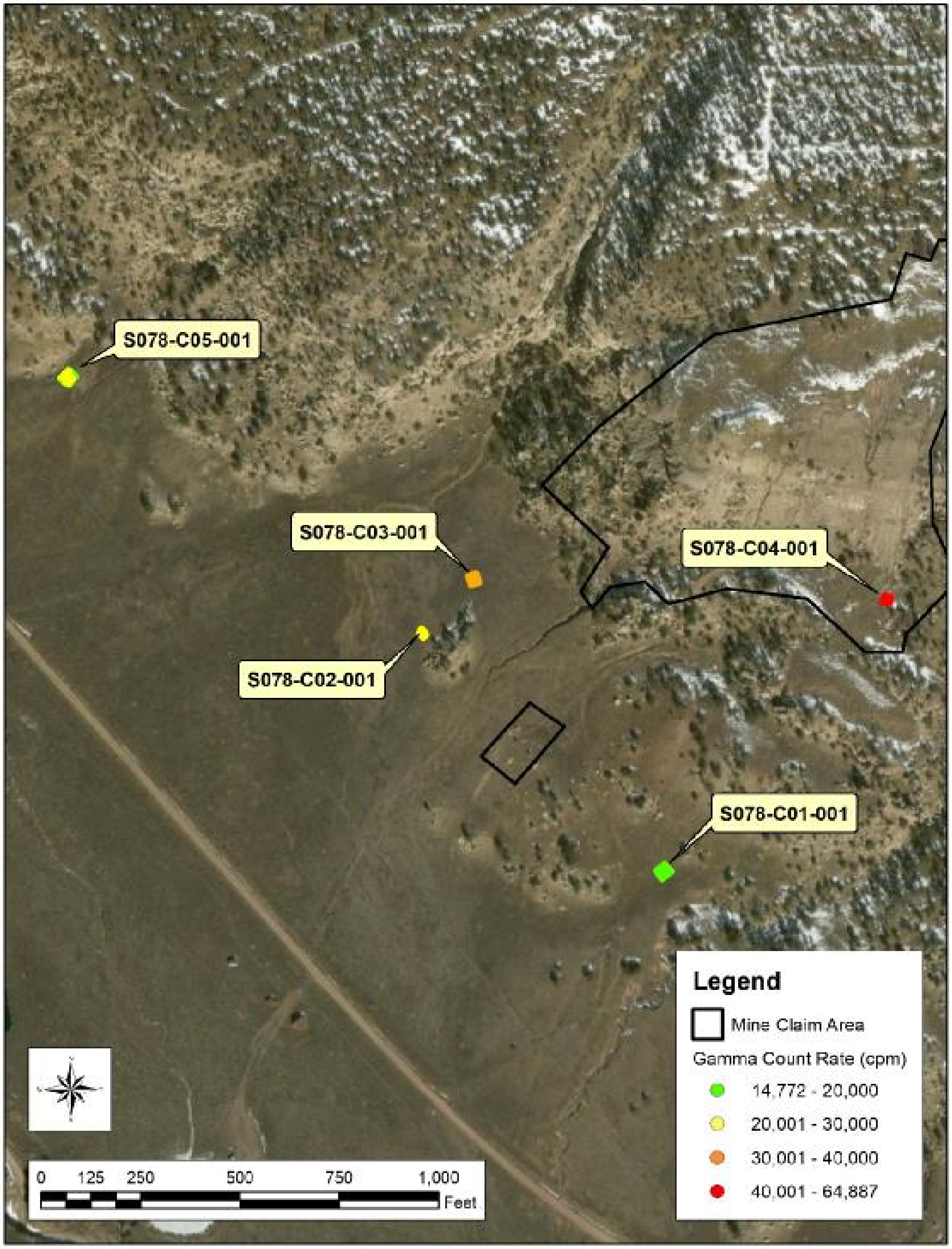


Figure 7. GPS-based gamma count rate measurements made for the correlation study.

Table 4. Gamma count rates and associated concentrations of radium-226 in samples of surface soils obtained in the correlation study.

	Gamma Count Rate (cpm)				Ra-226 (pCi/g)		
Location	**Mean**	**Minimum**	**Maximum**	**σ**	**Result**	**Error ±1σ**	**MDL**
S078-C01-001[a]	16,151	14,772	19,419	763	2.0	0.38	0.49
S078-C02-001	24,027	20,120	28,985	1,866	2.69	0.445	0.56
S078-C03-001	33,222	30,071	37,554	1,459	19.1	2.4	0.6
S078-C04-001	52,335	35,196	64,887	6,923	19.9	2.5	0.7
S078-C05-001	18,846	16,056	22,113	1,136	2.69	0.46	0.51

Notes:
[a]Result is the average of primary and duplicate sample results.
cpm = counts per minute
MDL = method detection limit
pCi/g = picocuries per gram
σ = standard deviation

Table 5. Concentrations of isotopes of thorium in samples of surface soils obtained in the correlation study.

	Thorium-228 (pCi/g)			Thorium-230 (pCi/g)			Thorium-232 (pCi/g)		
Sample ID	**Result**	**Error ± 1 σ**	**MDL**	**Result**	**Error ± 1 σ**	**MDL**	**Result**	**Error ± 1 σ**	**MDL**
S078-C01-001	0.7	0.135	0.045	1.415	0.245	0.07	0.71	0.02	0.1
S078-C02-001	1.16	20.5	0.04	1.885	0.32	0.07	1.125	0.01	0.1
S078-C03-001	1.38	0.23	0.04	11.7	1.8	0.1	1.26	0.01	0.1
S078-C04-001	1.48	0.25	0.05	12.3	1.9	0.1	1.41	0.02	0.1
S078-C05-001	1.16	0.2	0.04	1.88	0.31	0.07	1.15	0.02	0.1

Notes:
MDL = method detection limit
pCi/g = picocuries per gram
σ = standard deviation

A model was made of the results in Table 4, predicting the concentrations of radium-226 in surface soils from the mean gamma count rate in each area. The best predictive relationship between the measurements, shown in Figure 8, is a strong, power function with a Pearson's Correlation Coefficient (R^2) of 0.837, as expressed in the equation:

$$\text{Radium-226 Concentration (pCi/g)} = 8\text{x}10^{-10}\,(\text{Gamma Count Rate in cpm})^{2.2279}$$

R^2 is a measure of the dependence between two variables, and is expressed as a value between -1 and +1 where +1 is a positive correlation, 0 is no correlation, and -1 is a negative correlation. The root mean square error and p-value for the model are 0.533939 and 0.0294, respectively; these parameters are not data quality objectives (DQOs) and are included only as information.

The concentrations of thorium-232 and thorium-228, isotopes in the thorium series, in the correlation samples are similar and at most 1.48 pCi/g. Given these low concentrations and the high R^2 of the power function, the thorium series radionuclides do not appear to affect the prediction of concentrations of radium-226, using gamma count rates.

This equation was used to convert the gamma count rate measurements observed in the gamma surveys to predicted concentrations of radium-226. Table 6 presents summary statistics for the predicted concentrations of radium-226 in the Survey Area. The range of the predicted concentrations of radium-226 in the Survey Area is 0.4 to 1,285 pCi/g, with a mean and median of 3.5 and 2.4 pCi/g, respectively. Note that the radium-226 concentrations predicted from gamma count rate measurements exceeding approximately 53,000 cpm are extrapolated from the regression model and are uncertain.

Figure 9 shows the predicted concentrations of radium-226, the spatial and numerical distribution of which mirror those depicted in Figure 4.

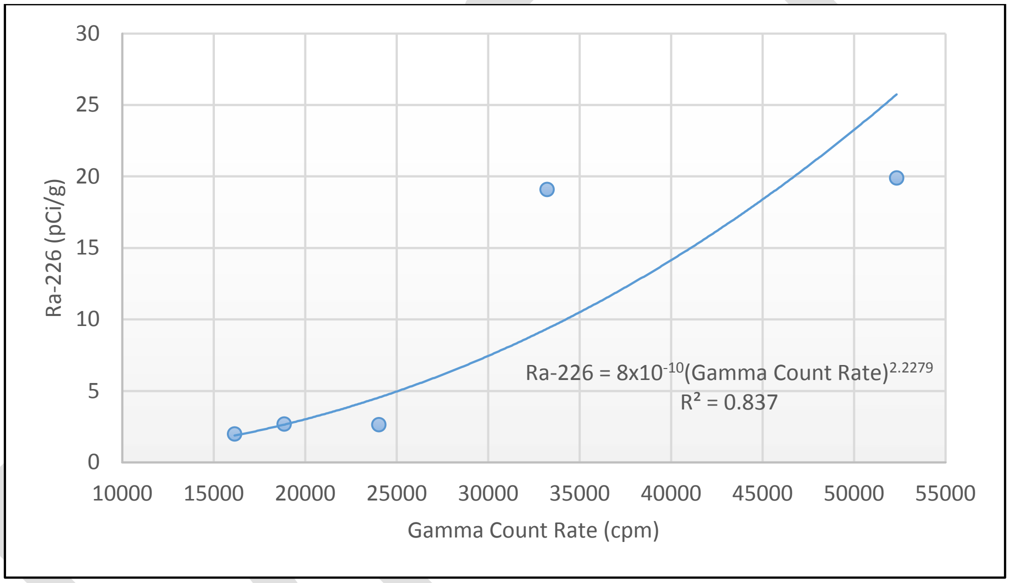


Figure 8. Correlation of gamma count rates and concentrations of radium-226 in surface soils.

Table 6. Predicted concentrations of radium-226 in the Survey Area.

Parameter	Radium-226 (pCi/g)
n	108,660
Minimum	0.2
Maximum	1,285
Mean	3.5
Median	2.4
Standard Deviation	9.0

Notes:
pCi/g = picocuries per gram

3.2 Equilibrium in the uranium series

Secular equilibrium occurs when the activities of a parent radionuclide and its decay product are equal. This can occur in a closed system, when the half-life of the parent radionuclide is much larger than that of the decay product.

The ratio of the concentrations of radium-226 to thorium-230 can be used as an indicator of the status of equilibrium in the uranium series. The half-lives of thorium-230 and radium-226 are 77,000 and 1,600 years, respectively. The ratios in the five correlation samples are 1.4 (Sample S078-C01-001), 1.4 (Sample S078-C02-001), 1.6 (Sample S078-C03-001), 1.6 (Sample S078-C04-001), and 1.4 (Sample S078-C05-001) indicating that thorium-230 is depleted in relation to radium-226 and, by extrapolation, the uranium series itself is not in secular equilibrium.

Note this observation is based on the results of five samples, subject to differing analytical methods. Gamma spectroscopy, the method used to determine the concentration of radium-226, assesses an intact portion of the whole sample as it was collected. The concentration of thorium-230 was determined by alpha spectroscopy of an acid-leached aliquot of the sample.

This evaluation is not related to the correlation of radium-226 concentrations in surface soils and gamma count rates. It may be used for a future risk assessment.

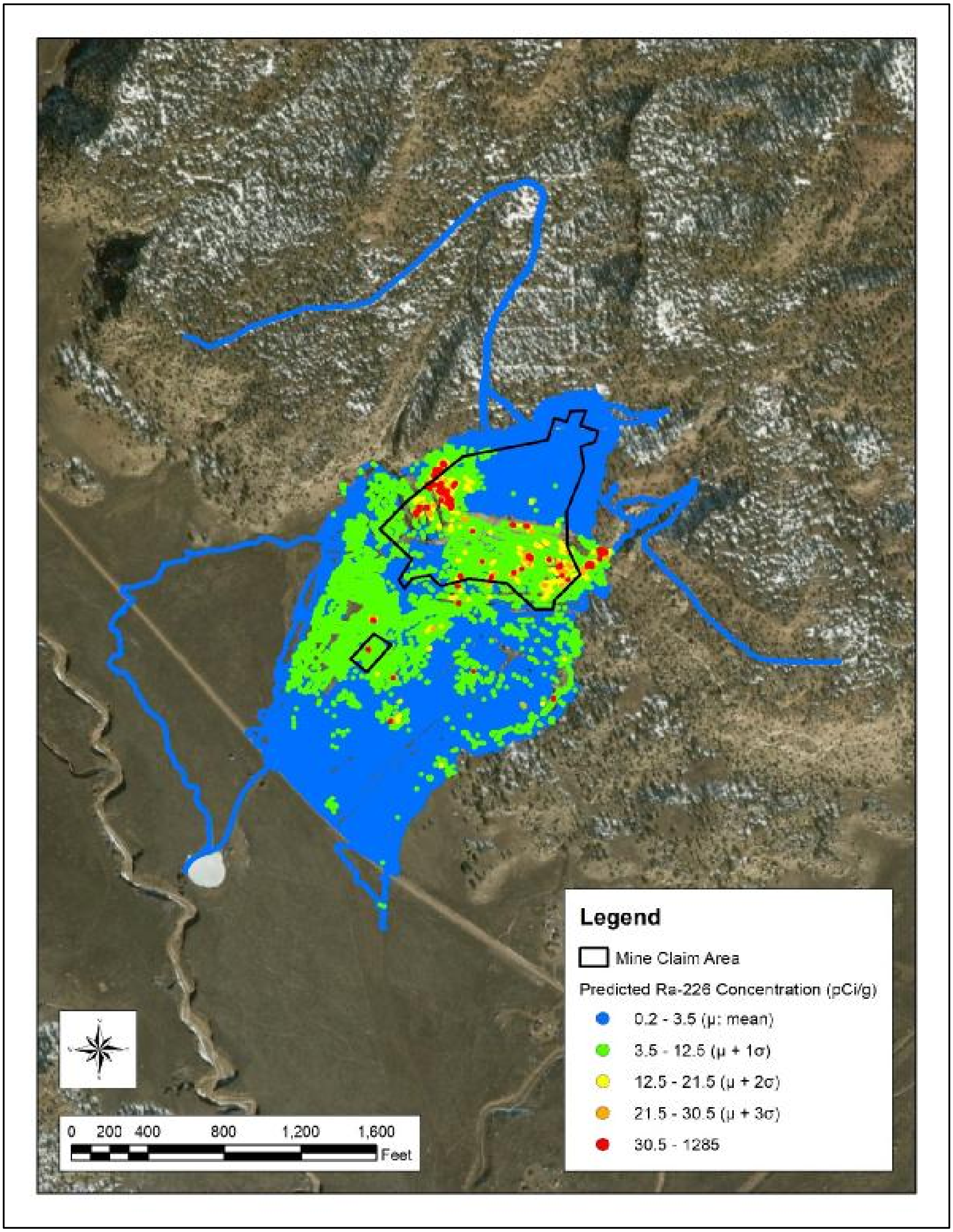


Figure 9. Predicted concentrations of radium-226 in the Survey Area.

3.3 Exposure rates and gamma count rates

On October 11, 2016 field personnel made co-located one-minute static count rate and exposure rate measurements at the five locations within the Survey Area, representing the range of gamma count rates obtained in the GPS-based gamma survey. Figure 7 shows the locations of the co-located measurements, which were made in the centers of the areas.

The gamma count rate and exposure rate measurements were made at 0.5 meters (m) and 1 m above the ground surface, respectively. The gamma count rate measurements were made using one of the sodium iodide detection systems used in the GPS-based gamma survey of the AUM (Serial Number PR303727/254772). The exposure rate measurements were made using a Reuter Stokes Model RSS-131 (Serial Number 07J00KM1) high pressure ionization chamber (HPIC) at six-second intervals for about 10 minutes. The exposure rates used in the comparison was the mean of these measurements, less those occurring in initial instrument spikes. The HPIC was in current calibration and function checked before and after use. Calibration forms for the HPIC are provided in Appendix A. Table 7 presents the results for the two types of measurements made at each of the five locations. Appendix B presents the individual (one second) exposure rate measurements.

The best predictive relationship between the measurements is linear with an R^2 of 0.9947 indicating a strong, positive correlation. The root mean square error and p-value for the model are 0.659598 and 0.0002, respectively; these parameters are not DQOs and are included only as information.

The following equation is the linear regression (shown in Figure 10) between the mean exposure rate and gamma count rate results in Table 7 that was generated using MS Excel:

$$\text{Exposure Rate (microRoentgens per hour [µR/h])} = 5\text{x}10^{-4} \text{ x Gamma Count Rate (cpm)} + 7.4537$$

Figure 11 presents the exposure rates predicted from the gamma count rate measurements, the spatial and numerical distribution of which mirror those depicted in Figure 4.

Tables 8 and 9 present summary statistics for the predicted exposure rates in the two Background Reference Areas and AUM, respectively.

The range of predicted exposure rates at:

- BG1 is 15.2 to 18.8 µR/h, with a mean and median of 16.5 and 16.4 µR/h, respectively
- BG2 is 12.5 to 15.7 µR/h, with a mean and median of 13.8 and 13.7 µR/h, respectively

The range of predicted exposure rates in the Survey Area is 10.2 to 158 µR/h, with a mean and median of 17.2 and 16.4 µR/h, respectively.

Table 7. Co-located gamma count rate and exposure rate measurements.

Location	Gamma Count Rate (cpm)	Exposure Rate (µR/h)
S078-C01-001	16,092	15.3
S078-C02-001	25,299	20
S078-C03-001	33,606	25.3
S078-C04-001	53,767	35.2
S078-C05-001	18,734	17.9

Notes:
cpm = counts per minute
µR/h = microRoentgens per hour

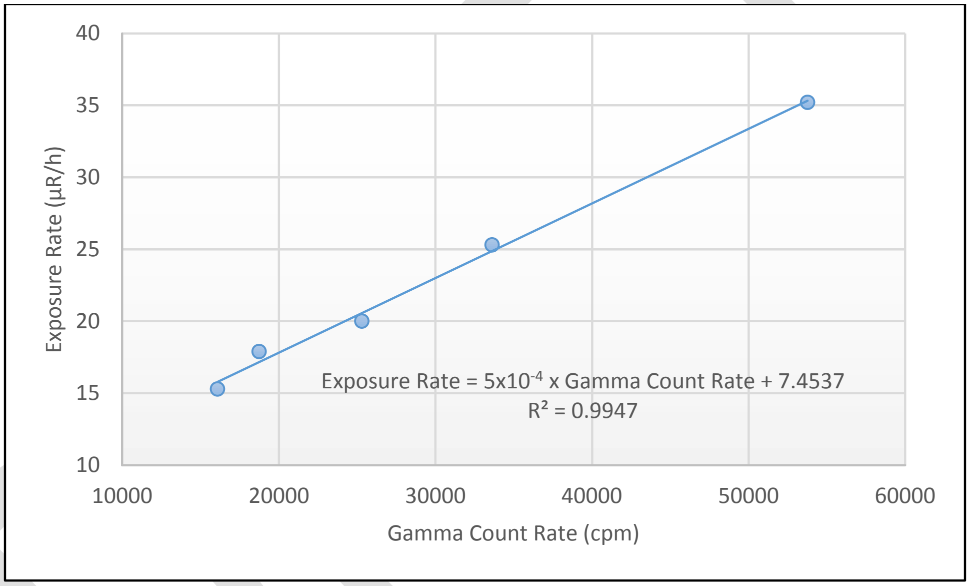


Figure 10. Correlation of gamma count rates and exposure rates.

Table 8. Predicted exposure rates in the potential Background Reference Areas.

Potential Background Reference Area	BG1	BG2
Parameter	Exposure Rate (µR/h)	
n	237	338
Minimum	15.2	12.5
Maximum	18.8	15.7
Mean	16.5	13.8
Median	16.4	13.7
Standard Deviation	0.7	0.6

Notes:
BG1 = Background Reference Area 1
BG2 = Background Reference Area 2
µR/h = microRoentgens per hour

Table 9. Predicted exposure rates in the Survey Area.

Parameter	Exposure Rate (µR/h)
n	108,660
Minimum	10.2
Maximum	158
Mean	17.2
Median	16.4
Standard Deviation	3.8

Notes:
µR/h = microRoentgens per hour

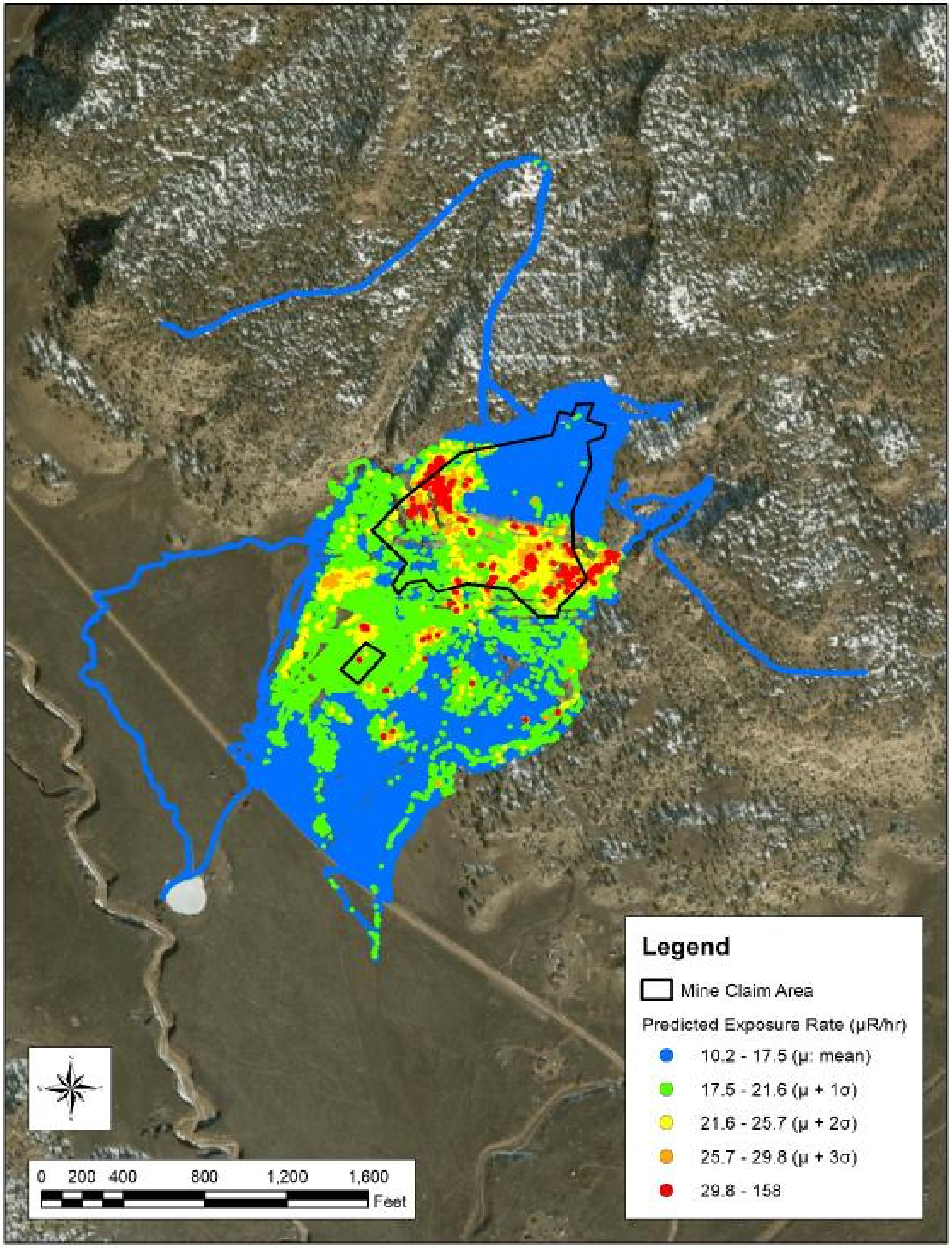


Figure 11. Predicted exposure rates in the Survey Area.

4.0 Deviations to RSE Work Plan

The RSE Work Plan specifies that the comparison of gamma count rates and radium concentrations in surface soils was to occur in 900 square foot areas. Field personnel adjusted the areas as necessary, to minimize the variability of gamma count rates observed, particularly where the spatial distribution of waste rock was heterogeneous.

5.0 Conclusions

The findings of the RSE pertaining to these activities are:

- The horizontal extent and magnitude of mining-related materials were delineated sufficiently to support additional characterization of the subsurface.

- Elevated count rates were observed largely on waste rock situated at the western edge of the larger of the two mine claims and on naturally occurring materials in the approximate southern half of that claim, extending onto the valley floor.

- Two potential Background Reference Areas were established.

- The relationship between gamma count rates and concentrations of radium-226 in surface soils (0 to 0.5 ft below ground surface) is described by a power regression model:

  Radium-226 Concentration (pCi/g) = $8\text{x}10^{-10}$ (Gamma Count Rate in cpm)$^{2.2279}$

- The distribution of concentrations of radium-226 in surface soils predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 0.2 to 1,285, with a central tendency (median) of 2.4 pCi/g.

- The thorium series radionuclides do not appear to affect the prediction of concentrations of radium-226 from gamma count rates.

- The uranium series radionuclides appear not to be in secular equilibrium.

- The relationship between gamma count rates and exposure rates is described by a linear regression model:

  Exposure Rate (µR/h) = Gamma Count Rate (cpm) x $5\text{x}10^{-4}$ + 7.4537

The distribution of exposure rates predicted using this model resembles a lognormal distribution. The values in the Survey Area range from 7.5 to 158, with a central tendency (median) of 16.4 µR/h.

6.0 References

ANSI, 1997. Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments, American National Standards Institute (ANSI) Standard N232A. June 20, 2014.

MWH, 2016. Navajo Nation AUM Environmental Response Trust, First Phase, Removal Site Evaluation Work Plan, October 24, 2016.

Stantec, 2018. Claim 28 Removal Site Evaluation Report, January 2018.

Appendix A Instrument calibration and completed function check forms

ERG

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:	254772
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR303727

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed

☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

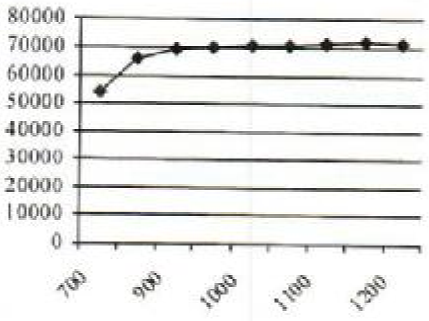
Barometric Pressure: 24.6 inches Hg
Temperature: 73 °F
Relative Humidity: 20 %

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Coun
x 1000	400	400	400	398773	400
x 1000	100	100	100		100
x 100	400	400	400	39887	400
x 100	100	100	100		100
x 10	400	400	400	3988	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	53957	
800	65946	
900	69049	
950	69687	
1000	70240	9925
1050	70288	
1100	71224	
1150	71563	
1200	71161	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

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
☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Calibration Date: 1-20-16
Calibration Due 1-20-17

Reviewed By:
Date: 1/20/16

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

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: 254772

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR303727

✓ Mechanical Check
✓ F/S Response Check
✓ Geotropism
✓ Meter Zeroed

✓ THR/WIN Operation
✓ Reset Check
✓ Audio Check
✓ 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:

Source Geometry: ✓ Side ☐ Below ☐ Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.75 inches Hg

Temperature: 74 °F

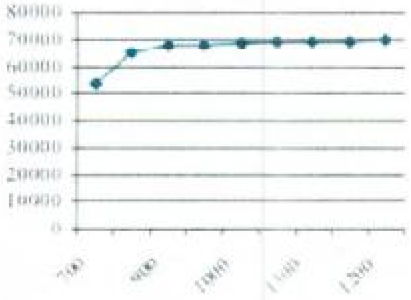
Relative Humidity: 20 %

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	398857	400
x 1000	100	100	100		100
x 100	400	400	400	39913	400
x 100	100	100	100		100
x 10	400	400	400	3992	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	53620	
800	64979	
900	67955	
950	67795	
1000	68536	9542
1050	69153	
1100	69331	
1150	69346	
1200	69492	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ✓ 201932

Fluke multimeter serial number: 87490128

☐ 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

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

☐ Other Source:

Calibrated By:

Calibration Date: 7 6 16

Calibration Due: 7-6-17

Reviewed By: Cf

Date: 7/20/16

ERG Form ITC. 101.A

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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: 196086

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR295014

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

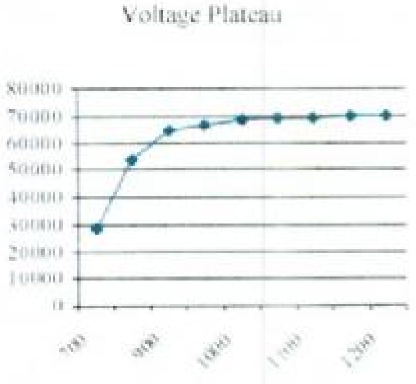
HV Check (+/- 2.5%): ✓ 500 V ✓ 1000 V ✓ 1500 V
Cable Length: 39-inch ✓ 72-inch Other:

Barometric Pressure: 24.78 inches Hg
Source Distance: Contact ✓ 6 inches Other:
Threshold: 10 mV
Temperature: 74 °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	399802	400
x 1000	100	100	100		100
x 100	400	400	400	39989	400
x 100	100	100	100		100
x 10	400	400	400	3999	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	28456	
800	53330	
900	64430	
950	66209	
1000	68333	
1050	69077	
1100	69121	8924
1150	69973	
1200	70155	



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: 97743 ✓ 201932
Fluke multimeter serial number: 87490128
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: 7 [illegible] 16
Calibration Due: 7 [illegible] 17
Reviewed By:
Date: 7/20/16

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This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

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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: 138368

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR154615

✓ Mechanical Check
✓ F/S Response Check
✓ Geotropism
✓ Meter Zeroed

✓ THR/WIN Operation
✓ Reset Check
✓ Audio Check
✓ 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:
Source Geometry: ✓ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

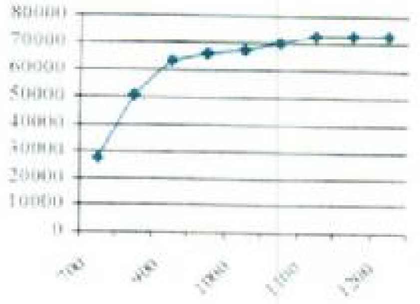
Barometric Pressure: 24.78 inches Hg
Temperature: 74 °F
Relative Humidity: 20 %

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	398436	400
x 1000	100	100	100		100
x 100	400	400	400	39845	400
x 100	100	100	100		100
x 10	400	400	400	3984	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	26998	
800	51037	
900	63340	
950	65550	
1000	67410	
1050	70113	
1100	72217	
1150	72561	9216
1200	72337	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1150

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: 87490128
✓ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
Other Source:

Calibrated By:
Calibration Date: 7-6-16
Calibration Due: 7-6-17

Reviewed By:
Date: 7/20/16

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

Certificate of Calibration

Calibration and Voltage Plateau

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	282966
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR150507

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

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 60"

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

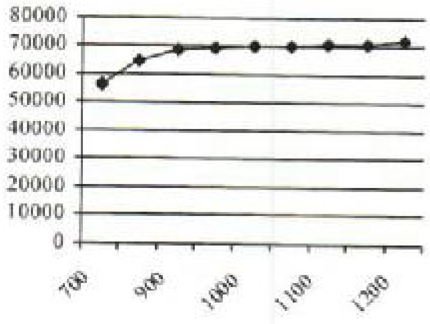
Barometric Pressure: 24.89 inches Hg
Temperature: 73 °F
Relative Humidity: 20 %

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	398753	400
x 1000	100	100	100		100
x 100	400	400	400	39879	400
x 100	100	100	100		100
x 10	400	400	400	3989	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	56463	
800	64304	
900	68534	
950	69331	
1000	69868	9696
1050	70054	
1100	70609	
1150	70681	
1200	71955	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

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: ☐ 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: 10-31-16
Calibration Due: 10-31-17
Date: 10/31/16

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

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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:	254772
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR303727

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed

☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

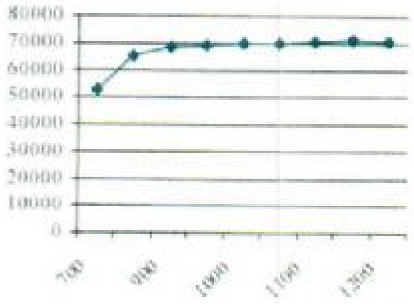
Barometric Pressure: 24.24 inches Hg
Temperature: 78 °F
Relative Humidity: 20 %

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	399859	400
x 1000	100	100	100		100
x 100	400	400	400	39991	400
x 100	100	100	100		100
x 10	400	400	400	4001	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	52821	
800	65213	
900	68644	
950	69245	
1000	69492	9111
1050	69792	
1100	70472	
1150	71183	
1200	70571	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1000

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: ☐ 87490128
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: ~~2 March 17~~ 2/28/17 ASH Calibration Due: ~~2 March 18~~ 2/28/18 ASH

Date: 3-1-17

ERG Form ITC, 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

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:	196086
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR295014

✓ Mechanical Check
✓ F/S Response Check
✓ Geotropism
✓ Meter Zeroed
☑ THR/WIN Operation
✓ Reset Check
✓ Audio Check
✓ 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:
Source Geometry: ✓ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

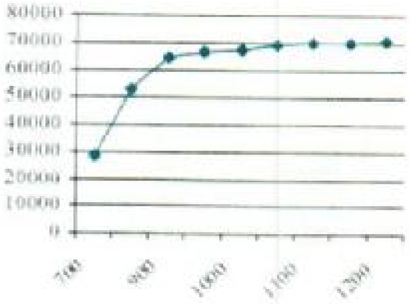
Barometric Pressure: 24.27 inches Hg
Temperature: 78 °F
Relative Humidity: 20 %

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	399386	400
x 1000	100	100	100		100
x 100	400	400	400	39949	400
x 100	100	100	100		100
x 10	400	400	400	3995	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	28235	
800	52834	
900	64481	
950	66468	
1000	67321	
1050	69009	
1100	69981	9079
1150	69564	
1200	70538	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1100

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: ☐ 87490128
✓ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: ~~3 March 17~~ 2/28/17 BLW
Calibration Due: ~~3 March 18~~ BLW 2/28/18
Date: 3 1-17

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

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:	282971
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR320678

☑ Mechanical Check
☑ F/S Response Check
☑ Geotropism
☑ Meter Zeroed
☑ THR/WIN Operation
☑ Reset Check
☑ Audio Check
☑ 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:
Source Geometry: ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

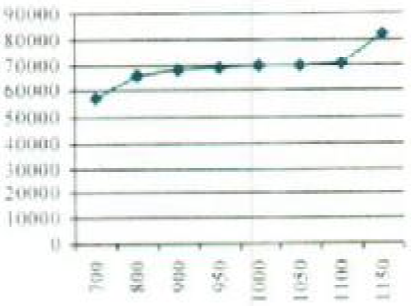
Barometric Pressure: 24.63 inches Hg
Temperature: 75 °F
Relative Humidity: 20 %

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	399936	400
x 1000	100	100	100		100
x 100	400	400	400	39984	400
x 100	100	100	100		100
x 10	400	400	400	3998	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	57641	
800	65850	
900	68414	
950	68639	
1000	69410	9773
1050	69358	
1100	70301	
1150	81822	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
Fluke multimeter serial number: ☐ 87490128
☐ Alpha Source: Th-230 sn: 4098-03 @ 12,800dpm/6,520 cpm (1/4/1
☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Beta Source: Tc-99 sn: 4099-03 @ 17,700dpm/11,100cpm (1/4/12
☐ Other Source:

Calibrated By:
Calibration Date: 3-13-17
Calibration Due: 3-13-18

Reviewed By:
Date: 14 March 2017

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

K&S Associates, Inc.
1926 Elm Tree Drive
Nashville, Tennessee 37210-3718
Phone 800-522-2325 Fax 615-871-0856

ACCREDITED
CALIBRATION CERT #1866.01

CALIBRATION REPORT

SUBMITTED BY: ERG
8809 Washington Street Northeast
Suite 150
Albuquerque, NM 87113

INSTRUMENT: Reuter Stokes RSS-131, #07J00KM1

REPORT NUMBER: 161866
TEST NUMBER(S) M161588
REPORT DATE: June 29, 2016

The CALIBRATION COEFFICIENTS contained in this report were obtained by intercomparison with instruments calibrated by, or directly traceable to, the National Institute of Standards and Technology (NIST). K• S Associates, Inc. is licensed by the State of Tennessee (R-19075-G97, R-19136-B00) to perform calibrations, and is recognized by the Health Physics Society (HPS) as an ACCREDITED INSTRUMENT CALIBRATION LABORATORY. As part of the accreditation K • S participates in a measurement assurance program conducted by the HPS and NIST. K • S also certifies that the calibration was performed using quality policies, methods and procedures that meet or exceed the requirements of ISO/IEC 17025:2005.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined in accordance with the laboratory's terms of accreditation unless stated otherwise in this report

The CALIBRATION COEFFICIENTS stated herein are valid under the conditions specified. It is the instrument user's responsibility to perform the appropriate constancy tests prior to shipment and after return from calibration. It is also the responsibility of the user to assure that the interpretation of the information in this report is consistent with that intended by K • S Associates, Inc.

K&S Associates, Inc
Nashville, Tennessee 37210-3718

ACCREDITED

CALIBRATION CERTIFICATE

Calibration Date: 6/27/2016 Report Number: 161866 Test Number: M161588

K&S certifies that the environmental radiation monitor identified below has been calibrated for radiation measurement using collimated radiation sources whose output has been calibrated with instruments calibrated by or directly traceable to the National Institute of Standards and Technology. K&S is accredited by the American Association for Laboratory Accreditation to perform environmental level calibrations and further certifies that the calibration was performed using accredited policies and procedures (SI 25) that meet or exceed the requirements of ISO/IEC 17025:2005.

Sensor Type: 100 mR/h

Serial Number: 07J00KM1

Average Calibration Coefficient for the range of 0.012 mR/h – 0.220 mR/h*:
1.02 mR/"mR" reading
(Measured at 4 points)

Calibration Coefficient for the 50.0 mR/h point*:
1.12 mR/"mR" reading

Calibration Coefficient for the 80.0 mR/h point*:
1.10 mR/"mR" reading

Found RAC: 2.169e-8

*Multiply the reading in **mR/h** by the Calibration Coefficient to obtain true **mR/h**.

Calibrated By: Richard Hardison Reviewed By: Angela Royer
Richard Hardison Angela Royer
Title: Calibration Technician Title: Calibration Physicist

Log: M-53 Page: 73

K&S Associates, Inc
Nashville, Tennessee 37210-3718

ACCREDITED
CALIBRATION CERT #1866.01

AS FOUND DATA
Reuter-Stokes Chamber Calibration

June 27, 2016 *Test Number* *M161588*

CHAMBER:

Mfgr: Reuter Stokes
Model: RSS-131
Serial: 07J00KM1

SUBMITTED BY:

ERG

Albuquerque, NM

ORIENTATION/CONDITIONS:

Serial number away from source

"True" background exposure rate of 6.7 uR/h, instrument reading was 0.0076 mR/h

ATMOSPHERIC COMMUNICATION: SEALED

POLARIZING POTENTIAL 401V

LEAKAGE: negligible

BEAM QUALITY				CALIBRATION		
BEAM		EXPOSURE RATE		COEFFICIENT	UNCERT	LOG
CsEn220	(11mCi)	0.22mR/h	N_x=	1.00 mR/h/rdg	11%	M-53 73
CsEn80	(11mCi)	0.08mR/h	N_x=	1.03 mR/h/rdg	11%	
CsEnv12	(1mCi)	0.012mR/h	N_x=	1.01 mR/h/rdg	11%	
CsEnv15	(1mCi)	0.015mR/h	N_x=	1.02 mR/h/rdg	11%	
Cs199m	(20 Ci)	50mR/h	N_x=	1.12 mR/h/rdg	8%	
Cs252m	(20 Ci)	80mR/h	N_x=	1.10 mR/h/rdg	8%	

Comments Batt: 6.1V, Temp: 24.6 deg C. K&S Environment: Temp:21 deg C , RH 59%, Press: 752 mmHg;
Report Number: 161866
Refer to Appendix I of this report for details on PIC ionization chamber calibrations. Procedure: SI 25
RAC Found: 2.169e-8

Calibrated By Richard Hardison
Richard Hardison
Title: Calibration Technician

Reviewed By:
Title: Calibration Physicist

Checked By:
Prepared By: REH

Form RSS

①

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	~~7-9-17~~ NW 1-9-17 NW ~~1-20-17~~ STET

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	~~7-9-17~~ NW 7-9-17 ~~1-20-17~~ STET

Comments:

NNEET

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-2-16	0821	5.7	1008	99	45344	6195	39149	NW	Charles Keith
11-2-16	1721	5.6	1002	99	44348	5346	39002	NW	Goulding's in SUV
11-3-16	1037	5.7	1007	100	43600	5834	37766	NW	Charles Keith
11-3-16	1848	5.7	1003	100	46842	7821	39021	NW	Chinle Holiday Inn SUV
11-4-16	0845	5.7	1007	100	48258	8617	39641	NW	Occurrence B
11-4-16	1255	5.5	1003	99	46329	8608	37721	NW	Occurrence B
11-5-16	1108	5.6	1006	99	47858	9264	38594	NW	Claim 28
11-5-16	1527	5.6	1006	99	45039	7398	37641	NW	Chinle lot in SUV
11-7-16	0905	5.7	1008	100	48193	9249	38944	NW	Claim 28
11-7-16	1836	5.6	1003	99	46785	6986	39797	NW	Chinle lot in SUV
11-8-16	0800	5.6	1009	99	47951	9183	38768	NW	Claim 28
11-8-16	1637	5.5	1003	100	45094	6916	38178	NW	Chinle lot

Reviewed by: MM

Review Date: 11/29/16

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	7-5-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	7-5-17

Comments:

NNGRT

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-9-16	0729	5.6	1009	100	47673	8821	38852	NW	Occurrence B
11-9-16	1415	5.4	1002	99	46465	7541	38924	NW	Chinle lot
11-10-16	0820	5.6	1011	100	47628	9750	37878	NW	Claim 28
11-10-16	1632	5.4	1002	99	50634	8930	41704	NW	Claim 28 (2nd location)
11-11-16	0816	5.5	1010	100	49034	9824	39210	NW	Claim 28
11-11-16	1555	5.4	1002	99	48985	8643	40342	NW	Occurrence B
11-12-16	0819	5.5	1009	100	49296	9054	40242	NW	Hoskie Tso
11-12-16	1340	5.3	1002	99	49800	8556	41244	NW	Hoskie Tso
11-14-16	0818	5.5	1012	100	47737	9609	38128	NW	Hoskie Tso
11-14-16	1637	5.3	1002	99	47714	9150	38564	NW	Hoskie Tso (2nd location)
11-16-16	0809	5.4	1011	100	49413	12340	37073	NW	Standing Rock
11-16-16	1510	5.3	1003	99	49649	11268	38381	NW	Gallup lot

Reviewed by:

Review Date: 11/29/16

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ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR295014
Cal. Due Date:	7-9-17

Comments:
NNEAT

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-1-16	0744	5.3	1107	100	43406	4729	38677	NW	Charles Keith
11-1-16	1718	5.2	1102	99	44319	5332	38987	NW	Goulding's in SUV
11-2-16	0818	5.2	1108	100	43456	5555	37901	NW	Charles Keith
11-2-16	1703	5.1	1101	100	43874	5111	38763	NW	Gouldings in SUV
a 11-3-16	1050	6.2	1107	100	45017	5399	39618	NW	Charles Keith
* 11-3-16	1845	6.2	1104	99	47896	7562	40334	NW	Chinle Holiday Inn SUV
11-4-16	0856	6.2	1109	100	47119	8387	38732	NW	Occurrence B
11-4-16	1147	6.1	1105	100	46025	7972	38053	NW	Occurrence B
11-5-16	1112	6.1	1107	100	47483	8555	38928	NW	Claim 28
11-5-16	1524	6.1	1107	99	46828	7017	39811	NW	Chinle lot in SUV
11-7-16	0822	6.1	1108	100	46784	8794	37990	NW	Claim 28
11-7-16	1829	5.9	1104	99	46382	6448	39934	NW	Chinle lot

a. Charged batteries

Reviewed by:

Review Date: 11/29/16

ERG Form ITC.201.A

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Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR295014
Cal. Due Date:	7-9-17

Comments:
NNERT

Source: Cs-137
Activity: 5.12 uCi
Source Date: 6-6-94
Distance to Source: 6 inches
Serial No.: 333-94
Emission Rate: NA cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-8-16	0805	6.0	1109	100	49571	9246	40325	NW	Claim 28
11-8-16	1641	5.8	1104	100	45893	6864	39029	NW	Chinle lot
11-9-16	0724	5.8	1110	101	46451	8453	37998	NW	occurrance 3
11-9-16	1425	5.8	1104	100	47096	6903	40193	NW	Chinle lot
11-10-16	0826	5.8	1109	100	47011	9425	37586	NW	Claim 28
11-10-16	1628	5.7	1103	100	48672	8509	40163	NW	Claim 28 (2nd location)
11-12-16	0834	5.7	1109	101	47413	9188	38275	NW	Hoskie Tso
11-12-16	1347	5.6	1101	101	48929	8265	40664	NW	Hoskie Tso
11-14-16	1218	5.7	1105	100	48870	8074	40796	NW	Hoskie Ts.
11-14-16	1639	5.7	1105	100	47696	9068	38628	NW	Hoskie Tso (2nd locatn.)
11-15-16	0834	5.7	1110	101	50555	~~9195~~ 9150 NW	41405	NW	Hoskie Tso
11-15-16	1142	5.5	1101	100	48004	8598	39406	NW	Hoskie Tso

Reviewed by:

Review Date: 11/29/16

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ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	138638
Cal. Due Date:	7-9-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR154615
Cal. Due Date:	7-9-17

Comments:
NNERT

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s): Project reference points
11-4-16	1143	5.2	1131	110	46332	8240	38092	NW	occurrence B
11-5-16	1117	5.4	1135	112	46611	8815	37796	NW	Claim 28
11-5-16	1519	5.2	1127	104	46761	7064	39697	NW	Chinle lot
11-7-16	0815	5.3	1130	107	49792	8843	40949	NW	Claim 28
11-7-16	1821	5.2	1120	100	47318	6436	40882	NW	Chinle lot
11-16-16	0821	5.4	1158	132	50609	11976	38633	NW	Standing Rock
11-16-16	1507	5.2	1125	106	49562	10942	38620	NW	Gallup lot

nw 12-6-16

Reviewed by:

Review Date: 11/29/16

ERG Form ITC.201.A

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Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	282966
Cal. Due Date:	10-31-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR150507
Cal. Due Date:	10-31-17

Comments:
NNERT

Source: Cs-137
Serial No.: 333-94
Activity: 5.12 uCi
Emission Rate: NA cpm/emissions
Source Date: 6-6-94
Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
11-2-16	0832	6.0	1007	100	43939	6161	37778	NW	Project reference point, Charles Keith
11-2-16	1711	6.0	1003	101	44857	5744	39113	NW	Goulding's in SUV
11-4-16	0904	6.0	1008	101	47156	8938	38218	NW	Occurrence B
11-4-16	1152	5.9	1007	101	46787	8341	38446	NW	Occurrence B
11-5-16	1121	6.0	1007	101	47567	9195	38372	NW	Claim 28
11-5-16	1531	5.9	1007	101	46740	7360	39380	NW	Chinle lot in SUV
11-7-16	0810	6.0	1010	104	49757	9136	40621	NW	Claim 28
11-7-16	1832	5.8	1003	100	45791	6809	38982	NW	Chinle lot
11-8-16	0810	5.8	1009	100	49552	9855	39697	NW	Claim 28
11-8-16	1634	5.7	1003	100	48686	7133	41553	NW	Chinle lot
11-10-16	0812	5.8	1012	101	48023	9818	38205	NW	Claim 28
11-10-16	1635	5.7	1003	101	46906	9042	37864	NW	Claim 28 (2nd location)

Reviewed by: _______ Review Date: 11/29/16

ERG Form ITC.201.A

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	2-28-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 303727
Cal. Due Date:	2-28-18

Comments:
NNERT

Source: Cs-137
Serial No.: 544-96
Activity: 4 uCi
Emission Rate: N/A cpm/emissions
Source Date: 4-18-96
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
3-16-17	1322	6.2	947	100	40116	7260	32856	NW	Cameron Trading Post lot
3-16-17	1555	6.1	942	99	38643	5986	32657	NW	Boyd Tisi
3-17-17	0812	6.2	951	100	40087	7965	32122	NW	Cameron Trading Post lot
3-17-17	1328	6.1	943	100	42203	10206	31997	NW	Boyd Tisi ~200 ft from B64
3-18-17	0730	6.1	949	100	38598	6950	31648	NW	Harvey Blackwater
3-18-17	1505	6.0	941	100	35954	5035	30919	NW	Mitten No. 3
3-19-17	0651	6.1	949	99	36982	4952	32030	NW	Goulding's lot
3-19-17	1217	5.9	945	99	36802	5103	31699	NW	Charles Keith south of claim
3-20-17	0855	6.0	950	100	40829	8989	31840	NW	Claim 28
3-20-17	1555	5.9	943	100	37489	5569	32280	NW	Chinle parking lot
3-21-17	0635	5.9	950	100	38433	5735	32698	NW	Chinle lot
3-21-17	1657	5.9	946	100	36797	4997	31800	NW	Goulding's lot

Reviewed by:

Review Date: 10/17/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	2-28-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 295014
Cal. Due Date:	2-28-18

Comments:
NNEAT

Source: Cs-137

Serial No.: 544-96

Activity: 4 uCi

Emission Rate: NA cpm/emissions

Source Date: 4-18-96

Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
3-20-17	0905	5.7	1003	101	40471	8507	31964	NW	Claim 28
3-20-17	1547	5.6	996	101	36470	5494	30976	NW	Chinle lot
3-21-17	0641	5.7	1004	101	37904	5597	32307	NW	Chinle lot
3-21-17	1654	5.6	999	101	36212	4929	31283	NW	Goulding's lot
3-22-17	0702	5.6	1001	101	35714	5119	30595	NW	Goulding's lot
3-22-17	1437	5.4	995	101	35087	4539	30548	NW	Charles Keith shooting range
3-23-17	0907	5.6	1004	101	36031	4879	31152	NW	NA-0928
3-23-17	1922	5.5	1004	101	41793	9955	31838	NW	Gallup lot
3-24-17	0810	5.5	1007	101	35608	4282	31326	NW	Eunice Becenti
3-24-17	1735	5.5	1000	101	41923	10785	31138	NW	Gallup lot
3-27-17	0833	5.5	1005	101	36943	4282	32661	NW	Eunice Becenti
3-27-17	1235	5.4	1000	101	35141	4013	31128	NW	Eunice Becenti

Reviewed by:

Review Date: 10/19/17

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ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	254772
Cal. Due Date:	2-28-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	2-28-17

Comments:
NWERT

Source: Cs-137

Serial No.: 544-96

Activity: 4 uCi

Emission Rate: NA cpm/emissions

Source Date: 4-18-96

Distance to Source: 6 Inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4-11-17	0920	5.7	1000	101	36807	5626	31181	NW	NA-0928
4-11-17	1607	5.1	994	100	35724	5073	30651	NW	NA-0904 upper
4-14-17	0910	5.3	999	100	37554	5361	32193	NW	NA-0928
4-14-17	1050	5.3	997	100	37119	5165	31954	NW	NA-0928
4-17-17	0926	5.6	1000	101	37381	5937	31444	NW	NA-0928
4-17-17	1314	5.5	993	100	37712	5579	32133	NW	Berton 3
4-18-17	1400	5.6	997	100	40901	8541	32360	NW	Claim 28
4-18-17	1633	5.5	996	100	38299	8808	29491	NW	Claim 28
					NW				
					4.19.17				

Reviewed by: Markand Ash

Review Date: 11/08/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	282971
Cal. Due Date:	3-13-18

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR320178
Cal. Due Date:	3-13-18

Comments:
NNEAT

Source: Cs-137
Serial No.: 544-96
Activity: 4 uCi
Emission Rate: NA cpm/emissions
Source Date: 4-18-96
Distance to Source: 6 inches

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4-17-17	1312	5.9	1044	100	38272	6004	32268	NW	Barton 3
4-18-17	1356	5.9	1049	100	41042	8945	32097	NW	Claim 28
4-18-17	1636	5.8	1047	100	40713	9418	31295	NW	Claim 28
4-19-17	0821	5.9	1049	101	40983	9954	31029	NW	Claim 28
4-19-17	1350	5.7	1047	100	40955	9152	31803	NW	Claim 28
4-20-17	0919	5.8	1051	100	41485	9593	31892	NW	Claim 28
4-20-17	1315	5.7	1046	100	40970	9549	31421	NW	Claim 28

4-24-17

Reviewed by:

Review Date: 10/4/17

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	Ludlum
Model:	2221
Serial No.:	196086
Cal. Due Date:	2-28-17

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 295094
Cal. Due Date:	2-28-17

Comments:

NNERT

Source: Cs - 137

Activity: 4 uCi

Source Date: 4-18-96

Distance to Source: 6 inches

Serial No.: 544-96

Emission Rate: NA cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4-11-17	0932	5.5	1100	100mv	36776	5404		NW	NA-0928
4-11-17	1601	5.4	1094	100	36796	5031		NW	NA-0904 (upper)
4-12-17	0850	5.4	1100	101	37067	5050		NW	NA-0928
4-12-17	1510	5.3	1092	100	36453	5524		NW	NA-0904
4-13-17	0855	5.4	1101	101	36895	5793		NW	NA-0928
4-12-17	1648	5.3	1092	100	38916	5572		NW	NA-0904
4-15-17	0840	5.4	1100	101	37457	5291		NW	NA-0928
4-13-17	1612	5.2	1090	100	38092	6045		NW	Barton 3
4-17-17	0921	5.4	1101	101	38591	5561		NW	NA-0928
4-17-17	1317	5.3	1090	100	37050	5496		NW	Barton 3
4-18-17	1354	5.4	1098	101	40983	8497		NW	Claim 28
4-18-17	1642	5.2	1091	101	39900	8193		NW	Claim 28

Reviewed by:

Review Date: 10/9/17

ERG Form ITC.201.A

ERG

Single-Channel Function Check Log

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

METER	
Manufacturer:	GE
Model:	RS3-131
Serial No.:	07J00KM1
Cal. Due Date:	6-29-17

DETECTOR	
Manufacturer:	SAME AS METER
Model:	/
Serial No.:	
Cal. Due Date:	

Comments:
NNERP

Source: Cs-137

Serial No.: 333-94

Activity: 5.12 uCi

Emission Rate: NA cpm/emissions

Source Date: 6-6-94

Distance to Source: Contact - housing

Date	Time	Battery	High Voltage	Threshhold	Source Counts μR/h	BKG Counts μR/h	Net Counts	Initials	Note(s): Project reference points
10-26-16	0525	~6.4	~400	NA	~27.8	~10.5	~17.3	NW	Best Western room - Flagstaff
10-26-16	2010	~6.3	~400	NA	~26	~9.5	~16.5	NW	Gouldings room ~~Best Western room - Flagstaff~~
10-27-16	0720	~6.2	~400	NA	~26.7	~10.0	~16.7	NW	Gouldings room
10-27-16	1710	~6.2	~400	NA	~27.0	~10.8	~16.2	NW	Gouldings room
10-31-16	0609	~6.3	~400	NA	~27.0	~10	~16	NW	Gouldings room
10-31-16	1520	~6.3	~400	NA	~26	~10	~16	NW	Gouldings room
11-3-16	0700	~6.2	~400	NA	~26.5	~10.5	~16	NW	Gouldings room
11-3-16	1924	~6.1	~400	NA	~28.8	~12.5	~16.3	NW	Holiday Inn Chinle-room
11-9-16	0615	~6.3	~400	NA	~30	~12.8	~17.2	NW	Holiday Inn-Chinle room
11-9-16	1430	~6.2	~400	NA	~29.5	~12.5	~17	NW	Holiday Inn Chinle - room
11-11-16	0610	~6.4	~400	NA	~31.5	~13.5	~18	NW	Holiday Inn Chinle - room
11-11-16	1825	~6.2	~400	NA	~28	~11	~17	NW	Holiday Inn Chinle - room

Reviewed by:

Review Date: 11-29-16

Appendix B Exposure Rate Measurements

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 10:30	0.0545	Correlation Location 1
11/11/2016 10:30	0.0958	Correlation Location 1
11/11/2016 10:30	0.0842	Correlation Location 1
11/11/2016 10:30	0.0585	Correlation Location 1
11/11/2016 10:30	0.0394	Correlation Location 1
11/11/2016 10:31	0.0279	Correlation Location 1
11/11/2016 10:31	0.0215	Correlation Location 1
11/11/2016 10:31	0.0182	Correlation Location 1
11/11/2016 10:31	0.0165	Correlation Location 1
11/11/2016 10:31	0.0154	Correlation Location 1
11/11/2016 10:31	0.0148	Correlation Location 1
11/11/2016 10:31	0.015	Correlation Location 1
11/11/2016 10:31	0.0156	Correlation Location 1
11/11/2016 10:31	0.0155	Correlation Location 1
11/11/2016 10:31	0.0154	Correlation Location 1
11/11/2016 10:32	0.015	Correlation Location 1
11/11/2016 10:32	0.0149	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:32	0.0147	Correlation Location 1
11/11/2016 10:32	0.0144	Correlation Location 1
11/11/2016 10:32	0.015	Correlation Location 1
11/11/2016 10:32	0.0153	Correlation Location 1
11/11/2016 10:33	0.0155	Correlation Location 1
11/11/2016 10:33	0.0152	Correlation Location 1
11/11/2016 10:33	0.0149	Correlation Location 1
11/11/2016 10:33	0.0148	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0151	Correlation Location 1
11/11/2016 10:33	0.0156	Correlation Location 1
11/11/2016 10:33	0.0155	Correlation Location 1
11/11/2016 10:33	0.0154	Correlation Location 1
11/11/2016 10:34	0.0158	Correlation Location 1
11/11/2016 10:34	0.0161	Correlation Location 1
11/11/2016 10:34	0.0156	Correlation Location 1
11/11/2016 10:34	0.0151	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:34	0.0151	Correlation Location 1
11/11/2016 10:34	0.015	Correlation Location 1
11/11/2016 10:34	0.0149	Correlation Location 1
11/11/2016 10:35	0.0153	Correlation Location 1
11/11/2016 10:35	0.0154	Correlation Location 1
11/11/2016 10:35	0.0155	Correlation Location 1
11/11/2016 10:35	0.0155	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:35	0.0164	Correlation Location 1
11/11/2016 10:35	0.0162	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:35	0.0156	Correlation Location 1
11/11/2016 10:35	0.0158	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0152	Correlation Location 1
11/11/2016 10:36	0.0154	Correlation Location 1
11/11/2016 10:36	0.0156	Correlation Location 1
11/11/2016 10:36	0.0153	Correlation Location 1
11/11/2016 10:36	0.0152	Correlation Location 1
11/11/2016 10:36	0.0155	Correlation Location 1
11/11/2016 10:36	0.0158	Correlation Location 1
11/11/2016 10:36	0.0158	Correlation Location 1
11/11/2016 10:37	0.0154	Correlation Location 1
11/11/2016 10:37	0.0155	Correlation Location 1
11/11/2016 10:37	0.0156	Correlation Location 1
11/11/2016 10:37	0.0158	Correlation Location 1
11/11/2016 10:37	0.0161	Correlation Location 1
11/11/2016 10:37	0.0162	Correlation Location 1
11/11/2016 10:37	0.0163	Correlation Location 1
11/11/2016 10:37	0.016	Correlation Location 1
11/11/2016 10:37	0.0156	Correlation Location 1
11/11/2016 10:37	0.0153	Correlation Location 1
11/11/2016 10:38	0.015	Correlation Location 1
11/11/2016 10:38	0.0147	Correlation Location 1
11/11/2016 10:38	0.0148	Correlation Location 1
11/11/2016 10:38	0.0145	Correlation Location 1
11/11/2016 10:38	0.0142	Correlation Location 1
11/11/2016 10:38	0.0142	Correlation Location 1
11/11/2016 10:38	0.0146	Correlation Location 1
11/11/2016 10:38	0.0151	Correlation Location 1
11/11/2016 10:38	0.0151	Correlation Location 1
11/11/2016 10:38	0.0149	Correlation Location 1
11/11/2016 10:39	0.0149	Correlation Location 1
11/11/2016 10:39	0.015	Correlation Location 1
11/11/2016 10:39	0.0151	Correlation Location 1
11/11/2016 10:39	0.015	Correlation Location 1
11/11/2016 10:39	0.0147	Correlation Location 1
11/11/2016 10:39	0.0151	Correlation Location 1
11/11/2016 10:39	0.0154	Correlation Location 1
11/11/2016 10:39	0.0156	Correlation Location 1
11/11/2016 10:39	0.0158	Correlation Location 1
11/11/2016 10:39	0.0158	Correlation Location 1
11/11/2016 10:40	0.0156	Correlation Location 1
11/11/2016 10:40	0.0153	Correlation Location 1
11/11/2016 10:40	0.0146	Correlation Location 1
11/11/2016 10:40	0.0144	Correlation Location 1
11/11/2016 10:40	0.0149	Correlation Location 1
11/11/2016 10:40	0.0153	Correlation Location 1
11/11/2016 10:40	0.0155	Correlation Location 1
11/11/2016 10:40	0.016	Correlation Location 1
11/11/2016 10:40	0.0158	Correlation Location 1
11/11/2016 10:40	0.0155	Correlation Location 1
11/11/2016 10:41	0.0151	Correlation Location 1
11/11/2016 10:41	0.0154	Correlation Location 1
11/11/2016 10:41	0.0153	Correlation Location 1
11/11/2016 11:14	0.0556	Correlation Location 2
11/11/2016 11:14	0.0983	Correlation Location 2
11/11/2016 11:15	0.0879	Correlation Location 2
11/11/2016 11:15	0.0626	Correlation Location 2

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 11:15	0.0433	Correlation Location 2
11/11/2016 11:15	0.0317	Correlation Location 2
11/11/2016 11:15	0.0258	Correlation Location 2
11/11/2016 11:15	0.0229	Correlation Location 2
11/11/2016 11:15	0.0211	Correlation Location 2
11/11/2016 11:15	0.0201	Correlation Location 2
11/11/2016 11:15	0.0198	Correlation Location 2
11/11/2016 11:15	0.0197	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0192	Correlation Location 2
11/11/2016 11:16	0.0194	Correlation Location 2
11/11/2016 11:16	0.0199	Correlation Location 2
11/11/2016 11:16	0.0198	Correlation Location 2
11/11/2016 11:16	0.0197	Correlation Location 2
11/11/2016 11:16	0.02	Correlation Location 2
11/11/2016 11:17	0.0202	Correlation Location 2
11/11/2016 11:17	0.02	Correlation Location 2
11/11/2016 11:17	0.0196	Correlation Location 2
11/11/2016 11:17	0.0197	Correlation Location 2
11/11/2016 11:17	0.0197	Correlation Location 2
11/11/2016 11:17	0.0192	Correlation Location 2
11/11/2016 11:17	0.0194	Correlation Location 2
11/11/2016 11:17	0.02	Correlation Location 2
11/11/2016 11:17	0.0205	Correlation Location 2
11/11/2016 11:17	0.0205	Correlation Location 2
11/11/2016 11:18	0.0202	Correlation Location 2
11/11/2016 11:18	0.0201	Correlation Location 2
11/11/2016 11:18	0.0207	Correlation Location 2
11/11/2016 11:18	0.0208	Correlation Location 2
11/11/2016 11:18	0.0204	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.02	Correlation Location 2
11/11/2016 11:18	0.0198	Correlation Location 2
11/11/2016 11:18	0.0196	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0194	Correlation Location 2
11/11/2016 11:19	0.019	Correlation Location 2
11/11/2016 11:19	0.019	Correlation Location 2
11/11/2016 11:19	0.0192	Correlation Location 2
11/11/2016 11:19	0.0196	Correlation Location 2
11/11/2016 11:19	0.02	Correlation Location 2
11/11/2016 11:20	0.0196	Correlation Location 2
11/11/2016 11:20	0.019	Correlation Location 2
11/11/2016 11:20	0.0192	Correlation Location 2
11/11/2016 11:20	0.0194	Correlation Location 2
11/11/2016 11:20	0.0197	Correlation Location 2
11/11/2016 11:20	0.02	Correlation Location 2
11/11/2016 11:20	0.0202	Correlation Location 2
11/11/2016 11:20	0.0201	Correlation Location 2
11/11/2016 11:20	0.0199	Correlation Location 2
11/11/2016 11:20	0.02	Correlation Location 2
11/11/2016 11:21	0.0202	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.02	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.0201	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.0198	Correlation Location 2
11/11/2016 11:21	0.0199	Correlation Location 2
11/11/2016 11:21	0.02	Correlation Location 2
11/11/2016 11:22	0.02	Correlation Location 2
11/11/2016 11:22	0.02	Correlation Location 2
11/11/2016 11:22	0.0196	Correlation Location 2
11/11/2016 11:22	0.0194	Correlation Location 2
11/11/2016 11:22	0.0198	Correlation Location 2
11/11/2016 11:22	0.0204	Correlation Location 2
11/11/2016 11:22	0.0207	Correlation Location 2
11/11/2016 11:22	0.0207	Correlation Location 2
11/11/2016 11:22	0.0209	Correlation Location 2
11/11/2016 11:22	0.0208	Correlation Location 2
11/11/2016 11:23	0.0208	Correlation Location 2
11/11/2016 11:23	0.0209	Correlation Location 2
11/11/2016 11:23	0.0211	Correlation Location 2
11/11/2016 11:23	0.0207	Correlation Location 2
11/11/2016 11:23	0.0202	Correlation Location 2
11/11/2016 11:23	0.0201	Correlation Location 2
11/11/2016 11:23	0.0204	Correlation Location 2
11/11/2016 11:23	0.021	Correlation Location 2
11/11/2016 11:23	0.0215	Correlation Location 2
11/11/2016 11:23	0.0213	Correlation Location 2
11/11/2016 11:24	0.0213	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:24	0.02	Correlation Location 2
11/11/2016 11:24	0.0198	Correlation Location 2
11/11/2016 11:24	0.0198	Correlation Location 2
11/11/2016 11:24	0.0201	Correlation Location 2
11/11/2016 11:24	0.0211	Correlation Location 2
11/11/2016 11:24	0.0211	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:24	0.0206	Correlation Location 2
11/11/2016 11:25	0.0208	Correlation Location 2
11/11/2016 11:25	0.0206	Correlation Location 2
11/11/2016 11:25	0.02	Correlation Location 2
11/11/2016 11:25	0.0201	Correlation Location 2
11/11/2016 11:25	0.0201	Correlation Location 2
11/11/2016 11:25	0.0199	Correlation Location 2
11/11/2016 11:25	0.0199	Correlation Location 2
11/11/2016 11:55	0.0566	Correlation Location 3
11/11/2016 11:56	0.1014	Correlation Location 3
11/11/2016 11:56	0.0929	Correlation Location 3
11/11/2016 11:56	0.068	Correlation Location 3
11/11/2016 11:56	0.0491	Correlation Location 3
11/11/2016 11:56	0.0377	Correlation Location 3
11/11/2016 11:56	0.0319	Correlation Location 3
11/11/2016 11:56	0.0289	Correlation Location 3
11/11/2016 11:56	0.027	Correlation Location 3

Claim 28 Exposure Rate Measurements for Correlation

Date and Time	Exposure Rate (mR/h)	Location
11/11/2016 11:56	0.0256	Correlation Location 3
11/11/2016 11:56	0.0253	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0245	Correlation Location 3
11/11/2016 11:57	0.0244	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0249	Correlation Location 3
11/11/2016 11:57	0.0253	Correlation Location 3
11/11/2016 11:57	0.0256	Correlation Location 3
11/11/2016 11:58	0.0258	Correlation Location 3
11/11/2016 11:58	0.0259	Correlation Location 3
11/11/2016 11:58	0.0255	Correlation Location 3
11/11/2016 11:58	0.0249	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:58	0.0252	Correlation Location 3
11/11/2016 11:58	0.0255	Correlation Location 3
11/11/2016 11:58	0.0251	Correlation Location 3
11/11/2016 11:58	0.0247	Correlation Location 3
11/11/2016 11:59	0.0245	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0247	Correlation Location 3
11/11/2016 11:59	0.0251	Correlation Location 3
11/11/2016 11:59	0.0252	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0245	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 11:59	0.0252	Correlation Location 3
11/11/2016 11:59	0.0249	Correlation Location 3
11/11/2016 12:00	0.0249	Correlation Location 3
11/11/2016 12:00	0.0249	Correlation Location 3
11/11/2016 12:00	0.0245	Correlation Location 3
11/11/2016 12:00	0.0243	Correlation Location 3
11/11/2016 12:00	0.0245	Correlation Location 3
11/11/2016 12:00	0.0247	Correlation Location 3
11/11/2016 12:00	0.0247	Correlation Location 3
11/11/2016 12:00	0.0251	Correlation Location 3
11/11/2016 12:00	0.0256	Correlation Location 3
11/11/2016 12:00	0.026	Correlation Location 3
11/11/2016 12:01	0.0255	Correlation Location 3
11/11/2016 12:01	0.0256	Correlation Location 3
11/11/2016 12:01	0.0259	Correlation Location 3
11/11/2016 12:01	0.0261	Correlation Location 3
11/11/2016 12:01	0.0263	Correlation Location 3
11/11/2016 12:01	0.0264	Correlation Location 3
11/11/2016 12:01	0.0267	Correlation Location 3
11/11/2016 12:01	0.0268	Correlation Location 3
11/11/2016 12:01	0.027	Correlation Location 3
11/11/2016 12:01	0.0268	Correlation Location 3
11/11/2016 12:02	0.0263	Correlation Location 3
11/11/2016 12:02	0.0262	Correlation Location 3
11/11/2016 12:02	0.0262	Correlation Location 3
11/11/2016 12:02	0.026	Correlation Location 3
11/11/2016 12:02	0.0256	Correlation Location 3
11/11/2016 12:02	0.0256	Correlation Location 3
11/11/2016 12:02	0.0254	Correlation Location 3
11/11/2016 12:02	0.0253	Correlation Location 3
11/11/2016 12:02	0.0254	Correlation Location 3
11/11/2016 12:02	0.0255	Correlation Location 3
11/11/2016 12:03	0.0253	Correlation Location 3
11/11/2016 12:03	0.0251	Correlation Location 3
11/11/2016 12:03	0.0251	Correlation Location 3
11/11/2016 12:03	0.0249	Correlation Location 3
11/11/2016 12:03	0.0249	Correlation Location 3
11/11/2016 12:03	0.0254	Correlation Location 3
11/11/2016 12:03	0.0253	Correlation Location 3
11/11/2016 12:03	0.0249	Correlation Location 3
11/11/2016 12:03	0.0251	Correlation Location 3
11/11/2016 12:03	0.0253	Correlation Location 3
11/11/2016 12:04	0.0251	Correlation Location 3
11/11/2016 12:04	0.0249	Correlation Location 3
11/11/2016 12:04	0.0247	Correlation Location 3
11/11/2016 12:04	0.0247	Correlation Location 3
11/11/2016 12:04	0.0253	Correlation Location 3
11/11/2016 12:04	0.0251	Correlation Location 3
11/11/2016 12:04	0.0249	Correlation Location 3
11/11/2016 12:04	0.0247	Correlation Location 3
11/11/2016 12:04	0.0247	Correlation Location 3
11/11/2016 12:04	0.0249	Correlation Location 3
11/11/2016 12:05	0.0254	Correlation Location 3
11/11/2016 12:05	0.0259	Correlation Location 3
11/11/2016 12:05	0.026	Correlation Location 3
11/11/2016 12:05	0.0258	Correlation Location 3
11/11/2016 12:05	0.0256	Correlation Location 3
11/11/2016 12:05	0.0254	Correlation Location 3
11/11/2016 12:05	0.0252	Correlation Location 3
11/11/2016 12:05	0.0253	Correlation Location 3
11/11/2016 12:05	0.0253	Correlation Location 3
11/11/2016 12:05	0.0253	Correlation Location 3
11/11/2016 12:06	0.0255	Correlation Location 3
11/11/2016 12:06	0.0256	Correlation Location 3
11/11/2016 12:06	0.0254	Correlation Location 3
11/11/2016 12:06	0.0253	Correlation Location 3
11/11/2016 12:06	0.0252	Correlation Location 3
11/11/2016 12:06	0.0252	Correlation Location 3
11/11/2016 12:06	0.0252	Correlation Location 3
11/11/2016 12:06	0.0249	Correlation Location 3
11/11/2016 12:06	0.0251	Correlation Location 3
11/11/2016 12:46	0.0582	Correlation Location 4
11/11/2016 12:46	0.105	Correlation Location 4
11/11/2016 12:46	0.0985	Correlation Location 4
11/11/2016 12:46	0.0755	Correlation Location 4
11/11/2016 12:46	0.0577	Correlation Location 4
11/11/2016 12:47	0.0471	Correlation Location 4
11/11/2016 12:47	0.0413	Correlation Location 4
11/11/2016 12:47	0.0387	Correlation Location 4
11/11/2016 12:47	0.0372	Correlation Location 4
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Date and Time	Exposure Rate (mR/h)	Location
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11/11/2016 12:48	0.0355	Correlation Location 4
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11/11/2016 12:49	0.0351	Correlation Location 4
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11/11/2016 12:49	0.035	Correlation Location 4
11/11/2016 12:50	0.0355	Correlation Location 4
11/11/2016 12:50	0.0357	Correlation Location 4
11/11/2016 12:50	0.0355	Correlation Location 4
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11/11/2016 12:50	0.036	Correlation Location 4
11/11/2016 12:50	0.0357	Correlation Location 4
11/11/2016 12:50	0.0351	Correlation Location 4
11/11/2016 12:50	0.0348	Correlation Location 4
11/11/2016 12:50	0.035	Correlation Location 4
11/11/2016 12:50	0.0354	Correlation Location 4
11/11/2016 12:51	0.0357	Correlation Location 4
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11/11/2016 12:51	0.036	Correlation Location 4
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11/11/2016 12:52	0.0357	Correlation Location 4
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11/11/2016 12:56	0.0346	Correlation Location 4
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11/11/2016 12:56	0.0344	Correlation Location 4
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Date and Time	Exposure Rate (mR/h)	Location
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11/11/2016 13:56	0.018	Correlation Location 5
11/11/2016 13:57	0.018	Correlation Location 5
11/11/2016 13:57	0.0176	Correlation Location 5
11/11/2016 13:57	0.0172	Correlation Location 5
11/11/2016 13:57	0.017	Correlation Location 5
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11/11/2016 13:58	0.0179	Correlation Location 5
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11/11/2016 13:58	0.0177	Correlation Location 5
11/11/2016 13:58	0.0176	Correlation Location 5
11/11/2016 13:58	0.018	Correlation Location 5
11/11/2016 13:58	0.0182	Correlation Location 5
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11/11/2016 13:59	0.0178	Correlation Location 5
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11/11/2016 14:02	0.0185	Correlation Location 5
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11/11/2016 14:03	0.0175	Correlation Location 5
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11/11/2016 14:04	0.0187	Correlation Location 5
11/11/2016 14:04	0.0187	Correlation Location 5
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11/11/2016 14:04	0.0182	Correlation Location 5
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11/11/2016 14:05	0.0173	Correlation Location 5
11/11/2016 14:05	0.0178	Correlation Location 5
11/11/2016 14:05	0.0175	Correlation Location 5
11/11/2016 14:05	0.0172	Correlation Location 5
11/11/2016 14:05	0.017	Correlation Location 5

RPT-2017-052

GEOPHYSICAL CHARACTERIZATION OF THE NAVAJO NATION CLAIM 28 SITE

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Prepared for:

Stantec

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

In October 2017, hydroGEOPHYSICS, Inc. (HGI), under contract to Stantec, completed a geophysical characterization of historic uranium mining operations within the Navajo Nation in Arizona. The site under investigation is the Claim 28 abandoned uranium mine site. The Claim 28 site consists of a former open pit with some unreclaimed areas with waste rock at the surface, and other areas where waste rock has been reclaimed and buried. The objective of the geophysical characterization was to investigate the thickness and volume of unconsolidated material above the bedrock within the former pit and surrounding waste piles. Ten lines of two-dimensional electrical resistivity were acquired to accomplish this objective.

Following the electrical resistivity survey, Stantec acquired soil borings using a track mounted sonic drill rig. The borehole logs and locations of these borings were made available to HGI in order to compare the logs to the resistivity profiles.

1.2 SITE LOCATION

The Claim 28 site is located in northern Arizona, U.S.A., approximately 120 miles northeast of Flagstaff, AZ (Figure 1).

1.3 OBJECTIVE OF INVESTIGATION

The objective of the geophysical characterization is to investigate the thickness of unconsolidated material above the bedrock within the former pit and surrounding waste piles. The electrical resistivity method was selected to take advantage of physical property contrasts that are reflective of site conditions. For example, it is expected that unconsolidated material would show an electrical contrast to bedrock, allowing an estimate of thickness at each of the three survey areas.

Figure 1. General Location Map of Claim 28.

Imagery source 2017 Google Earth

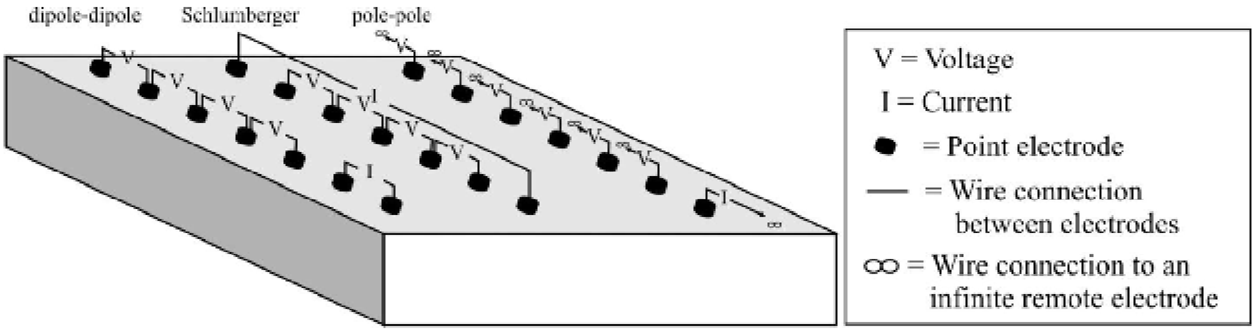
2.0 GEOPHYSICAL THEORY

2.1 ELECTRICAL RESISTIVITY

Electrical resistivity is a volumetric property that describes the resistance of electrical current flow within a medium (Rucker et al., 2011; Telford et al., 1990). Direct electrical current is propagated in rocks and minerals by electronic or electrolytic means. Electronic conduction occurs in minerals where free electrons are available, such as the electrical current flow through metal. Electrolytic conduction, on the other hand, relies on the dissociation of ionic species within a pore space. With electrolytic conduction, the movement of electrons varies with the mobility, concentration, and the degree of dissociation of the ions.

Mechanistically, the resistivity method uses electric current (I) that is transmitted into the earth through one pair of electrodes (transmitting dipole) that are in contact with the soil. The resultant voltage potential (V) is then measured across another pair of electrodes (receiving dipole). Numerous electrodes can be deployed along a transect (which may be anywhere from feet to miles in length), or within a grid. Figure 2 shows examples of electrode layouts for surveying. The figure shows transects with a variety of array types (dipole-dipole, Schlumberger, pole-pole). A complete set of measurements occurs when each electrode (or adjacent electrode pair) passes current, while all other adjacent electrode pairs are utilized for voltage measurements. Modern equipment automatically switches the transmitting and receiving electrode pairs through a single multi-core cable connection. Rucker et al. (2009) describe in more detail the methodology for efficiently conducting an electrical resistivity survey.

Figure 2. Possible Arrays for Use in Electrical Resistivity Characterization



The modern application of the resistivity method uses numerical modeling and inversion theory to estimate the electrical resistivity distribution of the subsurface given the known quantities of electrical current, measured voltage, and electrode positions. A common resistivity inverse method incorporated in commercially available codes is the regularized least squares optimization method (Sasaki, 1989; Loke, et al., 2003). The objective function within the optimization aims to minimize the difference between measured and modeled potentials (subject to certain constraints, such as the type and degree of spatial smoothing or regularization) and the optimization is conducted iteratively due to the nonlinear nature of the model that describes the potential distribution. The relationship between the subsurface resistivity (ρ) and the measured voltage is given by the following equation (from Dey and Morrison, 1979):

$$-\nabla\cdot\left[\frac{1}{\rho(x,y,z)}\nabla V(x,y,z)\right]=\left(\frac{I}{U}\right)\delta(x-x_s)\delta(y-y_s)\delta(z-z_s) \qquad (1)$$

where I is the current applied over an elemental volume U specified at a point (x_s, y_s, z_s) by the Dirac delta function.

Equation (1) is solved many times over the volume of the earth by iteratively updating the resistivity model values using either the L_2-norm smoothness-constrained least squares method, which aims to minimize the square of the misfit between the measured and modeled data (de Groot-Hedlin & Constable, 1990; Ellis & Oldenburg, 1994):

$$\left(J_i^T J_i+\lambda_i W^T W\right)\Delta r_i = J_i^T g_i-\lambda_i W^T W r_{i-1} \qquad (2)$$

or the L_1-norm that minimizes the sum of the absolute value of the misfit:

$$\left(J_i^T R_d J_i + \lambda_i W^T R_m W\right)\Delta r_i = J_i^T R_d g_i - \lambda_i W^T R_m W r_{i-1} \qquad (1)$$

where g is the data misfit vector containing the difference between the measured and modeled data, J is the Jacobian matrix of partial derivatives, W is a roughness filter, R_d and R_m are the weighting matrices to equate model misfit and model roughness, Δr_i is the change in model parameters for the i^th iteration, r_i is the model parameters for the previous iteration, and λ_i = the damping factor.

3.0 BACKGROUND

3.1 GEOLOGY

Per communication with the client and field observations, the primary bedrock in this region is sedimentary and predominantly composed of shale and/or sandstones. Coal seams were observed in outcrops and in material encountered during drilling. Geologic maps are available for this area via USGS, however, the scale is too small to provide a useful level of detail for this survey. The maps do indicate the site is within the sediments of the Cretaceous Black Mesa Basin (Nations et al, 2000) including the Wepo and Toreva Formations, and the underlying Mancos Shale and Dakota Sandstone (O'Sullivan and Beikman, 1963). These units are typically finely interbedded sands, silts, shales and coal beds (the latter of which was mined at the nearby Peabody Black Mesa coal mine).

Notes on the surfical geology were taken along the survey lines as different features can be tied to resistivity signatures. For example, dry washes typically have a higher resistivity signature due to the loose unconsolidated sands and gravels, while silty soils typically conduct electricity more effectively and have therefore show up as lower resistivity features in the profiles.

4.0 METHODOLOGY

4.1 SURVEY AREA AND LOGISTICS

Figure 3 shows detailed resistivity survey coverage for the three survey areas investigated:

- Area 1: Focused on a fenced-off section of material at the surface.
- Area 2: An elevated waste mound runs NW-SE following trend of Line 3.
- Area 3: The western part of this area is believed to be a shallow, relic mine pit.

Ten lines of resistivity data were acquired with survey parameters as detailed in Table 1. Geophysical cables with 3-meter spaced stainless steel electrodes were used along with an

Inverse Schlumberger array for acquisition of the electrical resistivity data. Different array types were tested to ensure the best electrode geometry was utilized to accomplish the project's goals. An additional resistivity line (Line 7) was originally proposed (eleven lines total); however, on-site analysis of survey design eliminated Line 7 due to topography concerns and distance from potential targets. The final survey contained ten lines total: Lines 1 and 2 (Area 1), Lines 3 through 6 (Area 2), and Lines 8 through 11 (Area 3).

Figure 3. Detailed Site Map.

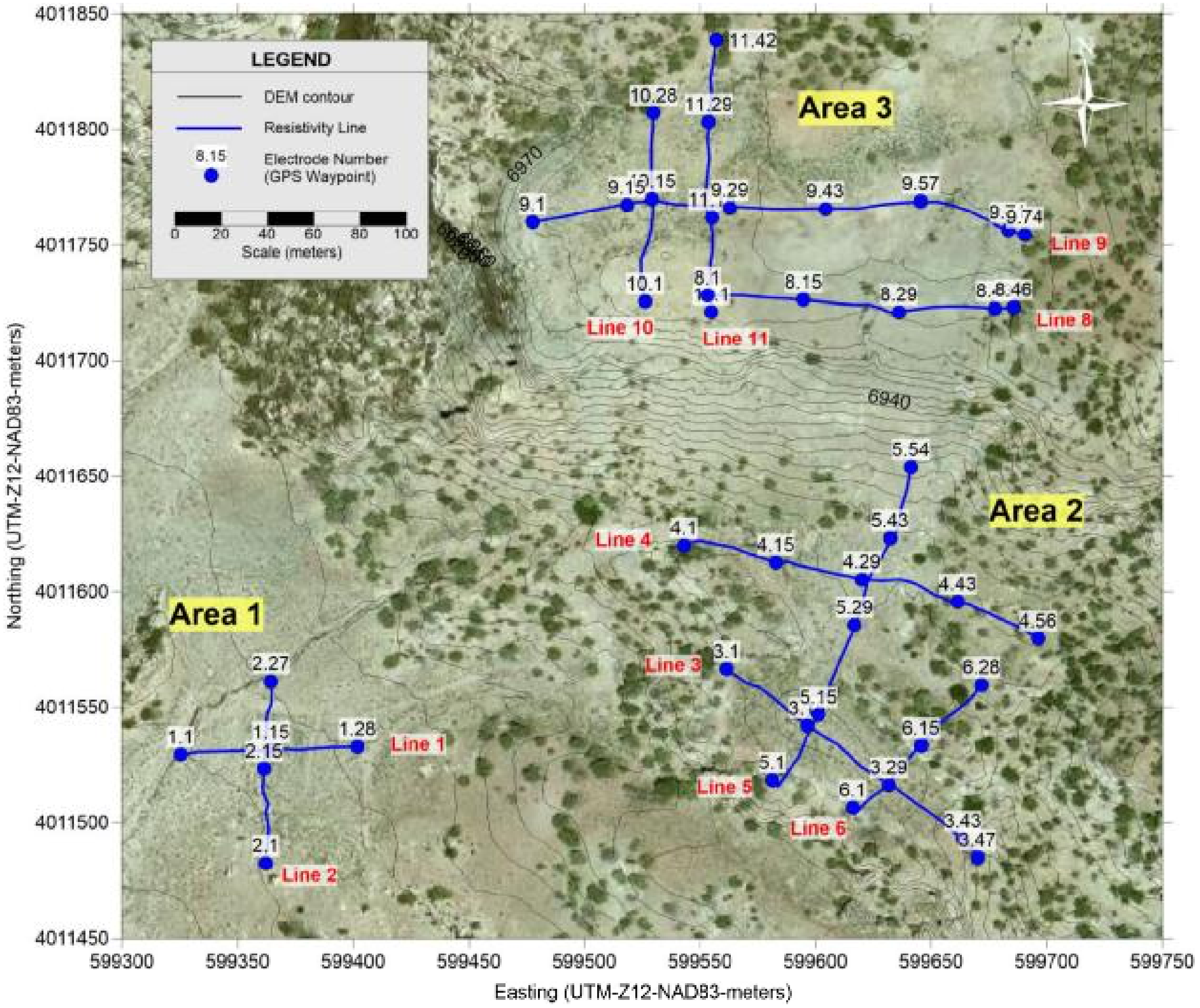
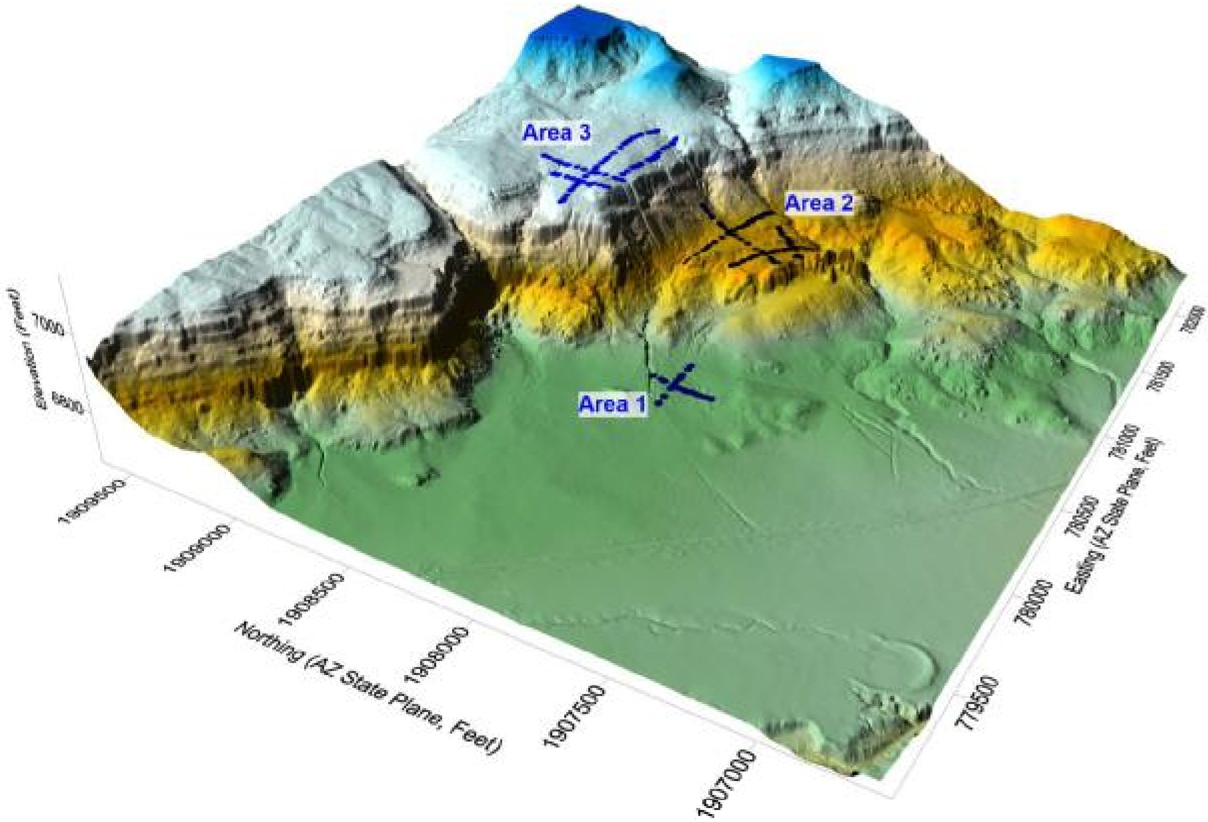


Table 1. Resistivity Survey Details

Line Name	Area	Date(s) of Acquisition	Line Length
Line 1	1	10/5/17	81 meters (~266 feet)
Line 2	1	10/5/17	78 meters (~256 feet)
Line 3	2	10/3/17	138 meters (~453 feet)
Line 4	2	10/3/17	165 meters (~541 feet)
Line 5	2	10/3/17	165 meters (~541 feet)
Line 6	2	10/5/17	81 meters (~266 feet)
Line 8	3	10/4/17	135 meters (~443 feet)
Line 9	3	10/4/17	219 meters (~719 feet)
Line 10	3	10/4/17	81 meters (~266 feet)
Line 11	3	10/4/17	123 meters (~404 feet)

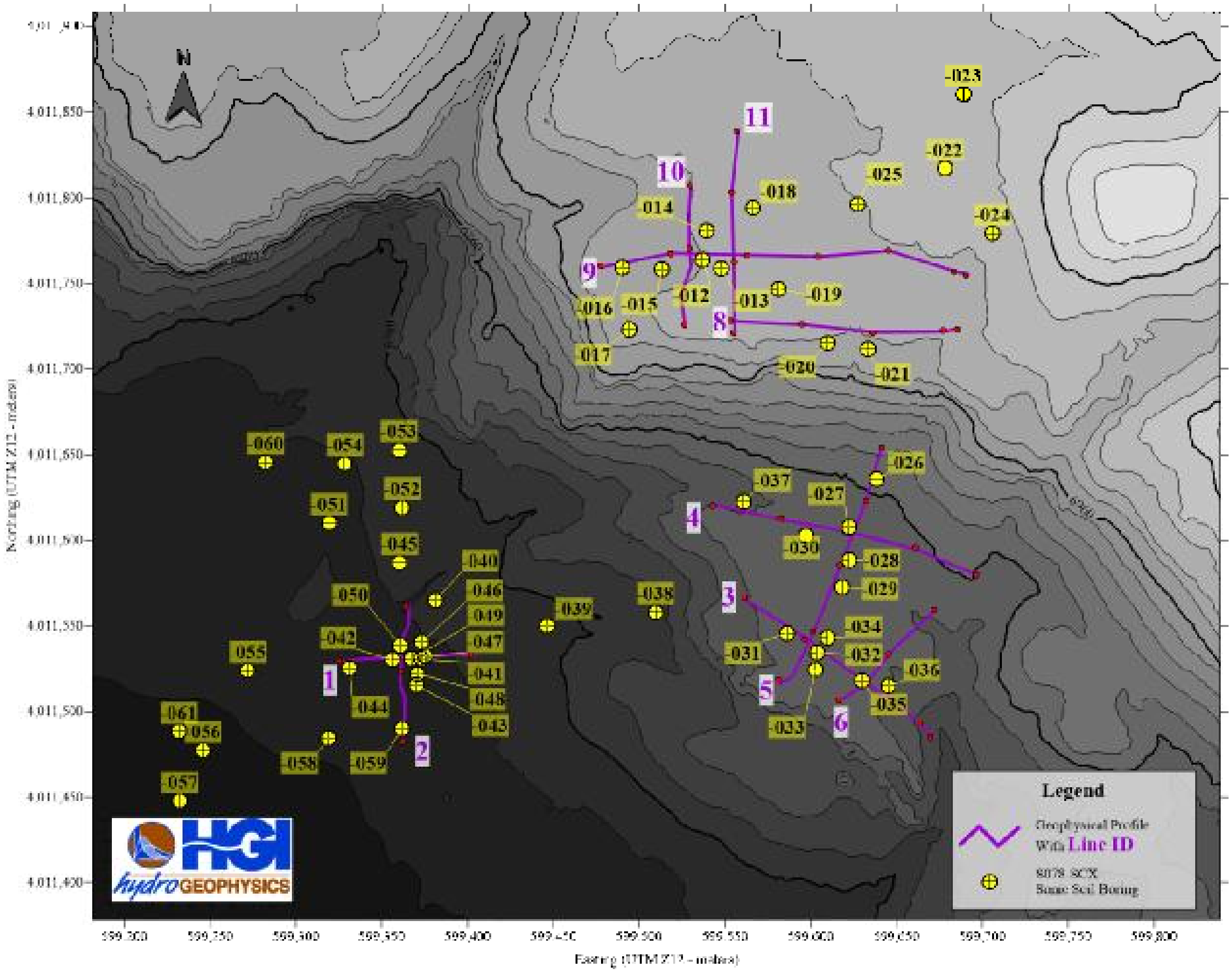
Figure 4. DEM used for 2D Resistivity Inverse Modeling.



4.2 DRILLING

Fifty shallow soil borings were conducted using a track mounted sonic drilling machine throughout the Claim 28 site (Figure 5). Borehole logs were collected by Stantec personnel and provided to HGI, along with the coordinates of the boreholes. The borehole logs are predominately of a geotechnical nature, describing the physical properties of the material, but do not specifically segregate between native- or anthropogenically-disturbed material. All the borehole logs are denoted as S078-SCX-###, with the ### indicating the borehole number. In this report, the borehole ID is contracted to only include the borehole number.

Figure 5. Soil Borings Drilled on Claim 28.



Several of the soil borings were located proximal to the HGI resistivity lines. Table 2 describes which boreholes were used to provide subsurface context to the resistivity profiles, as well as their locations along the lines. Crude borehole logs were created based on the general descriptions of material encountered during drilling, and are overlain on the resistivity profiles. The resistivity profiles are then interpreted based on the borehole logs and characteristics of the subsurface geophysics.

Table 2. Soil Borings Associated with Geophysical Lines.

Line Name	Boreholes (S078-SCX-)
Line 1	041, 042, 044, 047, 049, 050,
Line 2	042, 043, 048, 049, 050, 059,

Line Name	Boreholes (S078-SCX-)
Line 3	031, 032, 034, 035, 036,
Line 4	027, 030, 037,
Line 5	033, 032, 034, 029, 028, 027, 026
Line 6	035, 036
Line 8	019, 020, 021
Line 9	016, 015, 012, 013, 019, 025
Line 10	015, 012, 014
Line 11	013, 014, 018

4.3 EQUIPMENT

4.3.1 Resistivity Equipment

Data were collected using a Supersting™ R8 multichannel electrical resistivity system (Advanced Geosciences, Inc. (AGI), Texas) and associated cables, electrodes, and battery power supply. The Supersting™ R8 meter is commonly used in surface geophysical projects and has proven itself to be reliable for long-term, continuous acquisition. The stainless steel electrodes were laid out along lines with a constant electrode spacing (3 meters, or ~ 10 feet). Multi-electrode systems allow for automatic switching through preprogrammed combinations of four electrode measurements.

4.3.2 GPS

During field efforts, positional data were acquired via a handheld GPS; these data were used by the HGI field crew to record the location of survey lines and track survey progress, as well as produce preliminary model results. A DEM provided by the client (Stantec) was used to extract electrode elevations for final resistivity modeling. Figure 4 shows the locations of the resistivity lines with respect to DEM contours for the three areas surveyed.

4.4 DATA PROCESSING

4.4.1 Resistivity Data Editing

Following field data collection, the raw resistivity data files were transmitted to the HGI server located in Tucson, Arizona. The raw data were evaluated for measurement noise. Those data that appeared to be extremely noisy and fell outside the normal range of accepted conditions were removed. Examples of conditions that would cause data to be removed include: negative or very low voltages, high-calculated apparent resistivity, extremely low current, and high repeat measurement error. Overall data quality for this survey was high, with low repeat error and low occurrence of negative voltages, resulting in very little data removal per line (0% minimum to 6.7% maximum data removal during editing phase).

4.4.2 2D Resistivity Inversion

RES2DINVx64 software (Geotomo, Inc.) was used for inverting individual lines in two dimensions. RES2DINVx64 is a commercial resistivity inversion software package available to the public from www.geotomosoft.com. An input file was created from the edited resistivity data and inversion parameters were chosen to maximize the likelihood of convergence. It is important to note that up to this point, no resistivity data values had been manipulated or changed, such as smoothing routines or box filters. Noisy data had only been removed from the general population. The inversion process followed a set of stages that utilized consistent inversion parameters to maintain consistency between each model. Inversion parameter choices included the starting model, the inversion routine (robust or smooth), the constraint defining the value of smoothing and various routine halting criteria that automatically determined when an inversion was complete. Convergence of the inversion was judged whether the model achieved an RMS of less than 10% within four to six iterations, with the majority of the models converging below 5% within five iterations.

4.4.3 2D Resistivity Plotting

The inverted data were output from RES2DINVx64 and were gridded and color contoured in Surfer (Golden Software, Inc.). Electrode locations, line crossings, surface-based geologic field observations and other relevant features are plotted on the resistivity sections to assist in data analysis. Common color contouring scales are used for all of the lines to provide the ability to compare intensity of targets from line to line. Electrically conductive (low resistivity) regions are represented by cool hues (pinks to blues) and electrically resistive regions are represented by warm hues (reds to browns).

5.0 RESULTS & INTERPRETATION

This section contains the results of the electrical resistivity surveying for Claim 28, displayed as two-dimensional inverted resistivity profiles. The results are divided into sections by area, as denoted in Figure 3. Area 1 comprised Lines 1 and 2, Area 2 comprised Lines 3, 4, 5 and 6, and Area 3 contains Lines 8, 9, 10, and 11. The proposed Line 7 was not acquired due to logistical concerns on site. As a result, the remaining 10 lines were lengthened, when applicable, to ensure the total proposed coverage was met. The original line names were retained, with #7 omitted from the survey.

The inverse model results for the electrical resistivity lines are presented below in two versions, one showing only the electrical resistivity data, and one showing the electrical resistivity data with the borehole logs superimposed with the approximate line distance and elevation as determined by their coordinates. Distance from the line, and clustering of soil borings were taken into account when choosing which borehole logs to display on the profiles.

The objective of the survey was to geophysically characterize material associated with the historic mining activities using electrical resistivity, noting that the boundaries of the subsurface areas and depths were unclear. We anticipated a contrast in resistivity between the unconsolidated geologic materials associated with the historic mining activities and the underlying bedrock, though the electrical properties (resistive or conductive) were yet to be determined prior to surveying.

5.1 SURVEY LIMITATIONS

When interpreting the modeled resistivity profiles, it is important to understand the limitations of the method to resolve features at depth, as designed. Generally speaking, the longer the survey line, the greater the density of data at depth, and therefore the greater ability for resolution of deeper targets. In the current survey, survey lines ranged from 78 to 219 meters; it was communicated by HGI during the planning stage that lines of this length would provide reliable information to a depth of 20 to 30 feet. Below this, interpretation of lithology/structure should be approached with caution. A rule of thumb for identifying where the profiles may suffer loss of resolution, based on model testing for similar surveys, is to observe where the contoured data approach vertical lines at depth.

5.2 AREA 1

Figure 6 displays the two-dimensional resistivity inverse modeling results for Lines 1 and 2. Area 1 contains a fenced zone that (per Stantec communication) was in question as to whether it accurately represented the boundary of the unconsolidated material. Lines 1 and 2 run perpendicular to each other across the fenced area (Figure 3). The fenced area is within electrodes 12 through 20 for Line 1, and electrodes 10 and 22 for Line 2.

The electrical resistivity results for Lines 1 and 2 are interpreted to show approximately 10 feet of resistive material at the near surface. Resistivity of this layer ranges from approximately 100 to 250 ohm-meters (~2.0 to 2.4 log scale). Towards the center of the profiles, where the two lines cross, the resistive material appears less prevalent. Beneath this, the material is more conductive. This transition could indicate a lithologic change or a difference in weathering or moisture content of similar units. The middle conductive layer averages 10 to 15 feet in thickness and appears to overlie a more resistive layer that is likely lacking resolution towards the center of the profiles at depth, and has the potential to be more continuous horizontally than the model shows. The profiles appear to be losing resolution near an elevation of 6705 feet; detailed interpretation below this point is cautioned.

Figure 7 shows the graphic representation of the borehole logs around both Lines 1 & 2. The borehole logs show unconsolidated sediment ("sand and gravel") to depths that correlate fairly well with the more resistive bodies seen in the upper 10' of the geophysical profiles. In boreholes -042 and -041, the unconsolidated material is 18 and 13.75 feet thick and suggested to be 'Waste Rock' in the borehole logs. The underlying conductive body appears to be sandstone bedrock. Borehole -044 is an anomaly with 25 feet of unconsolidated sand and no bedrock observed. This borehole is on the edge of an alluvial channel, and may represent a different type of depositional system than the rest of the area.

5.3 AREA 2

Figure 8 displays the two-dimensional resistivity inverse modeling results for Lines 3, 4, 5 and 6, while Figure 9 shows the profiles with the borehole logs superimposed. Lines 3 and 4 run parallel to each other on a northwest to southeast trend across Area 2, and Lines 5 and 6 are perpendicular crosslines to Lines 3 and 4 (Figure 3). Area 2 is (per Stantec communication) a burial cell site, where material from the upper site (Area 3) may have been buried and capped.

Line 4 shows more highly conductive material on the western half of the line down to an elevation of approximately 6820ft (thickness ~20-25ft) before transitioning to a more resistive material beneath. Borehole logs show this conductive feature to be finely interbedded sands, silts, and clay, as noted in holes 030, and 027. The fine-grained nature of silts and clays act as a good conductor of electricity in natural systems. The eastern half of the line is generally resistive throughout. A 'shallow drainage' noted by field personnel shows increased resistivity compared to surrounding materials and particularly in contrast to the 'gravel, sand, sandy soil' to the west. No soil borings were completed in the eastern half of Line 4.

Line 3 was noted in the field as having unconsolidated material present from approximately electrode number 7 through 40 (annotated on top of profile, Figure 8). This material appears resistive, and to extend to an elevation of near 6835ft, on average 15ft thickness, before transitioning to a more conductive layer below. Resistivity of the top layer ranges from approximately 160 to 250 ohm-meters (~2.2 to 2.4 log scale). The middle more conductive layer averages 15 to 20ft thickness and overlies a more resistive layer that is likely lacking resolution and has the potential to be more continuous horizontally than the model shows. The profile appears to be losing resolution near an elevation of ~6800ft; detailed interpretation below this point is cautioned.

Borehole logs collected near to Line 3 show between 17 and 22 feet of "waste rock" at the surface of each of the boreholes. This unconsolidated material corresponds well to the highly resistive lens seen at the top of the geophysical profile, and the thickness of the material is nearly identical to that determined in the electrical resistivity profile. Below the unconsolidated material the borehole logs note sandstones and weathered sandstones interbedded with clays. The clay layers are likely the cause of the more conductive signature, as clay is typically a good conductor in natural systems. The boreholes did not go deep enough to penetrate the resistive body at the base of the profile.

Within the unconsolidated material (electrodes 9 to 19), Line 5 shows good agreement with Line 3 at the crossline location; though the layered features are not as continuous in this model, the depth to the conductive feature near electrode 15 occurs at approximately 15ft, and the thickness of the conductive layer is also approximately 15ft. A transition to more resistive materials is then also observed below elevation 6820ft. The northern half of the line is generally much more conductive at the near surface where sands, gravel and sediments were observed and noted during the field survey. The crossline location for Line 4 is in agreement with the more conductive materials observed in the near-surface 15 to 20ft, though the thickness is less clear in the Line 5 model.

Borehole logs near Line 5 show fairly good agreement with the resistive nature of the unconsolidated 'waste rock' material in the southern portion of the line. It is difficult to interpret the northern half of the line with respect to the borehole logs however, as the borehole logs do not note much difference in material, except for the existence of shales and shale bedrock. The highly conductive body seen at the very north end of the line may be attributed to a seep noted by the Stantec well-site geologist, located uphill from the line terminus.

The southern end of Line 6, where field personnel noted 'gravel and sand' versus other unconsolidated material at the ground surface, is in agreement with layering seen in Line 3 and 5; approximately 15ft of resistive near-surface material, followed by a 10 to 15-foot increased conductivity layer which transitions back to more resistive near an elevation of 6820ft. The northern end of the profile is generally less resistive, with the exception of the sandstone outcrop. The 'sandy wash' exhibits a resistivity decrease, likely due to decreased grain size and/or increased moisture content. The center of Line 6, below electrode 15, shows a strong vertical discontinuity, which may be structural in nature, such as a fault, or, judging from the topography, the boundary of a slump block.

In light of the borehole logs, it is more difficult to determine the base of the unconsolidated material in the southern part of the line, as the delineation is not as well defined as it is in Line 3. The borehole logs do suggest the presence of sandy bedrock at the base of -035. Borehole -036 is projected from approximately 12 meters to the east, and may not be representative of the material imaged in the resistivity line.

5.4 AREA 3

Figure 10 displays the two-dimensional resistivity inverse modeling results for Lines 8, 9, 10 and 11. Figure 11 displays the same resistivity data with the addition of the borehole logs. Lines 9 and 10 run parallel to each other on a west to east trend across Area 3; Lines 10 and 11 are crosslines to Lines 9 and 10, towards the west (Figure 3).

The western 30 electrodes (#1 through 30) are highly resistive for Line 9. This generally correlates to field-observed ‘unconsolidated material, gravel and sand’. The thickness of this layer ranges from ~10 to 35ft, though not extending below elevation 6960ft. Resistivity of this material ranges from approximately 200 to 2500 ohm-meters (~2.3 to 3.4 log scale). Lines 10 and 11 cross Line 9 within this resistive material and the results of these lines show agreement with similar-range high resistivity material present to an elevation of at least 6960ft. The highly conductive ‘soft soil and fine sand’ from electrode 33 eastward is in high contrast to this material. This conductive near-surface eastern layer ranges from 15 to 35ft thick, not extending below 6980ft elevation.

Line 8 runs south of Line 9 and does not exhibit any high resistivity material that would coincide with the material on the western half of Line 9. It is however likely that this high resistivity material exists offline to the west of Line 8; this is considering the thin band of high resistivity at the very western edge of the Line 8 model and the range of higher resistivity values observed throughout Line 11, which runs perpendicular crossing Line 8 at this point.

Borehole logs in Area 3 do not coincide well with the field surface-based geologic observations, and suggest the area is predominately bedrock dominated. The sonic drill rig did not penetrate deeply into the formations, since the borehole logs show that bedrock was close to the surface under a thin veneer of loose sand and gravel. The high resistivity zone in Lines 9, 10, and 11 is predominately sandstone with some thin inter-beds of coal and shale. The highly conductive band in Line 9 and, to a lesser degree in Line 8, is predominately composed of shale and weathered shale with a higher concentration of fine-grained material.

Figure 6. Area 1: Line 1 and 2 Two-dimensional Inverted Resistivity.

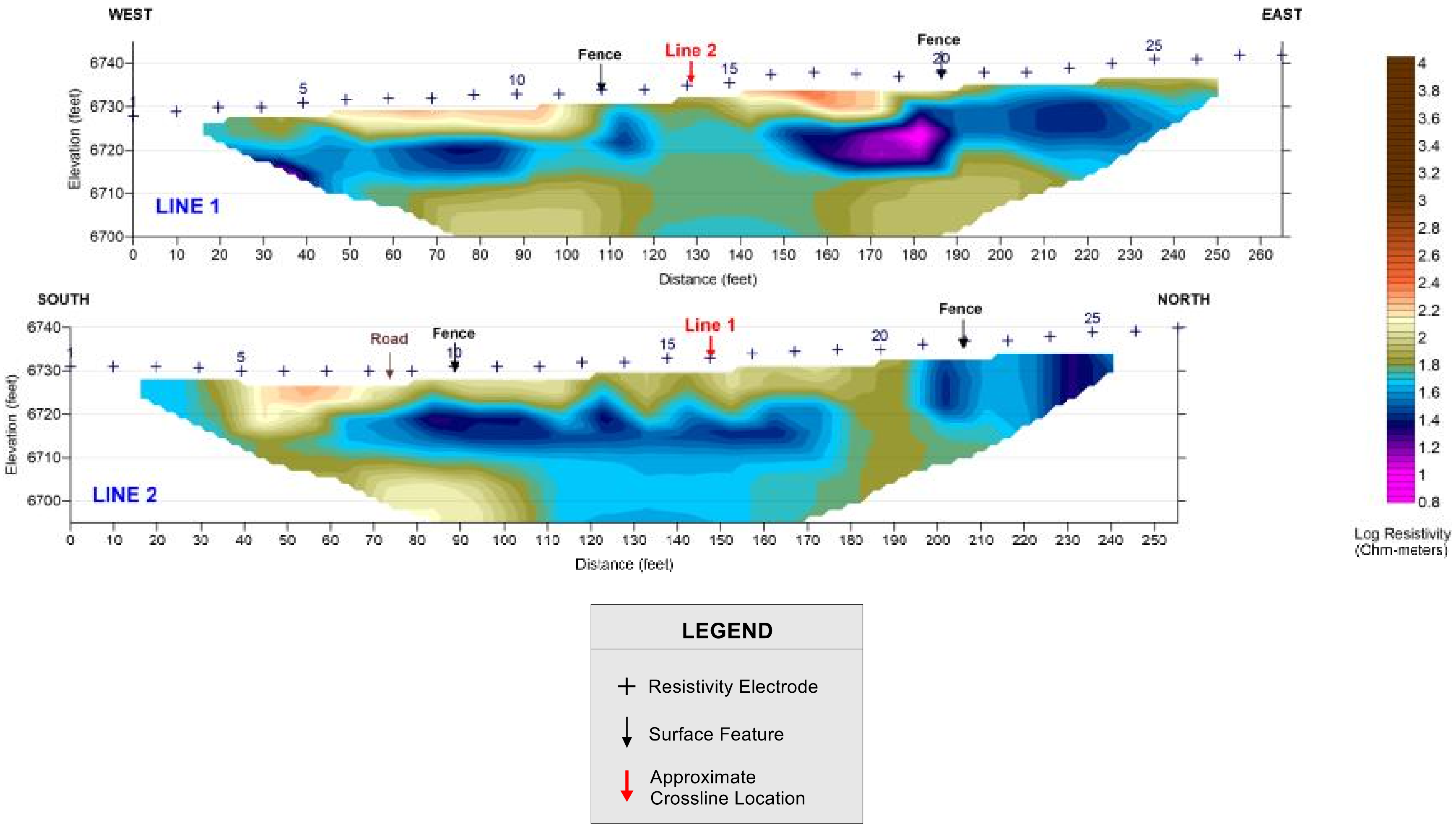


Figure 7. Area 1: Line 1 and 2 Resistivity Profiles with Borehole Logs.

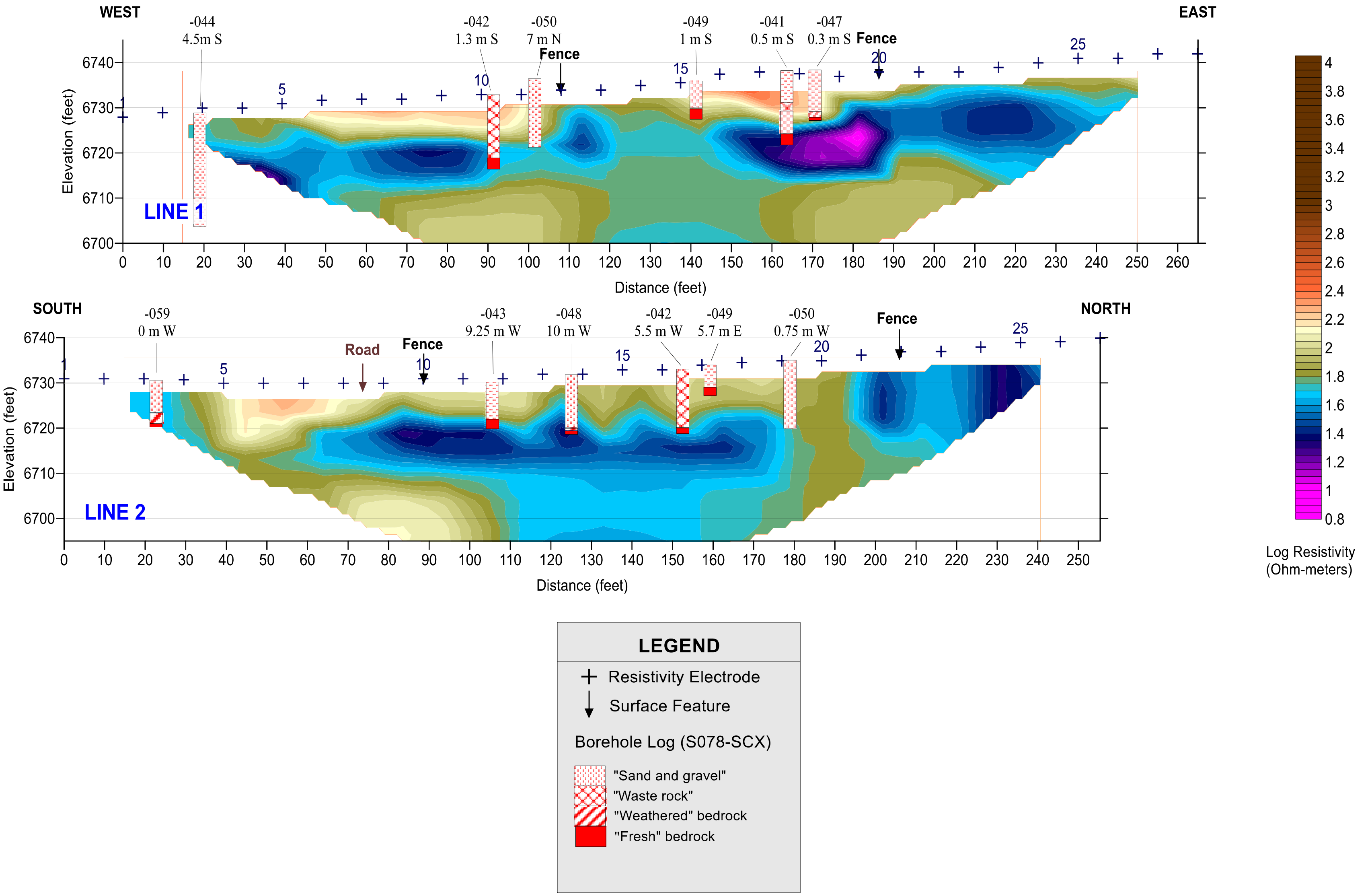


Figure 8. Area 2: Line 3, 4, 5, 6 Two-dimensional Inverted Resistivity.

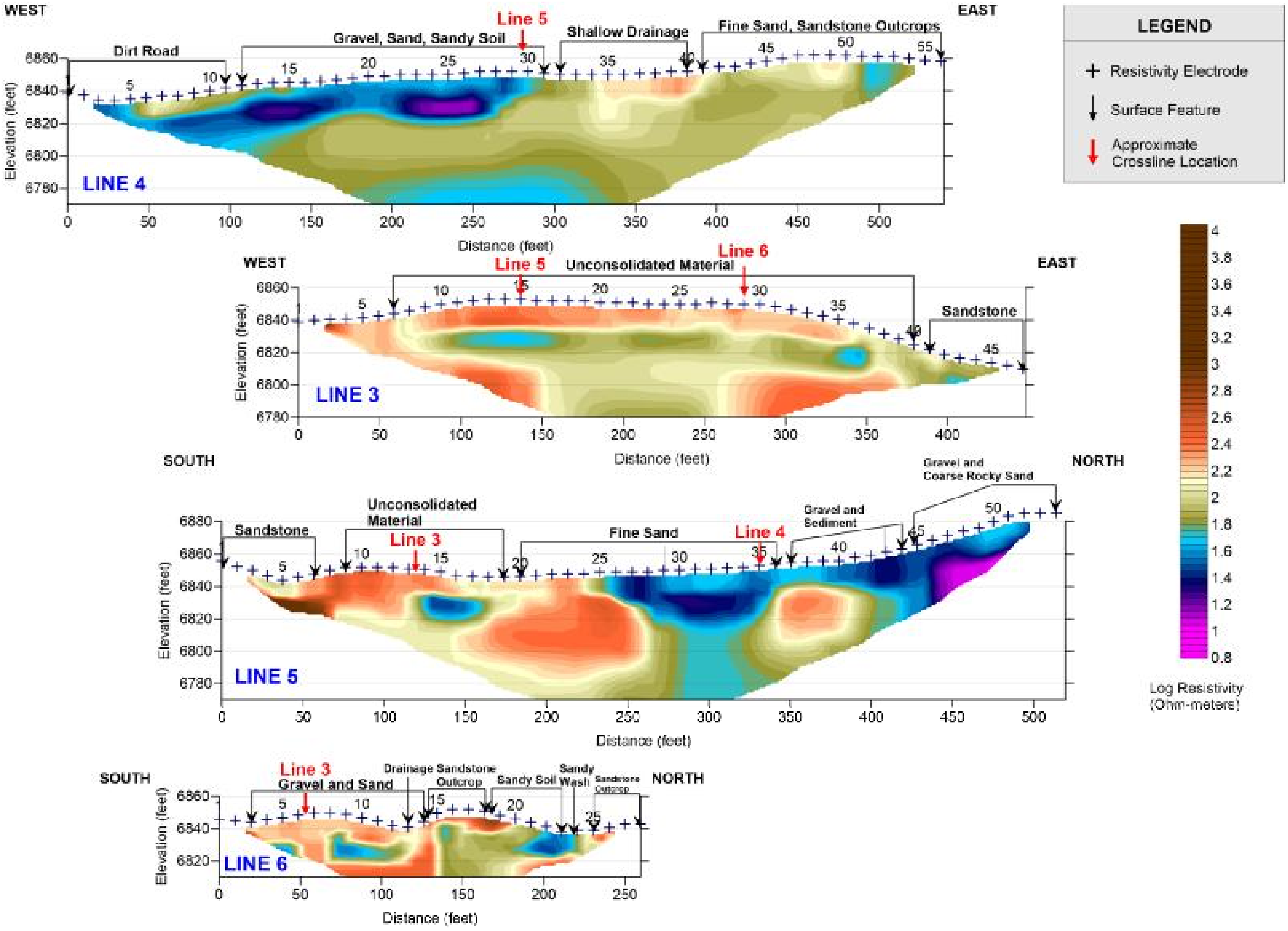


Figure 9. Area 2: Line 3, 4, 5, 6 Resistivity Profiles with Borehole Logs.

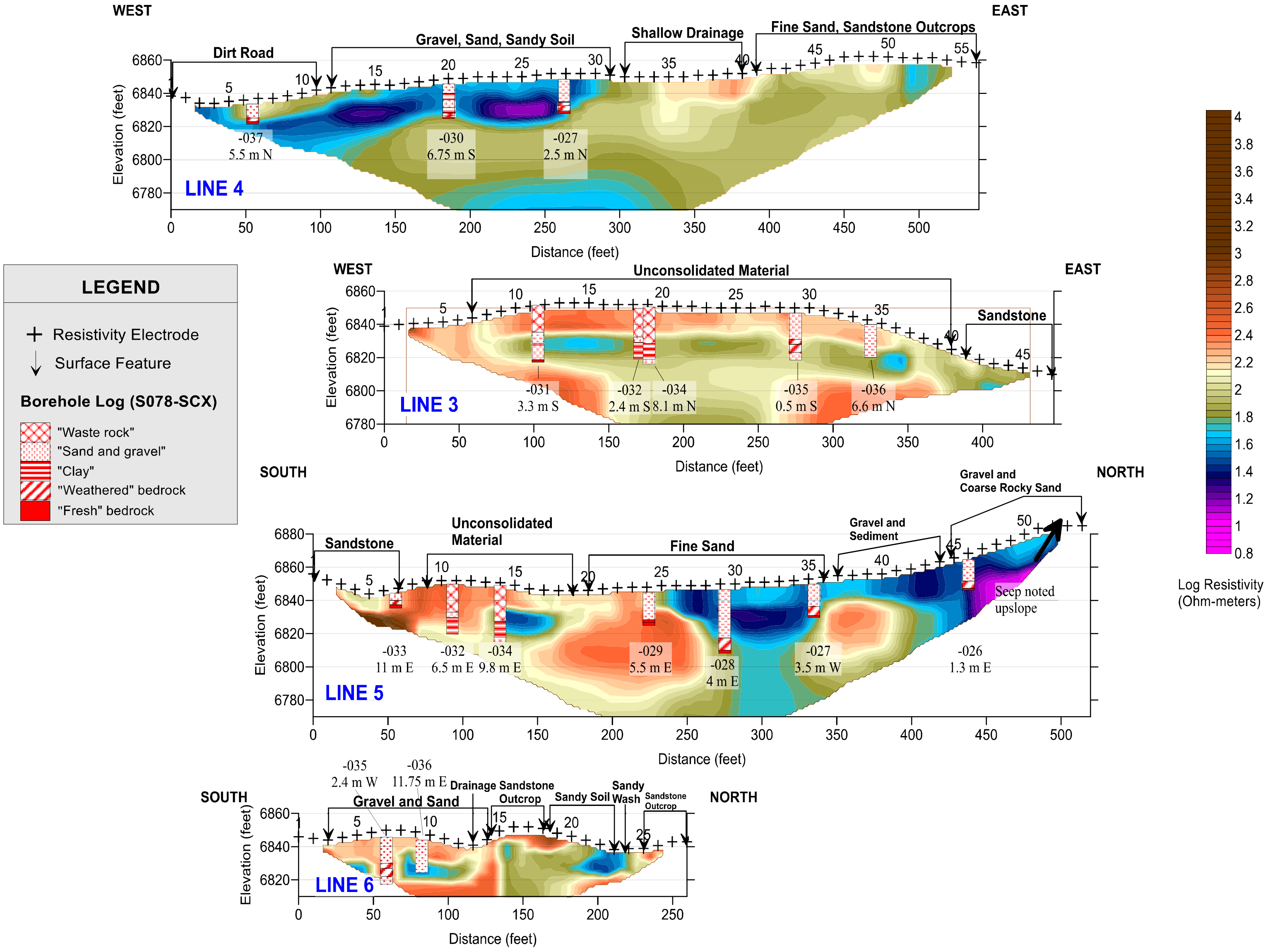


Figure 10. Area 3: Line 8, 9, 10, 11 Two-dimensional Inverted Resistivity.

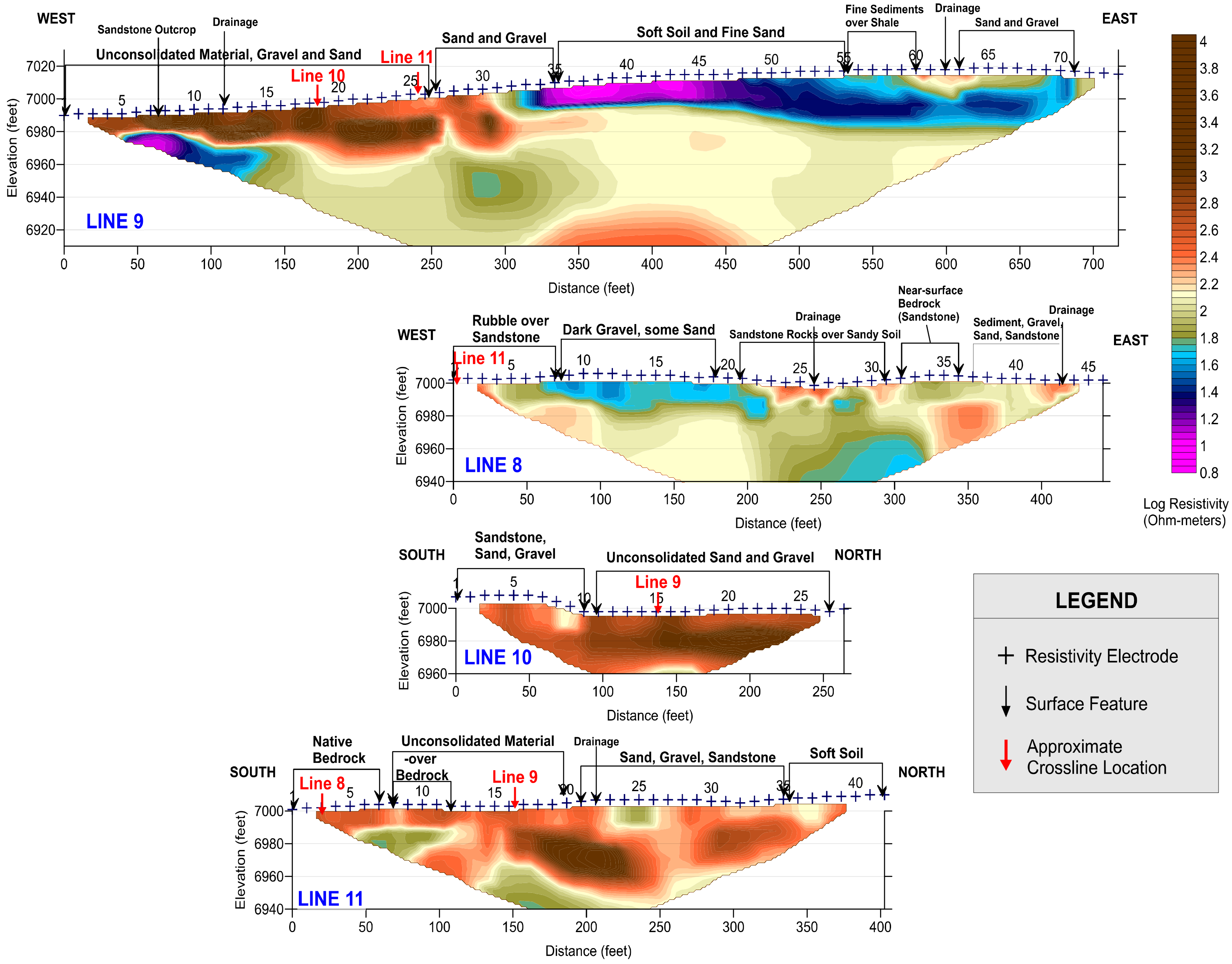
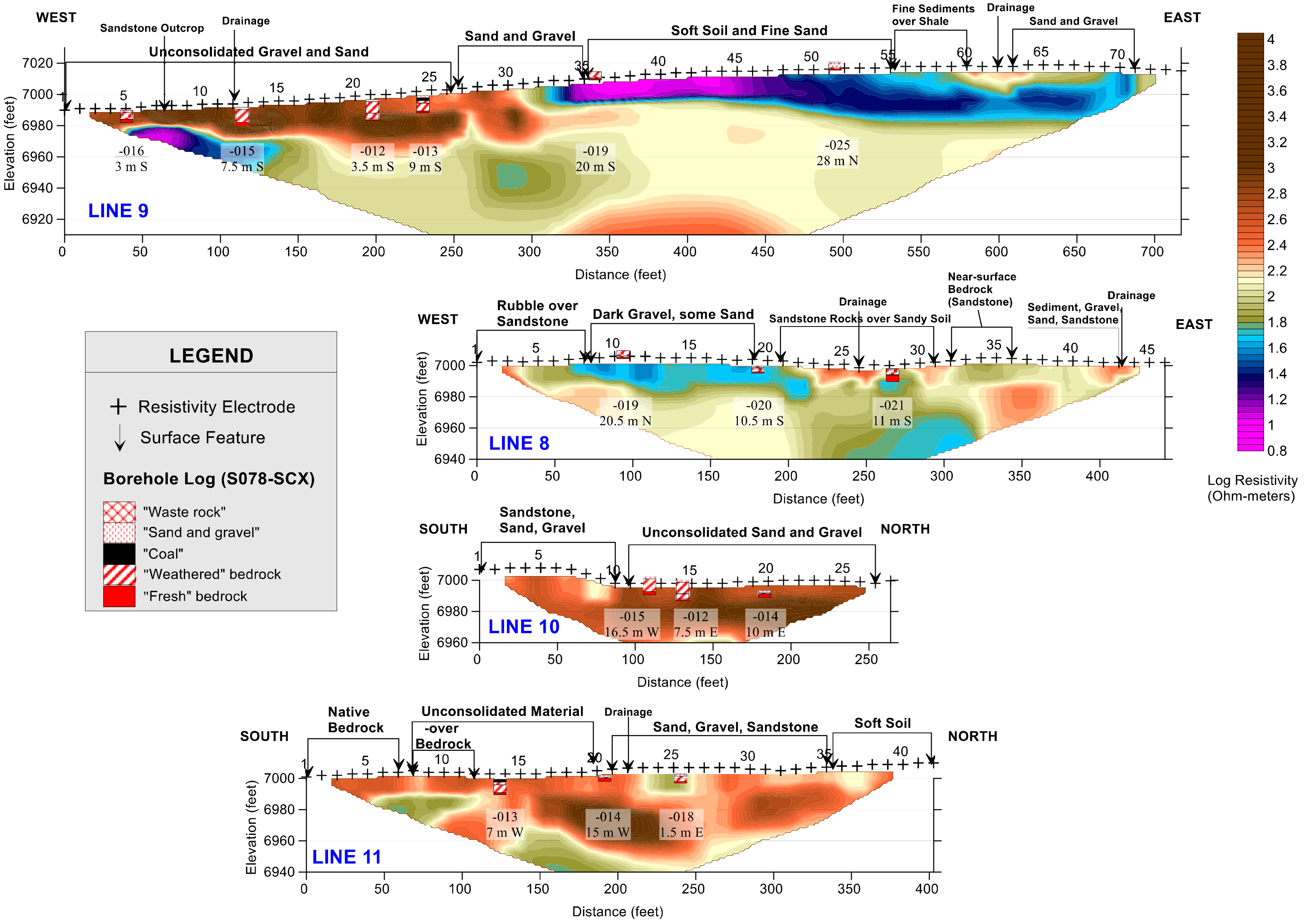


Figure 11. Area 3: Line 8, 9, 10, 11 Resistivity Profiles with Borehole Logs.



6.0 CONCLUSIONS

In October 2017, HGI completed a geophysical characterization of historic uranium mining operations within the Navajo Nation in Arizona at the Claim 28 site, a small-scale open pit mine and surrounding smaller waste piles. The objective of the geophysical characterization was to investigate the thickness of unconsolidated material above the bedrock. Ten lines of two-dimensional electrical resistivity, within three distinct areas, were acquired to accomplish this objective.

Overall, the three survey areas are highly electrically heterogeneous, with contrast observed that coincided with both field-observed and logged geology and lithology. Waste rock material, as defined in the borehole logs near Lines 3 and 5, correlated with higher electrical resistivity signatures seen in the geophysical profiles.

In Area 1, the geophysical results show near-surface high resistivity material in several areas of Lines 1 and 2, approximately 10ft deep on average and extending outside the fenced zone. Borehole logs show up to 18ft of “Poorly graded sand with gravel” in the area, with most boreholes ending in sandstone bedrock. In this instance, the geophysical data and field notes align well with the borehole logs.

Area 2 is (per Stantec communication) a burial cell site, where material from the upper site (Area 3) was buried and capped. Line 3 was noted in the field as having ‘unconsolidated material’ present throughout most of the line. This unconsolidated material maps as electrically resistive and extends on average 15ft thick, before transitioning to a more conductive layer below, similar to Area 1. Other lines in this area show good agreement with this finding. Borehole logs also reinforce this interpretation, with numerous borehole logs showing 17-18 feet of unconsolidated material or “waste rock” throughout the line.

Area 3, the uppermost area, showed near-surface resistive material thickness ranging from ~10 to 35ft and good agreement for locations of crosslines and similar electrical features and elevation ranges. In this area, the borehole logs do not match well with an interpretation of unconsolidated material for the near-surface resistive layer, and show instead thin loose sands overlying sandstone bedrock in the area of high resistivity on the west side of Area 3. Higher conductivity zones in the east correspond with siltstone-rich bedrock in the borehole logs.

In summary, the electrical resistivity method was able to map out the thickness of many of the resistive units at Claim 28. Thicknesses of 10-15 feet interpreted from the geophysical profiles in the known “fill zone” of Area 2 agree with those acquired from borehole logs. In Area 1, 10-15 foot thick zones of resistive material were interpreted that correspond to unconsolidated sediments in the borehole logs. These Area 1 resistive zones extend outside the fenced area. In Area 3, the resistive layer in the west is associated with a bedrock sandstone unit as determined by the borehole logs, and not unconsolidated sediment as the field-observed surface geology suggested. These examples show that the geophysical technique of electrical resistivity can be utilized effectively to determine the extent of unconsolidated material, but corroboration with direct sampling methods is useful to exact the geologic nature of the contrasting subsurface electrical signatures.

7.0 REFERENCES

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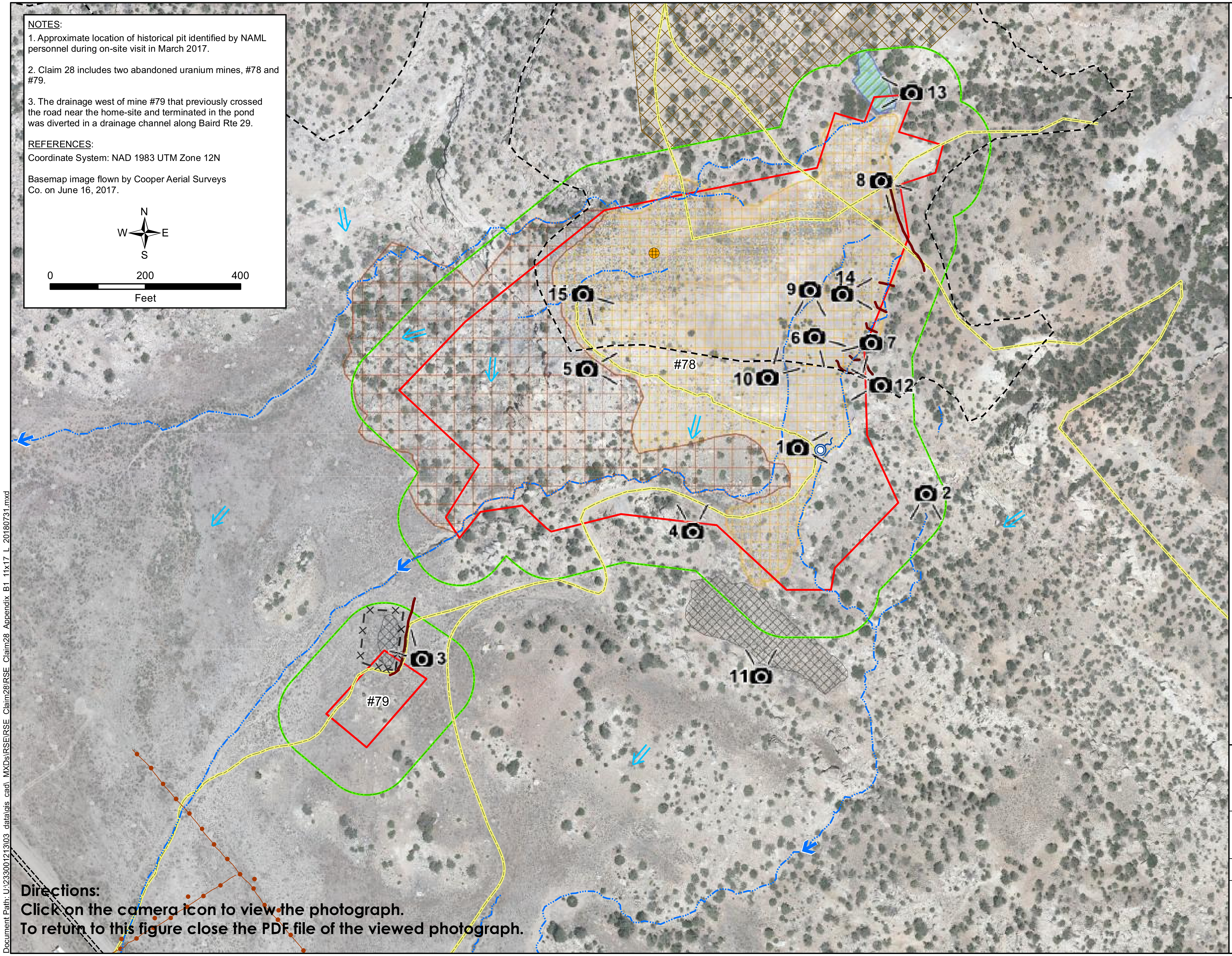
Appendix B Site Photographs

B.1 Site Photographs

B.2 Regional Photographs



NOTES:

1. Approximate location of historical pit identified by NAML personnel during on-site visit in March 2017.

2. Claim 28 includes two abandoned uranium mines, #78 and #79.

3. The drainage west of mine #79 that previously crossed the road near the home-site and terminated in the pond was diverted in a drainage channel along Baird Rte 29.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

Directions:
Click on the camera icon to view the photograph.
To return to this figure close the PDF file of the viewed photograph.

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Appendix B1 11x17 L 20180731.mxd

NAVAJO NATION
AUM Environmental
Response Trust-First Phase

LEGEND

📷	Photograph Indicating Direction Taken
●	Approximate Location of Historical Pit[1]
○	Seep
↑	Flow Direction
⇑	Approximate Overland Water Flow Direction
- - - -	Approximate Edge of Mesa
──	Berm
-··-··-	Drainage
×—×—×	Fence
────	Potential Haul Road
•—•—•	Power Line
========	Road
▨	Exploration Area
▨	Mine Waste Burial Pit
▦	Potential Mine Waste Material
▦	Mining / Reclaimed Disturbed Area
▨	Former Retention Pond
🟥	Claim Boundary
🟩	100-Foot Claim Buffer

TITLE:

Site Photographs

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 8/1/2018

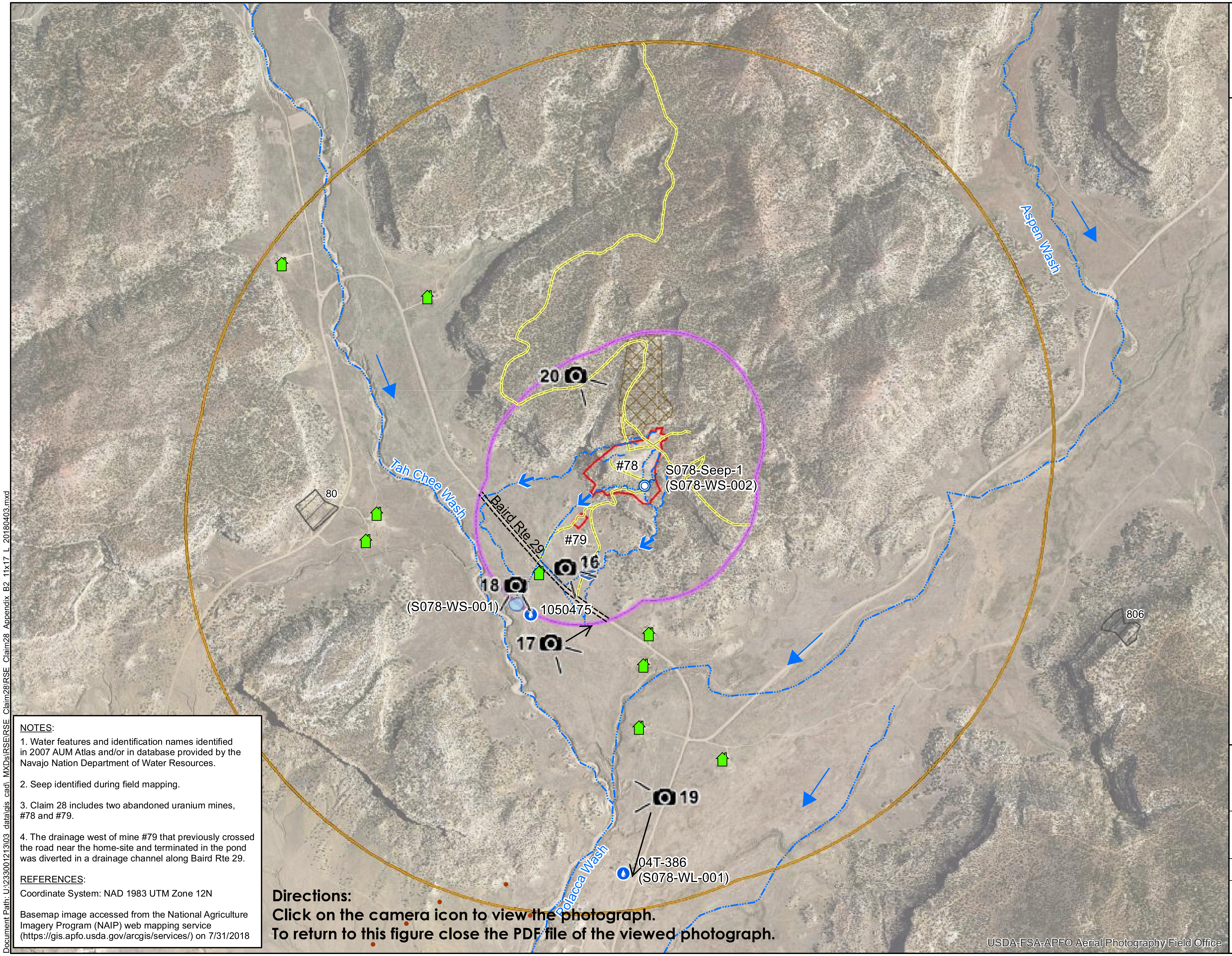
DOCUMENT NAME: Removal Site Evaluation Report

Stantec

AUTHOR: CBB

REVIEWER: EDZ

FIGURE: B-1



NOTES:

1. Water features and identification names identified in 2007 AUM Atlas and/or in database provided by the Navajo Nation Department of Water Resources.

2. Seep identified during field mapping.

3. Claim 28 includes two abandoned uranium mines, #78 and #79.

4. The drainage west of mine #79 that previously crossed the road near the home-site and terminated in the pond was diverted in a drainage channel along Baird Rte 29.

REFERENCES:

Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 7/31/2018

Directions:
Click on the camera icon to view the photograph.
To return to this figure close the PDF file of the viewed photograph.

NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

📷	Photograph Indicating Direction Taken
💧	Site Clearance Identified Water Feature[1]
🟩	Habitable Building
○	Seep[2]
↑	Flow Direction
-··-··-	Intermittent Stream/River
- - - -	Potential Haul Road
========	Road
▨	Exploration Area
▭	Pond
🟥	Claim Boundary
▭	1/4-Mile Claim Boundary Buffer
▭	1-Mile Claim Boundary Buffer
▨	Other Claim Boundary

N
W E
S

0 1,300 2,600
Feet

TITLE:

Regional Site Photographs

PROJECT:

Removal Site Evaluation
Claim 28 Mine Site

DATE: 7/31/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: CBB

REVIEWER: EDZ

Stantec

FIGURE: B-2

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 Appendix B2 11x17 L 20180403.mxd

Appendix C Field Activity Forms

C.1 Soil Sample Field Forms

C.2 Drilling and Hand Auger Borehole Logs

C.3 Water Sample Field Forms

C.1 Soil Sample Field Forms

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S028-BG1-001/201

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1230

SAMPLE COLLECTED BY K. Johnson

WEATHER CONDITIONS Clear, breezy

FIELD USCS DESCRIPTIONS Dry, sandy, silt with <5% gravels

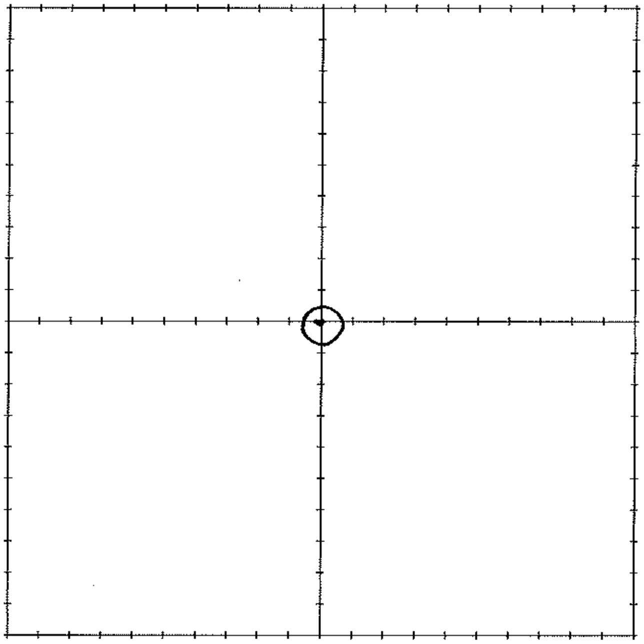
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☒ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) Ziplocs, 4

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. SO28-BG1-002, MS, MSD

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1240

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry silty fine sand w/ trace gravels

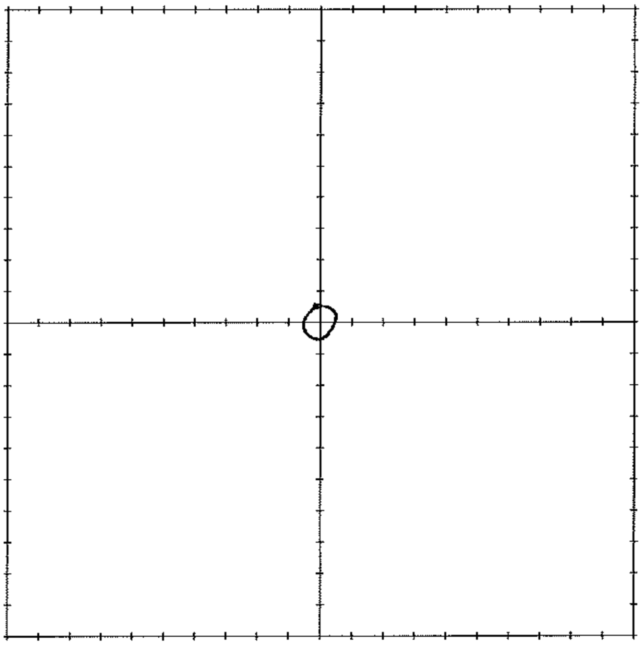
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 6 Ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S028-BG1-003

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1250

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Firm sandy silt w/ trace gravels

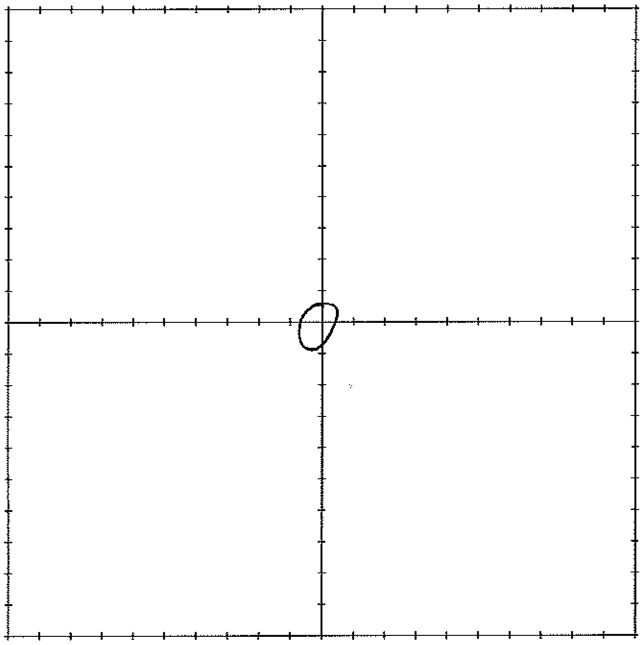
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☑ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☑ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 7E

SAMPLE I.D. S07E-BG1-004

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1256

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, Clear

FIELD USCS DESCRIPTIONS Dry silty fine sand.

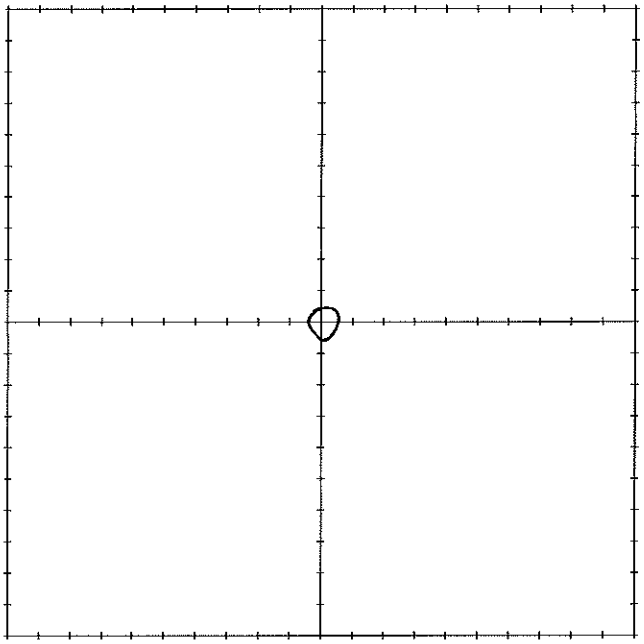
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 78

SAMPLE I.D. S078-BG1-005

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1303

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Sandy silt w/ 5-10% gravels

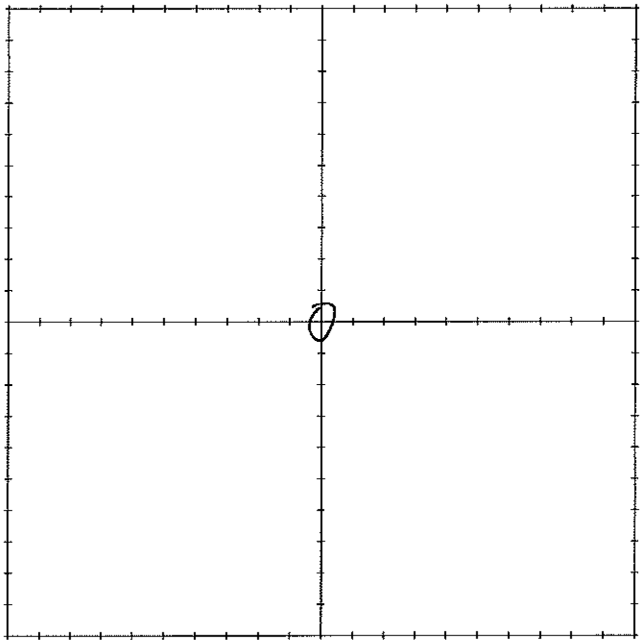
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 78

SAMPLE I.D. S078-BG1-006

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1312

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry Sandy silt w/ Roots & organics

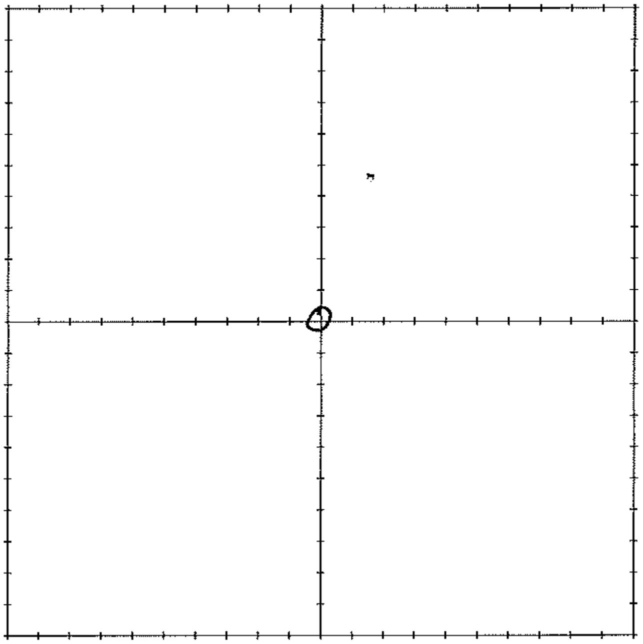
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 Ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. SOAE-BG1-007

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1320

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry sandy silt w/ gravels

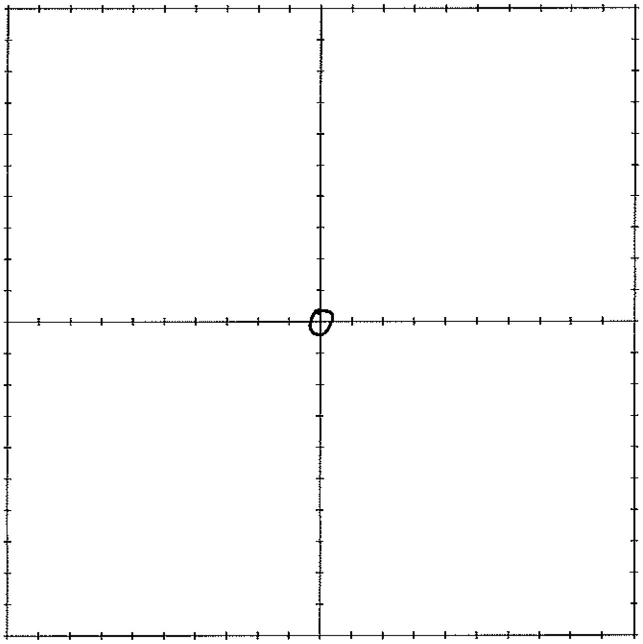
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 7E

SAMPLE I.D. 807E-BG1-008

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1326

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Sandy silt w/ trace gravels

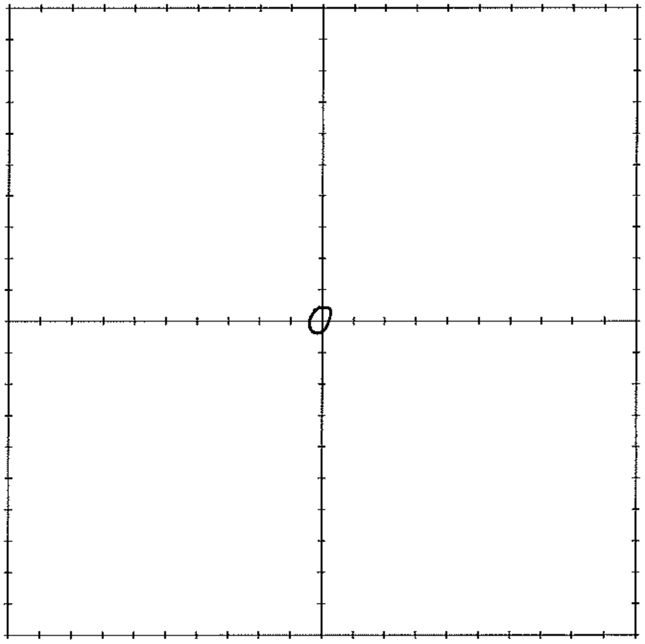
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☑ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☑ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Q2w 7E

SAMPLE I.D. S07E-BG1-009

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1333

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry sandy silt w/ gravels & roots

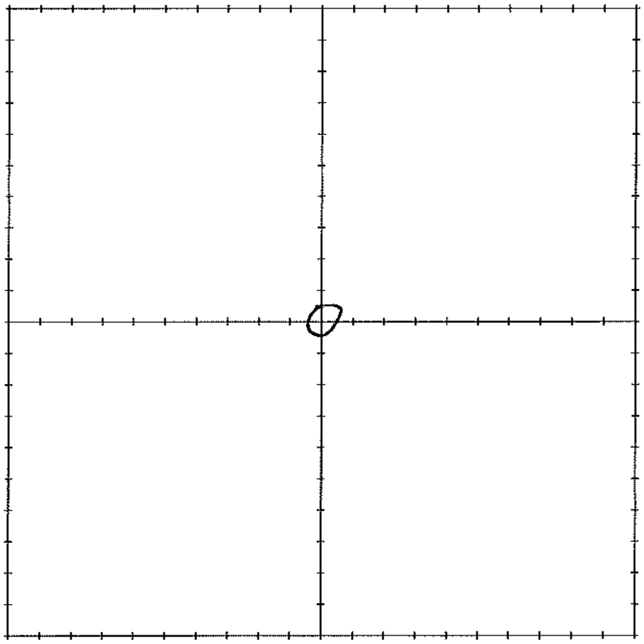
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☑ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 Ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S078-BG1-010

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1338

SAMPLE COLLECTED BY KJJ

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry silty fine sand w/gravels & roots

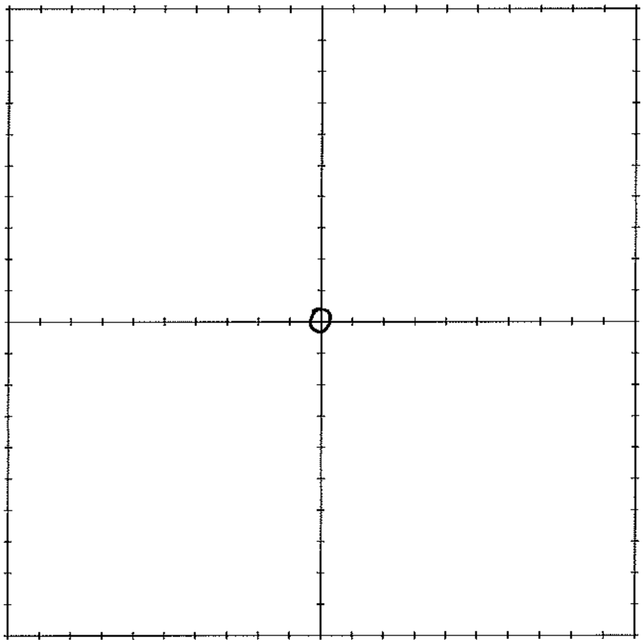
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☑ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☑ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Clam 28

SAMPLE I.D. S078-BG1-011

SAMPLE COLLECTION DATE 11/10/2016

SAMPLE COLLECTION TIME 15:20

SAMPLE COLLECTED BY N. Rendle

WEATHER CONDITIONS Sunny, slight Breeze, 60°

FIELD USCS DESCRIPTIONS Poorly sorted silty sand, dry, high sand, low silt, trace gravels

MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

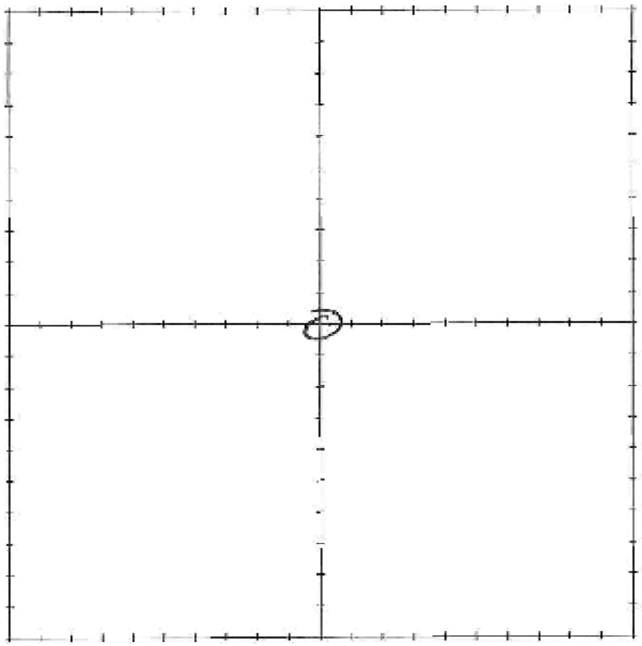
QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☐ FINE ☒ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

~~MUNSELL COLOR~~ NA

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S07E - 362 - 001 /201

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1431

SAMPLE COLLECTED BY KJJ , JK

WEATHER CONDITIONS Sunny , 60's

FIELD USCS DESCRIPTIONS Dry sandy silt w/ trace gravels & cobbles

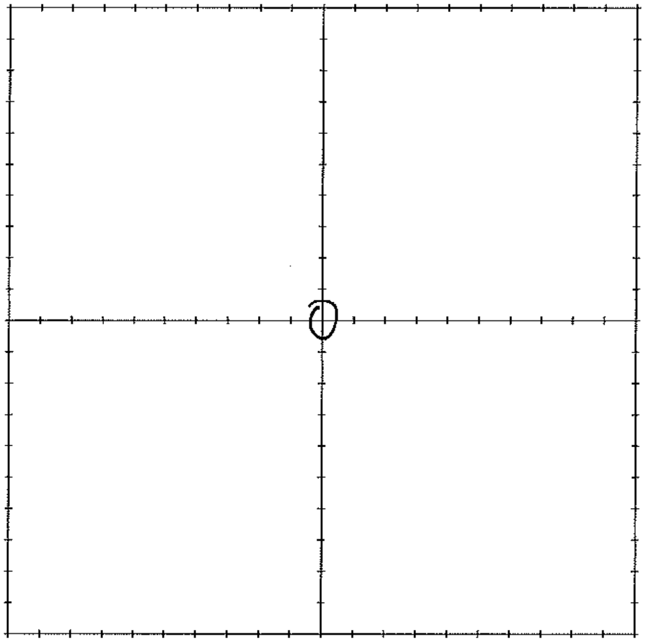
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) ~~8~~ 4 ziplocs

ANALYSES: Ra-226 metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 2E

SAMPLE I.D. S02E-BG2-002

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1440

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny 60°

FIELD USCS DESCRIPTIONS Dry sandy silt with hard pan on top, trace gravels

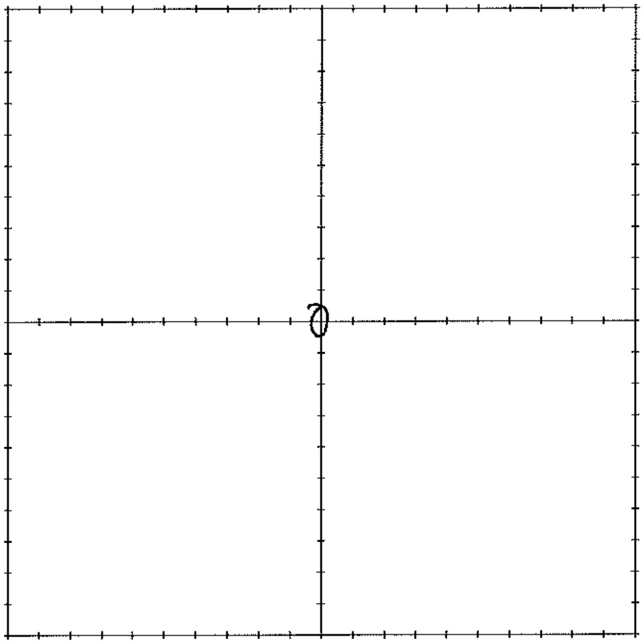
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 2E

SAMPLE I.D. S02E-BG2-003

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1445

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny 60's

FIELD USCS DESCRIPTIONS Dry sandy silt, trace clay & gravel

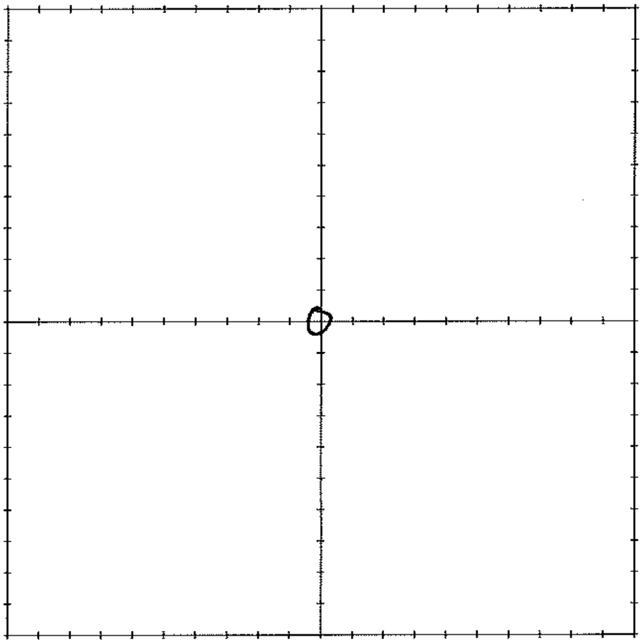
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☑ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S07E - BG2 - 004

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1451

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry sandy silt

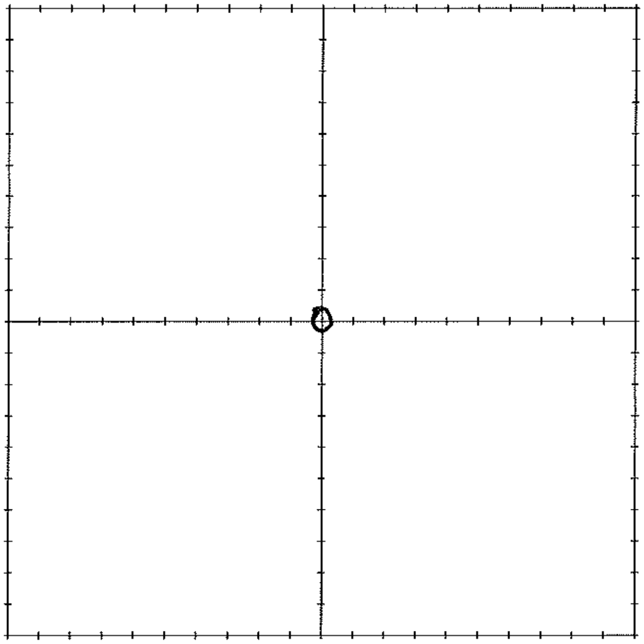
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☑ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☑ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 Ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. SO78 - BG2 - 005

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1456

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny 60's

FIELD USCS DESCRIPTIONS Dry very fine sand with silt

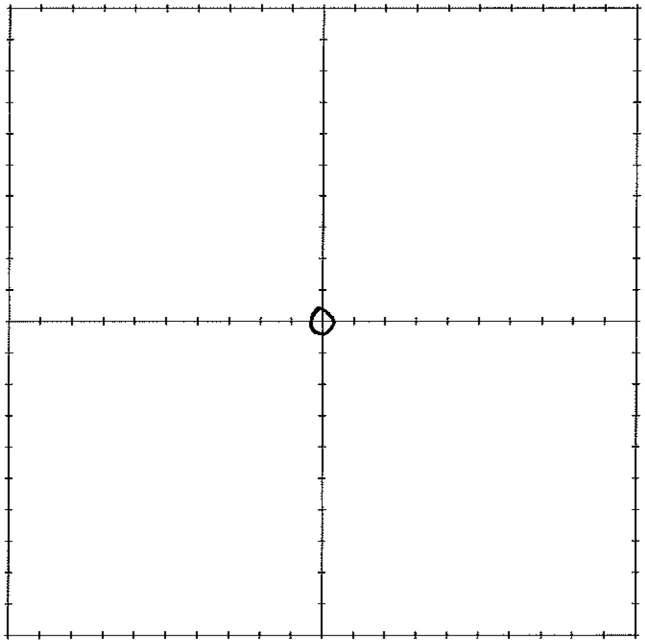
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S07E-BG2-006

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1501

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry very fine SAND with silt & some organics/gravels

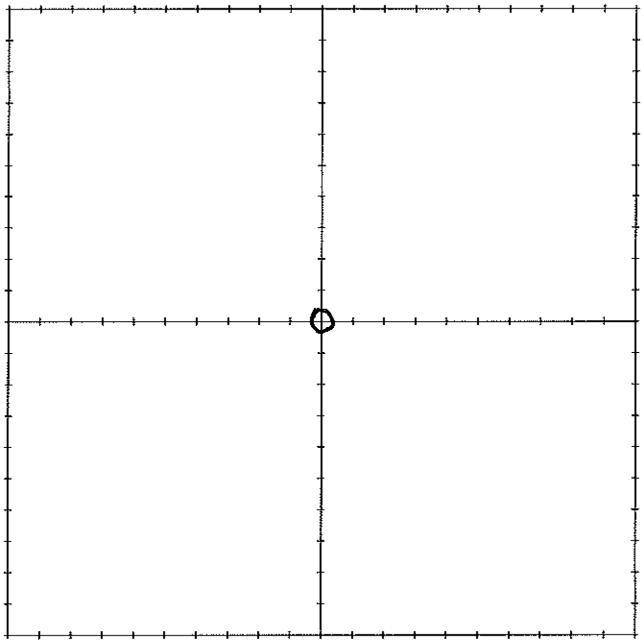
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S078-BG2-007

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1508

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry sandy silt trace gravel

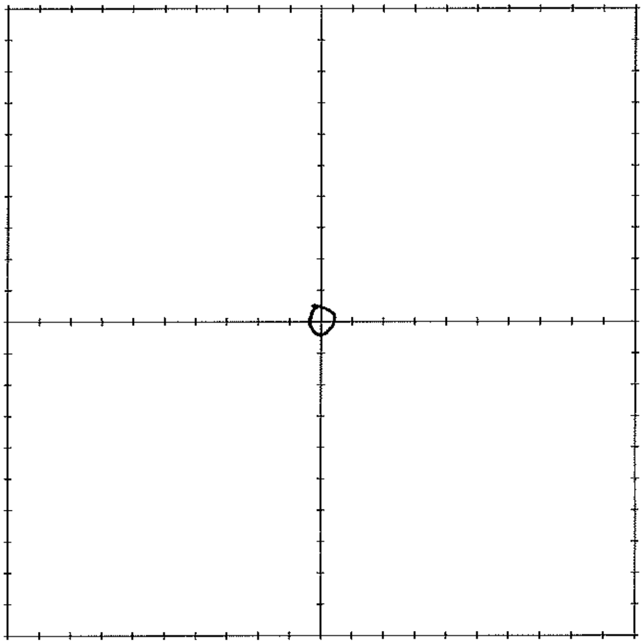
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. 8078-B6:2-008

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1513

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Slightly moist very fine sand with silt & minor grave

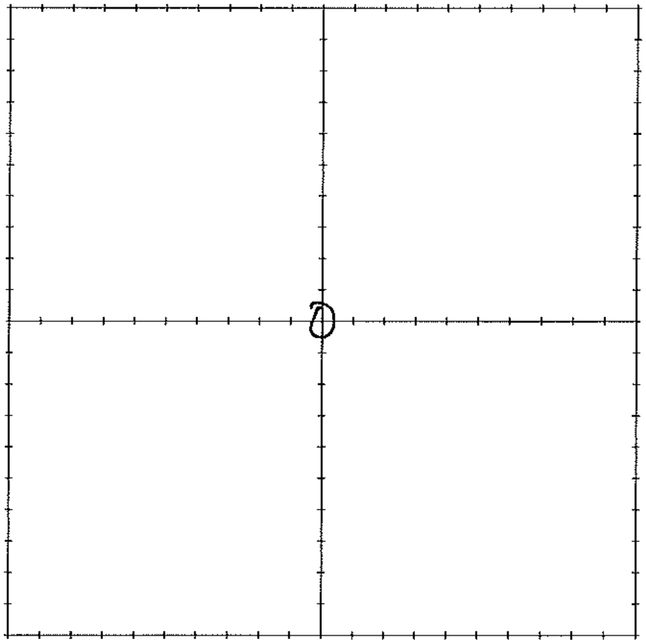
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☒ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☒ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. 8078-BG2-009

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1519

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Moist sandy silt with trace cobbles & gravels

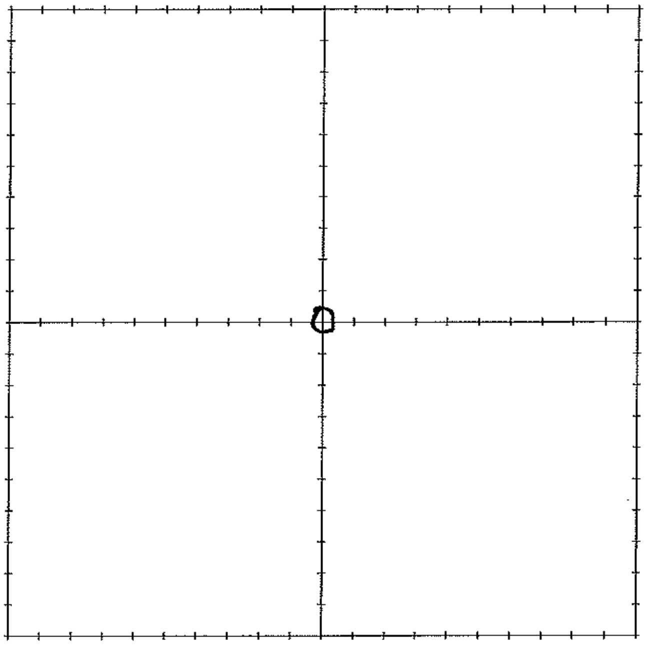
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☒ MINOR ☐ SOME; SAND SIZE ☑ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☒ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME Claim 28

SAMPLE I.D. S028-BG2-010

SAMPLE COLLECTION DATE 10/19/16

SAMPLE COLLECTION TIME 1524

SAMPLE COLLECTED BY JK

WEATHER CONDITIONS Sunny, 60's

FIELD USCS DESCRIPTIONS Dry to slightly moist silty fine to medium sand w minor gravel

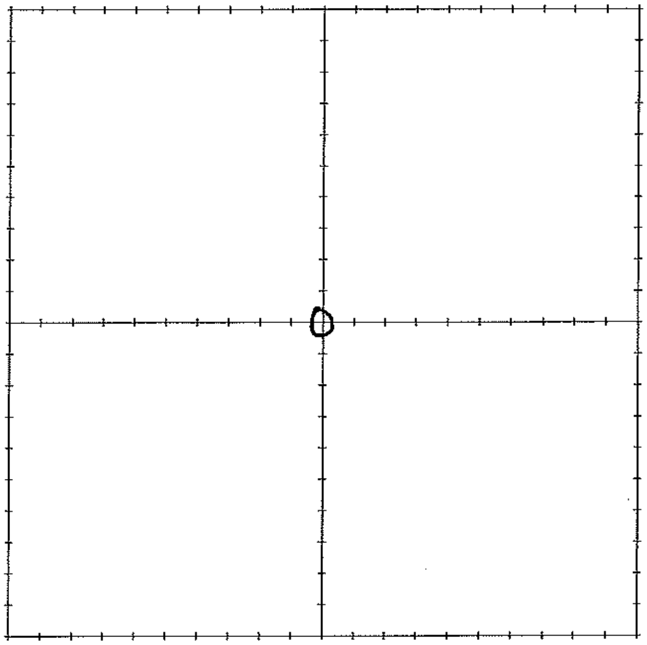
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☑ MINOR ☐ SOME; SAND SIZE ☒ FINE ☑ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☑ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 - C01 - 001 [claim 28]

SAMPLE I.D. S078 - C01 - 001

SAMPLE COLLECTION DATE 11/11/2016

SAMPLE COLLECTION TIME 09:15

SAMPLE COLLECTED BY N. Randle

WEATHER CONDITIONS ~60°F, Sunny

FIELD USCS DESCRIPTIONS

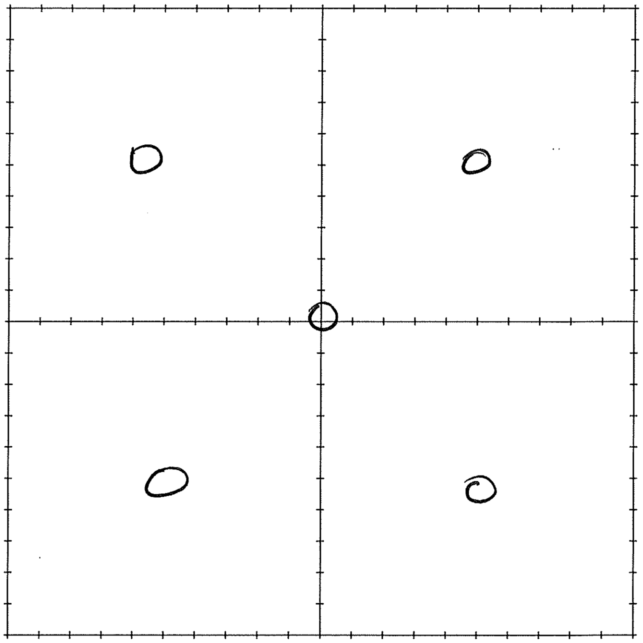
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 1 Ziplock

ANALYSES:



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078-C02-001 [Claim 28]

SAMPLE I.D. S078-C02-001

SAMPLE COLLECTION DATE 11/11/2016

SAMPLE COLLECTION TIME

SAMPLE COLLECTED BY N. Revelle

WEATHER CONDITIONS ~60°F, Sonny

FIELD USCS DESCRIPTIONS

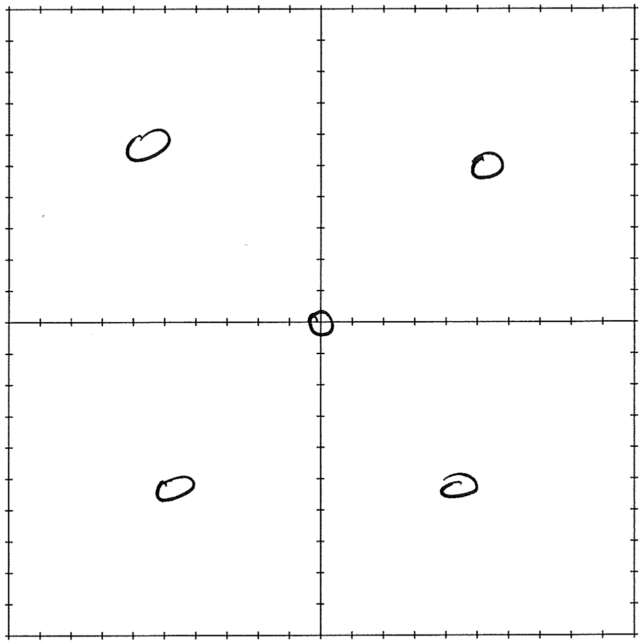
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 1 Ziplock

ANALYSES:



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078-C03-001 [Claim 28]

SAMPLE I.D. S078-C03-001

SAMPLE COLLECTION DATE 11/11/2016

SAMPLE COLLECTION TIME

SAMPLE COLLECTED BY N. Randle

WEATHER CONDITIONS ~60°F, Sunny

FIELD USCS DESCRIPTIONS

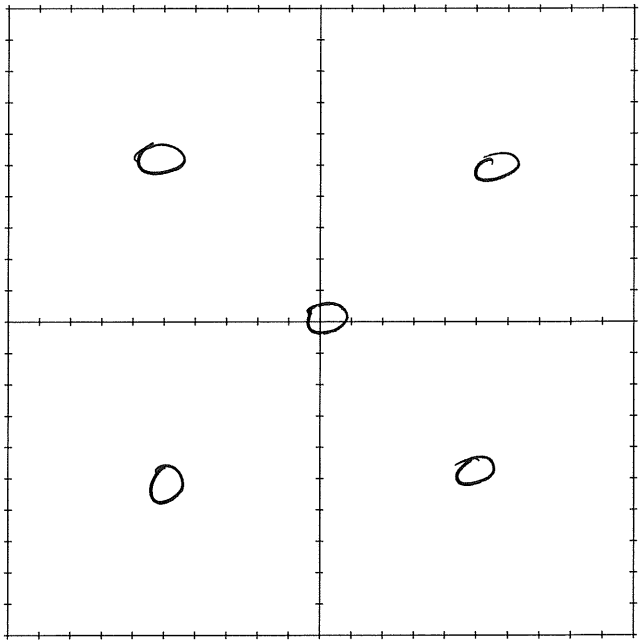
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 1 Ziplock

ANALYSES:



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078-C04-001 [Claim 28]

SAMPLE I.D. S078-C04-001

SAMPLE COLLECTION DATE 11/11/2016

SAMPLE COLLECTION TIME

SAMPLE COLLECTED BY N. Randle

WEATHER CONDITIONS ~60°F, Sunny

FIELD USCS DESCRIPTIONS

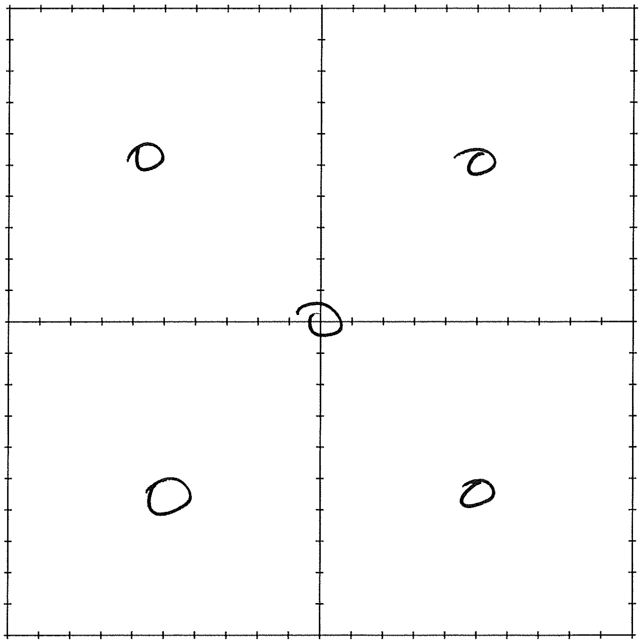
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 1 Ziplock

ANALYSES:



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078-C05-001 [Claim 28]

SAMPLE I.D. S078-C05-001

SAMPLE COLLECTION DATE 11/11/2016

SAMPLE COLLECTION TIME

SAMPLE COLLECTED BY N. Rundle

WEATHER CONDITIONS ~60°F, Sunny

FIELD USCS DESCRIPTIONS

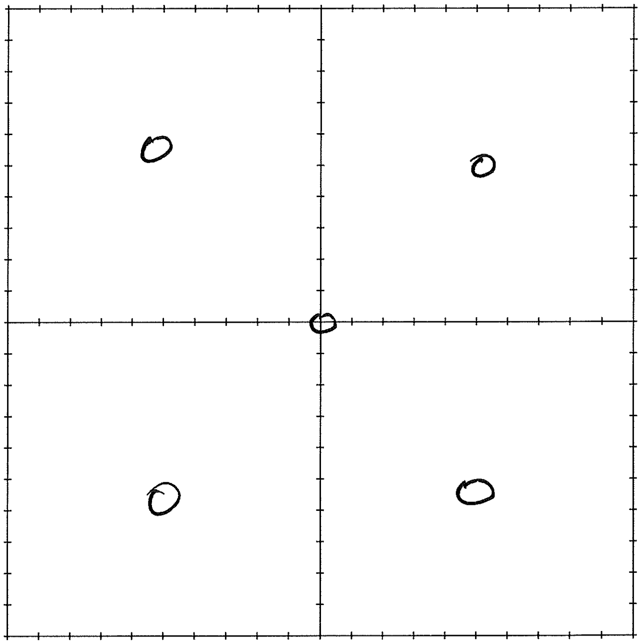
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 1 ziplock

ANALYSES:



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 ((Claim 28)

SAMPLE I.D. S078-CX-001

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1436

SAMPLE COLLECTED BY TO/LR

WEATHER CONDITIONS 70's sunny

FIELD USCS DESCRIPTIONS light brown silty sand, poorly graded, med. dense, Dry

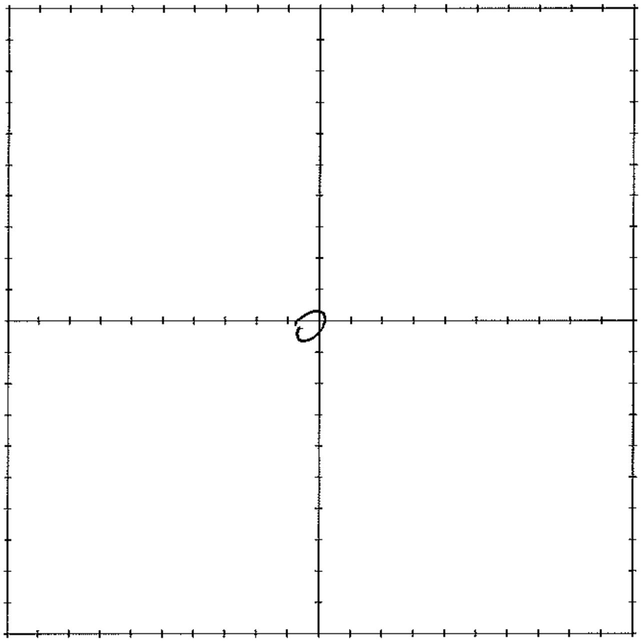
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziploc

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-002

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1450

SAMPLE COLLECTED BY TO/KR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS light brown silty sand, poorly graded, and dense

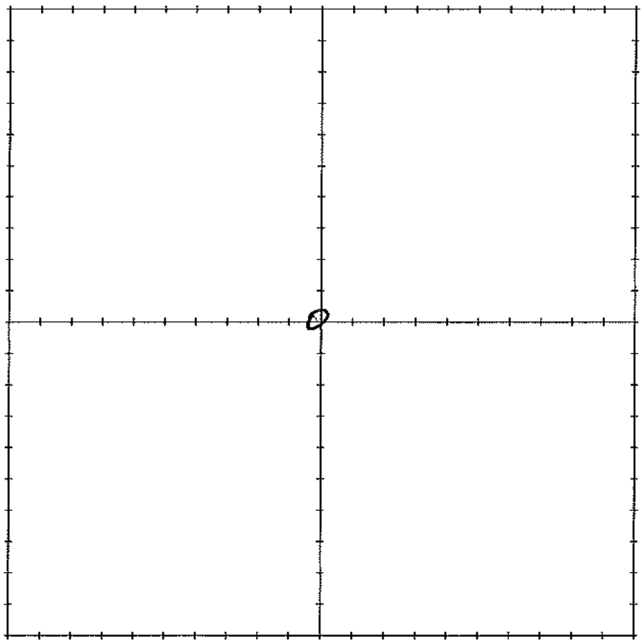
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 Ziploc

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-003

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1507

SAMPLE COLLECTED BY JO/LH

WEATHER CONDITIONS 70's sunny

FIELD USCS DESCRIPTIONS light brown silty sand poorly graded

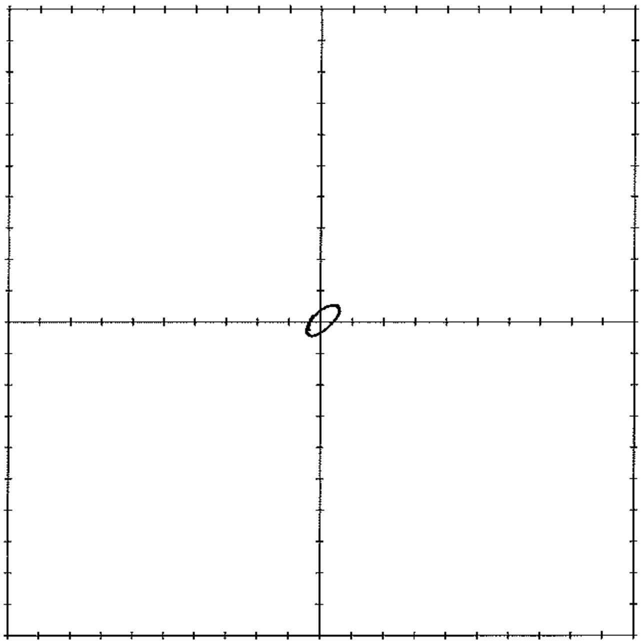
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziploc

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-004

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1527

SAMPLE COLLECTED BY TO/LR

WEATHER CONDITIONS 70's sunny

FIELD USCS DESCRIPTIONS Light brown/tan, poorly graded silty sand, md. dense

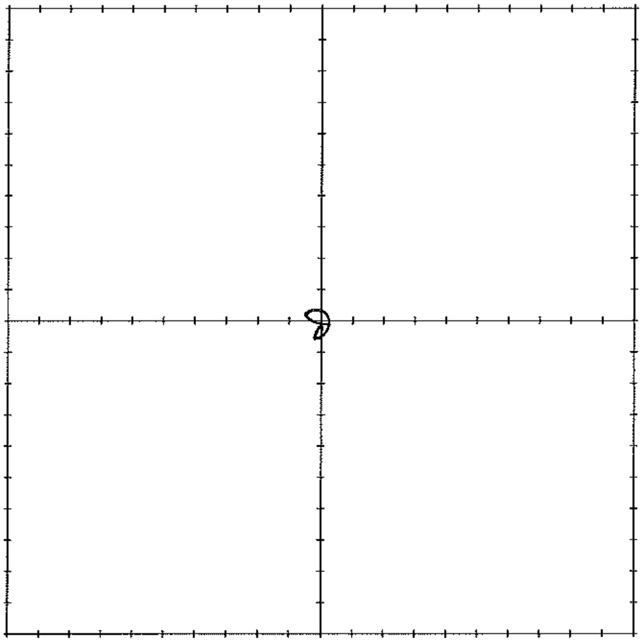
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☑ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziploc

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-005

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1603

SAMPLE COLLECTED BY TO/Lw

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Silty sands, trace gravels, med dense

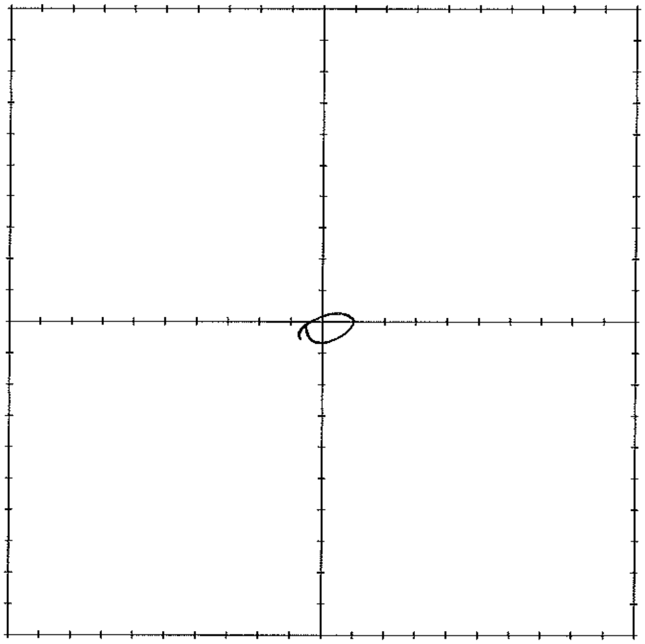
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-006

SAMPLE COLLECTION DATE 4/18/17

SAMPLE COLLECTION TIME 1629

SAMPLE COLLECTED BY CO/LW

WEATHER CONDITIONS 70°, sunny

FIELD USCS DESCRIPTIONS light brown silty sand, poorly sorted, med. dense

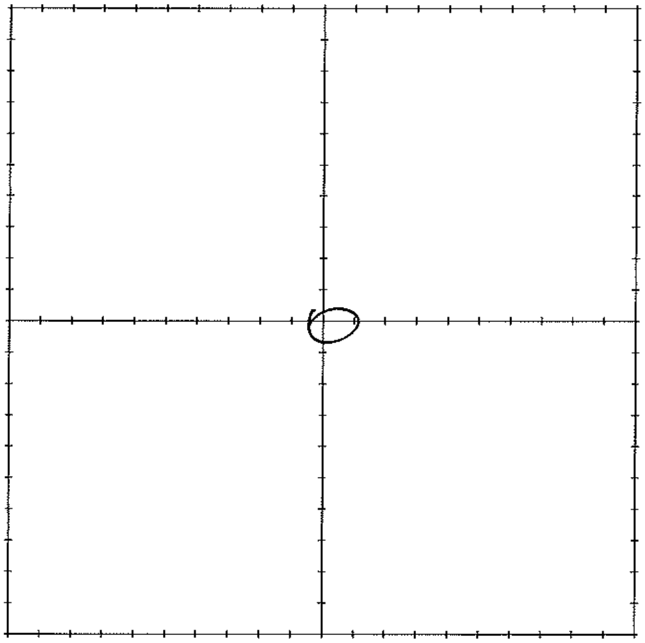
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☒ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziploc

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078 - CX-007, 207

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 0942

SAMPLE COLLECTED BY NW/LR

WEATHER CONDITIONS 70's, Sunny

FIELD USCS DESCRIPTIONS light gray/brown fine sand, trace slatey gravels, slightly moist.

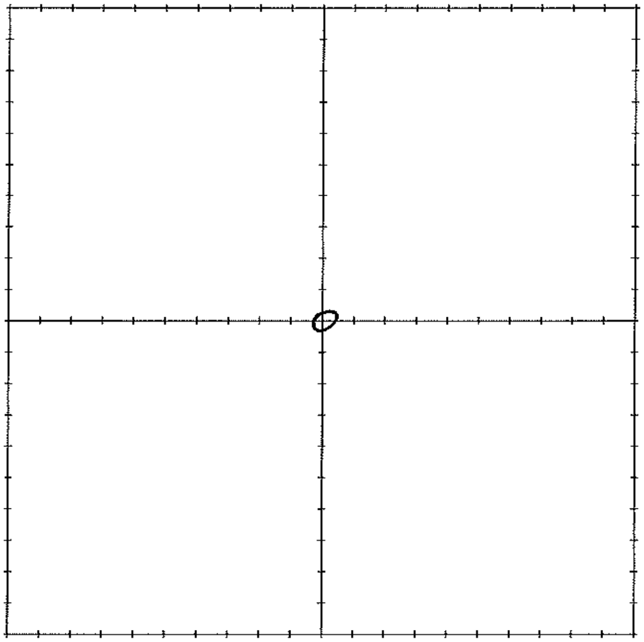
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☒ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☒ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☒ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplock

ANALYSES: Ra-226, Metals.



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078C (Claim 28)

SAMPLE I.D. S078-CX-008 MS/MSD

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 1000

SAMPLE COLLECTED BY NW/LR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Fine light brown/red sand, trace coarse sands, subrounded, cap material

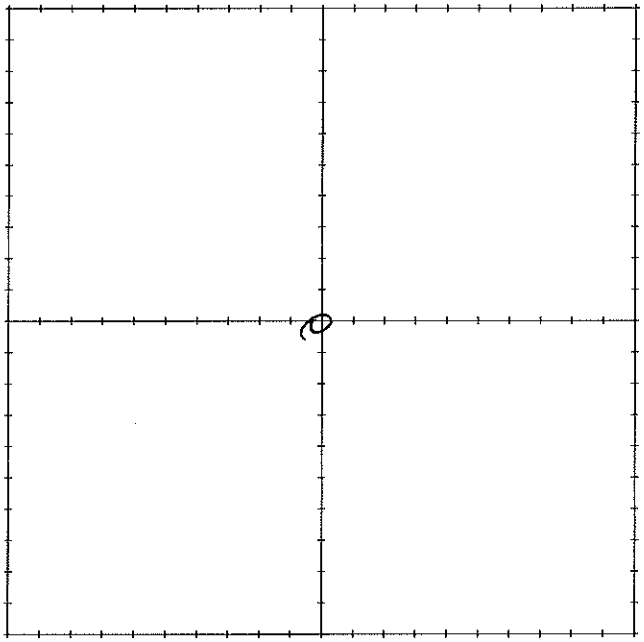
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☒ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☒ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplocs

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078-CX-009

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 1022

SAMPLE COLLECTED BY HW/LR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Fine light brown sand, trace coarse to fine gravels, subrounded,

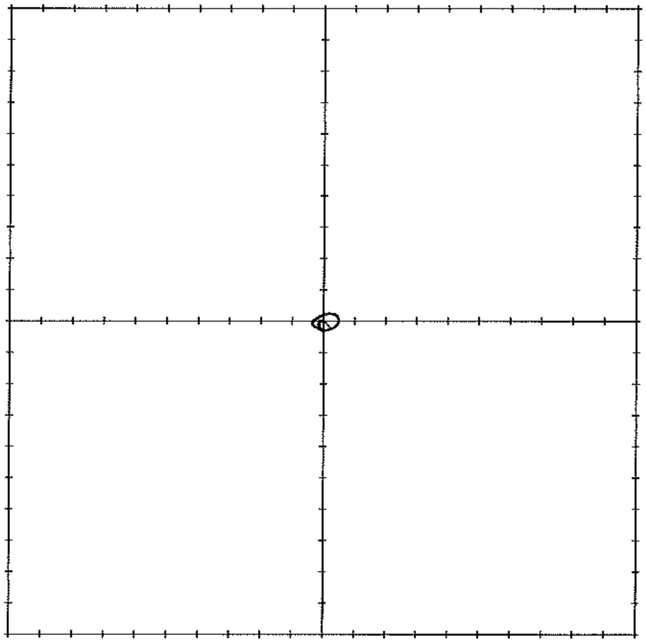
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☒ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☒ MEDIUM ☒ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 [illegible]

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME 5078C (Claim 28)

SAMPLE I.D. 5078-CX-010

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 1038

SAMPLE COLLECTED BY NW/ZR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Brown sand, med to fine, trace clay, sl. moist, v. low. plast.

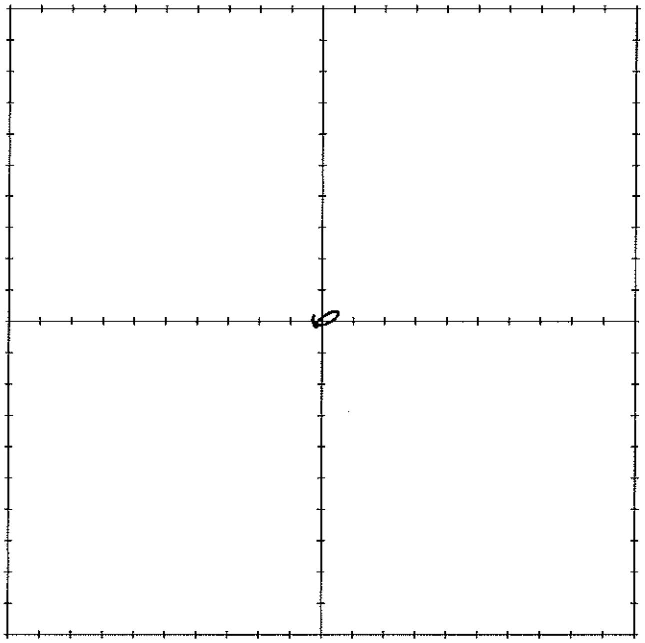
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☒ SC
☐ SM ☐ SP ☐ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☒ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☐ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziploc

ANALYSES: Ra-226, Metals.



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME 5078 (Claim 28)

SAMPLE I.D. 5078-CX-011, 211

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 1110

SAMPLE COLLECTED BY NW/LR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Brown soil, shaley mudstone frags, well graded

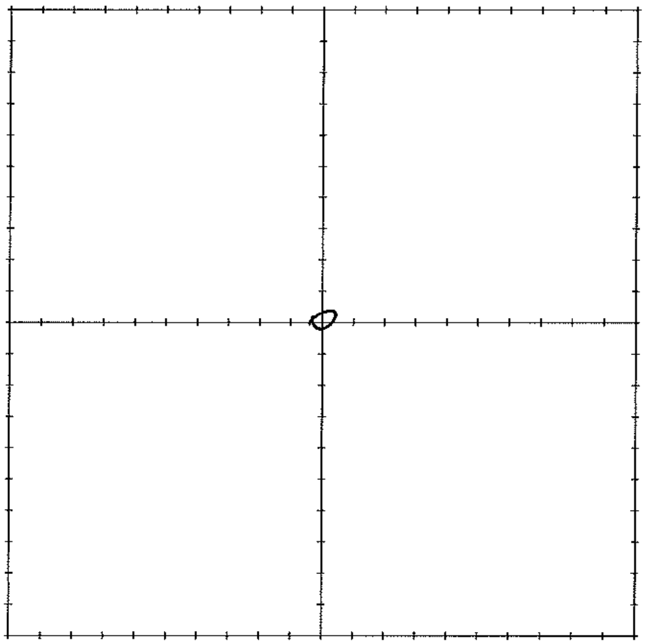
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☑ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☑ TRACE ☐ MINOR ☐ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☒ COARSE

MOISTURE: ☐ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplock

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

SURFACE SOIL SAMPLE LOG FORM

AREA #/NAME S078 (Claim 28)

SAMPLE I.D. S078- CX- 012

SAMPLE COLLECTION DATE 4/19/17

SAMPLE COLLECTION TIME 1142

SAMPLE COLLECTED BY NW/LR

WEATHER CONDITIONS 70's, sunny

FIELD USCS DESCRIPTIONS Gray/brown med. sand, few coarse sand to gravel.

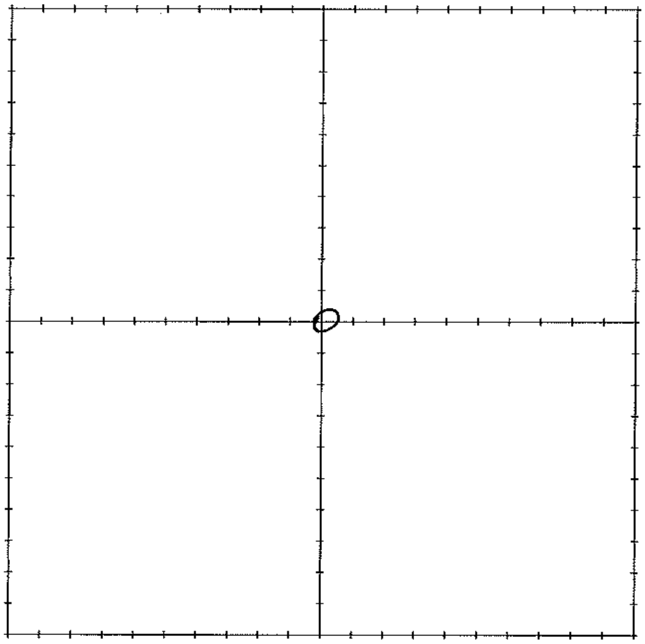
MAJOR DIVISIONS: ☐ OH ☐ CH ☐ MH ☐ OH ☐ CL ☐ ML ☐ SC
☐ SM ☐ SP ☒ SW ☐ GC ☐ GM ☐ GP ☐ GW

QUALIFIERS: ☐ TRACE ☐ MINOR ☑ SOME; SAND SIZE ☐ FINE ☐ MEDIUM ☒ COARSE

MOISTURE: ☒ DRY ☐ MOIST ☐ WET

SAMPLE CONTAINERS (NUMBER AND TYPE) 2 ziplock

ANALYSES: Ra-226, Metals



MARK INDIVIDUAL GRAB SAMPLE LOCATIONS IN GRID

MWH

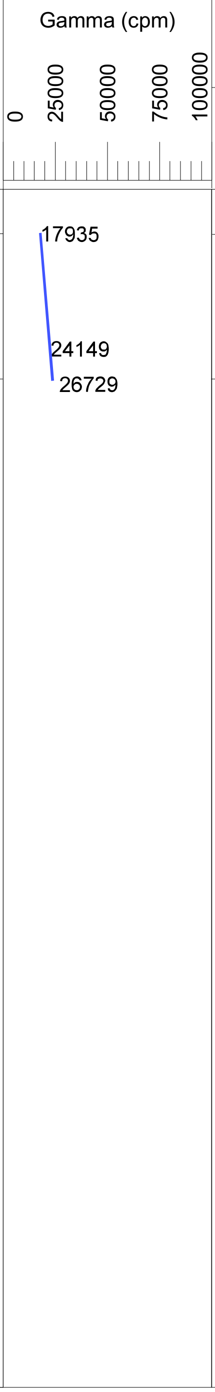
C.2 Drilling and Hand Auger Borehole Logs

BOREHOLE ID: **S078-BG1-012**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599020.44 NORTHING: 4011777.85
DATE STARTED: 11/10/2016 DATE STARTED: 11/10/2016
TOTAL DEPTH (ft.): 0.6 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Nicholas Randle

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION	SUBSURFACE SAMPLE INFORMATION			
			SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	▥	SILT WITH SAND (ML): light brown, low plasticity, fine sand.	No Sample			No Sample Collected. No Results Available.
		Terminated hand auger borehole at 0.6 ft. below ground surface. Refusal on hard surface.				



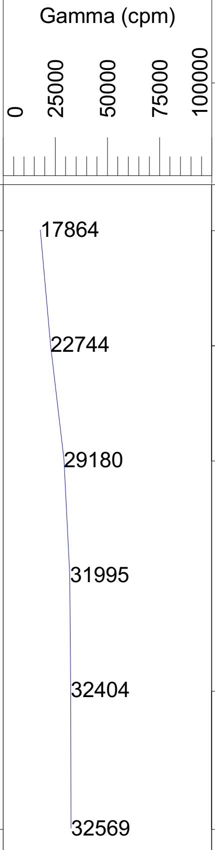
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-BG1-013**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599020.36 NORTHING: 4011779.04
DATE STARTED: 11/10/2016 DATE STARTED: 11/10/2016
TOTAL DEPTH (ft.): 2.6 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Nicholas Randle

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0–2.6	SILT WITH SAND (ML): light brown, low plasticity, fine sand.
2.6	Terminated hand auger borehole at 2.6 ft. below ground surface. Refusal in tight soils.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-BG1-013-1	0-0.5	grab	2.03
S078-BG1-013-2	0.5-1	grab	2.13
S078-BG1-013-3	2-2.6	grab	2.96

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

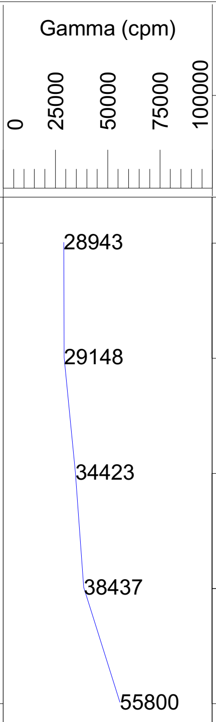
Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-001**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599471.7
NORTHING: 4011745.36
DATE STARTED: 4/19/2017
DATE STARTED: 4/19/2017
TOTAL DEPTH (ft.): 2
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION
0–2	▨	ORGANIC SOIL (OH): dark brown, black, silts and clay, medium plasticity, loose, with trace gravels, organic peaty odor.
2		Terminated hand auger borehole at 2 ft. below ground surface. Refusal on hard surface.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-001-01 S078-SCX-201-01	0-0.5	grab	5.61 14.20
S078-SCX-001-02	1-1.5	grab	2.49
S078-SCX-001-03	1.5-2	grab	3.03

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust–First Phase

BOREHOLE ID: **S078-SCX-002**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599507.56 NORTHING: 4011704.55
DATE STARTED: 4/19/2017 DATE STARTED: 4/19/2017
TOTAL DEPTH (ft.): 2.75 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

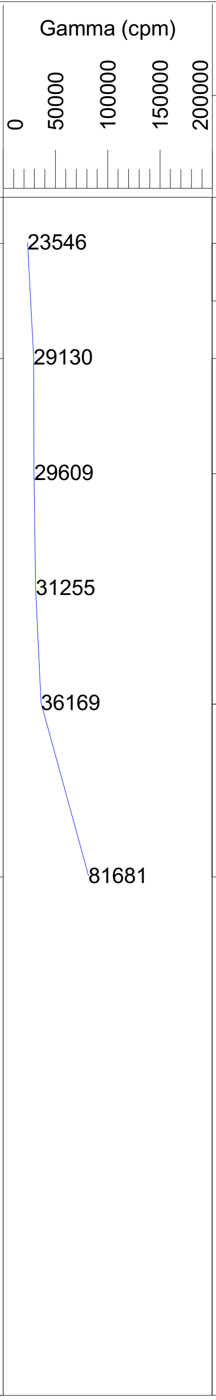
DEPTH (feet) | LITHOLOGICAL GRAPHIC

LITHOLOGICAL DESCRIPTION

0–0.5: SILT WITH SAND (ML): black, light gray, very fine sands, slight plasticity, loose, dry, trace gravels, gravels are subangular, gravels are 0.5 inches to 2.0 inches in diameter.

0.5–2.75: SILTY SAND (SM): tan, light brown, loose, dry, trace gravels, gravels are rounded to subangular, gravels are 0.5 inch to 2.0 inches in diameter.

Terminated hand auger borehole at 2.75 ft. below ground surface. Refusal on hard surface.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-002-01	0-0.25	grab	1.90
S078-SCX-002-02	0.5-1	grab	2.50
S078-SCX-002-03	1-2	grab	2.57
S078-SCX-002-04	2-2.75	grab	5.85

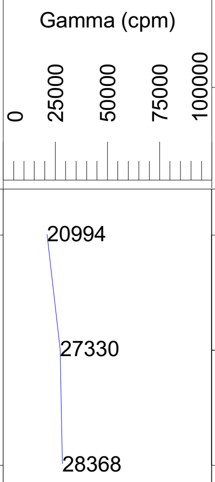
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-003**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599573.3
NORTHING: 4011675.45
DATE STARTED: 4/19/2017
DATE STARTED: 4/19/2017
TOTAL DEPTH (ft.): 1
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION
0	▨	SILTY SAND WITH GRAVEL (SM): brown, gravels are angular to subangular, dry.
1		Terminated hand auger borehole at 1 ft. below ground surface. Refusal on hard surface or rock.
2		
3		
4		
5		



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-003-01	0-0.5	grab	4.63
S078-SCX-003-02	0.5-1	grab	4.72

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

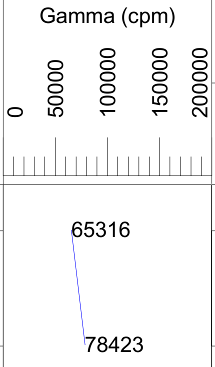
BOREHOLE ID: **S078-SCX-004**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599629.4
NORTHING: 4011662.08
DATE STARTED: 4/19/2017
DATE STARTED: 4/19/2017
TOTAL DEPTH (ft.): 0.5
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION
0	▨	SILTY SAND WITH GRAVEL (SM): brown, dry.
0.5		Terminated hand auger borehole at 0.5 ft. below ground surface. Borehole collapsing.
1		
2		
3		
4		
5		

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-004-01	0-0.5	grab	4.68

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

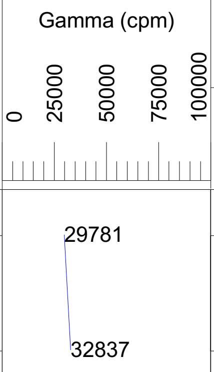
Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-005**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599687.74 NORTHING: 4011615.15
DATE STARTED: 4/19/2017 DATE STARTED: 4/19/2017
TOTAL DEPTH (ft.): 0.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn



DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SUBSURFACE SAMPLE INFORMATION			
				SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	▨	SILTY SAND (SM): light brown, fine grain sand, dry.	29781 32837	S078-SCX-005-01	0-0.5	grab	4.71
		Terminated hand auger borehole at 0.5 ft. below ground surface. Refusal on hard surface.					
1							
2							
3							
4							
5							

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

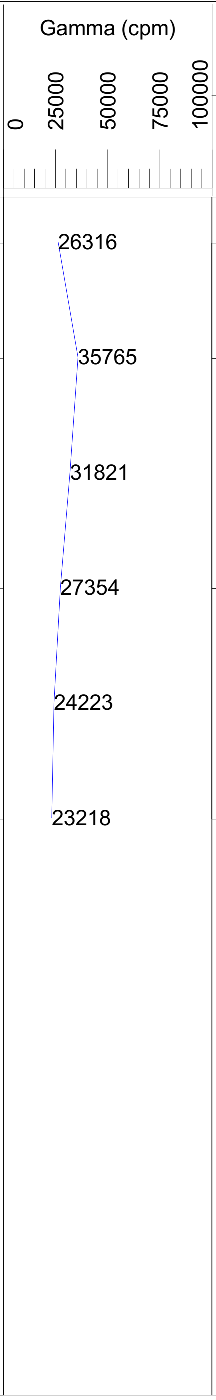
Stantec NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-006**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599336.37 NORTHING: 4011657.29
DATE STARTED: 4/20/2017 DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 2.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown, fine sand, dry, loose.	S078-SCX-006-01	0-0.5	grab	8.80
	SILT WITH SAND (ML): brown, inorganic silts, fine sand, loose, moist.				
1		S078-SCX-006-02	0.5-1.5	grab	3.49
	POORLY GRADED SAND (SP): brown, fine sand, dry, loose.				
2		S078-SCX-006-03	1.5-2.5	grab	1.20
	Terminated hand auger borehole at 2.5 ft. below ground surface. Hand augering ceased because field gamma measurements were reported as decreasing.				
3					
4					
5					



SUBSURFACE SAMPLE INFORMATION

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

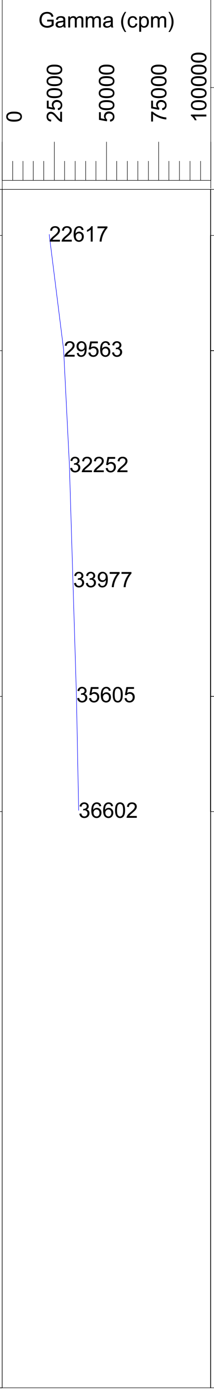
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-007**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599329.07 NORTHING: 4011534.76
DATE STARTED: 4/20/2017 DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 2.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	WELL GRADED SAND WITH GRAVELS (SW): brown, tan, dry, loose.
0.5	becoming moist.
2	minor clays and fines.
2.5	Terminated hand auger borehole at 2.5 ft. below ground surface. Refusal on hard surface.



SUBSURFACE SAMPLE INFORMATION

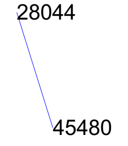
SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-007-01	0-0.5	grab	2.79
S078-SCX-007-02	0.5-2	comp	3.98
S078-SCX-007-03	2-2.5	grab	4.05

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-008**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599457.64
NORTHING: 4011525.24
DATE STARTED: 4/20/2017
DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 0.5
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION	Gamma (cpm) 0 25000 50000 75000 100000	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	▨	SILTY SAND WITH GRAVEL (SM): light brown, red, fine sands, medium dense, dry.	28044 45480	S078-SCX-008-01	0-0.5	grab 🟨	8.40
		Terminated hand auger borehole at 0.5 ft. below ground surface. Refusal on hard surface.					
1							
2							
3							
4							
5							

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-009**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599516.6
NORTHING: 4011472.83
DATE STARTED: 4/20/2017
DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 0.25
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION	Gamma (cpm) 0 25000 50000 75000 100000	SUBSURFACE SAMPLE INFORMATION SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	▦	SILTY SAND (SM): light brown, red, fine sands, trace gravels, dry, loose.	27449 28365	S078-SCX-009-01	0-0.25	grab	6.34
		Terminated hand auger borehole at 0.25 ft. below ground surface. Refusal on hard surface.					
1							
2							
3							
4							
5							

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

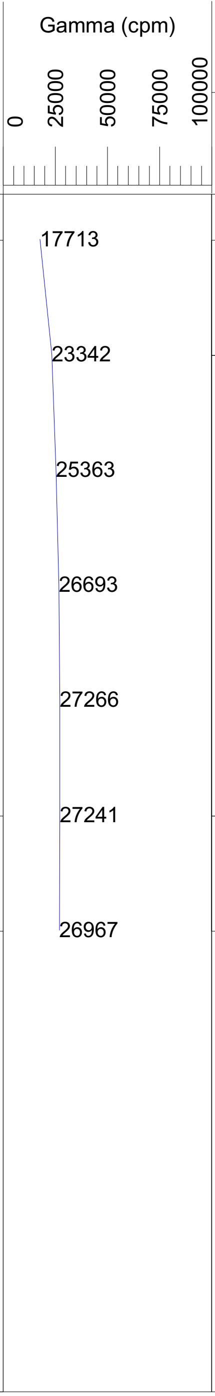
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-010**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599436.4
NORTHING: 4011275.95
DATE STARTED: 4/20/2017
DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 3
BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	SILT WITH SAND (ML): brown, inorganic silts, fine sand, slight plasticity, moist, loose.
2.5	CLAY (CL): brown, inorganic, medium plasticity, sandy, moist, loose.
3	Terminated hand auger borehole at 3 ft. below ground surface at maximum reach of the hand auger. No refusal.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-010-01	0-0.5	grab 🟨	2.86
S078-SCX-010-02	0.5-2.5	comp 🟧	2.56
S078-SCX-010-03	2.5-3	grab 🟨	4.01

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

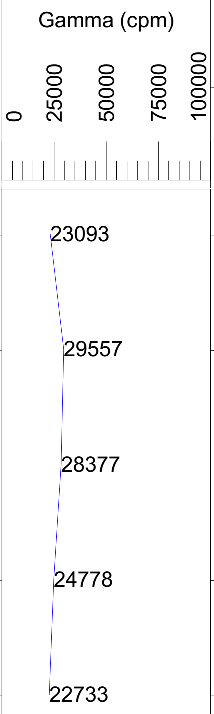
Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-011**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599301.95 NORTHING: 4011350.34
DATE STARTED: 4/20/2017 DATE STARTED: 4/20/2017
TOTAL DEPTH (ft.): 2 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Tom Osborn



SUBSURFACE SAMPLE INFORMATION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown, fine sand, dry, loose.	S078-SCX-011-01	0-0.5	grab	5.41
1	CLAYEY SANDS (SM): brown, moist, loose.	S078-SCX-011-02	0.5-1.5	grab	3.48
	POORLY GRADED SAND (SP): brown, fine sand, dry, loose.	S078-SCX-011-03	1.5-2	grab	1.86
2	Terminated hand auger borehole at 2 ft. below ground surface. Stopped hand augering as a result of a decrease in gamma count measurements recorded in the field.				
3					
4					
5					

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-012**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599536.93 NORTHING: 4011763.61
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 13 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC | LITHOLOGICAL DESCRIPTION

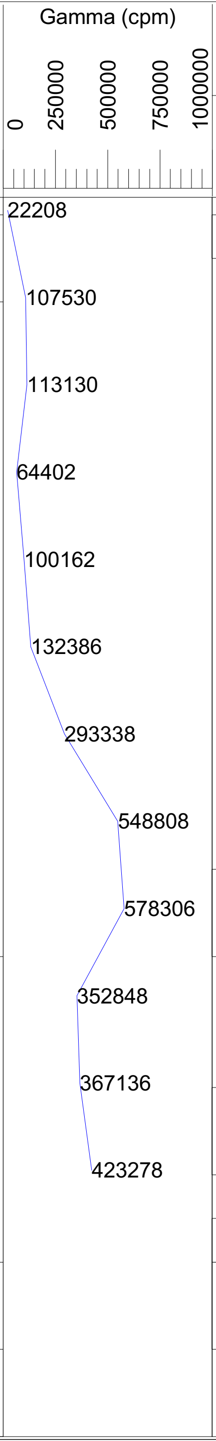
0 — POORLY GRADED SAND WITH GRAVEL (SP): light brown (7.5 YR 6/4), medium to coarse grained sand, lose, dry, gravels are rounded to angular.

1 — SANDSTONE: pinkish gray, highly weathered (W4), moderate soft (H5), weak (R2).

8.5 — SANDSTONE: black, highly weathered (W4), moderate soft (H5), weak (R2), interbedded with shales, shales are brown.

12 — SANDSTONE: light gray, slightly weathered to fresh (W1-W2), hard (H3), very strong (R4).

13 — Terminated borehole at 13 ft. below ground surface in bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-012-01	0-0.5	grab	🟨	2.30
S078-SCX-012-02	7.5-8.5	grab	🟨	136.00
S078-SCX-012-03	10-11	grab	🟨	59.10
S078-SCX-012-04	11.5-12	grab	🟨	117.00
S078-SCX-012-05	12-13	grab	🟨	18.50

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

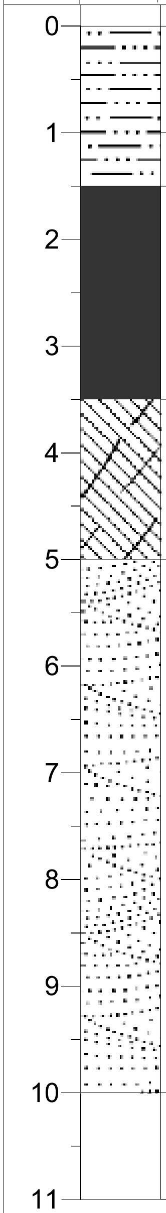
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-013**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599547.77 NORTHING: 4011758.6
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 10 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): fine to medium grained sand, grayish brown (2.5 Y 5/2), loose, dry, gravels are subrounded to angular, 10% silts, topsoil with roots.

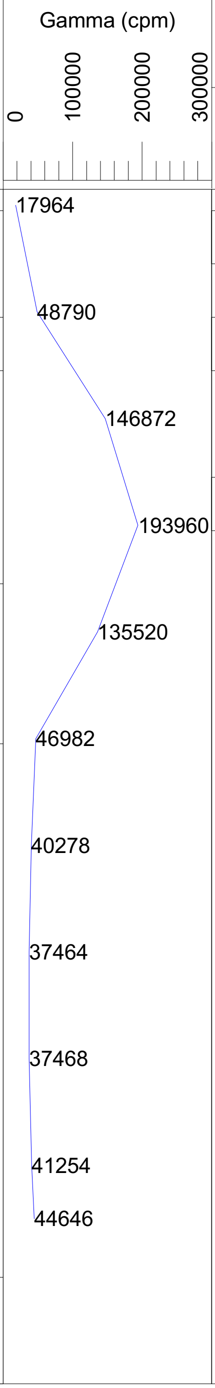
becoming more fine grained with less gravel, grayish brown (2.5 Y 4/2).

COAL: black, highly weathered (W4), soft (H6), weak to medium strong (R2-R3), black streak, interbedded with thin <3cm shales.

SHALE: dark gray, mottled bedding, very thin lenses, moderately weathered (W3), moderatly soft (H5), weak (R2).

SANDSTONE: light yellowish brown, slightly weathered (W2), moderately hard (H4), medium strong (R3).

Terminated borehole at 10 ft. below ground surface in bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-013-01	0-0.5	grab 🟨	2.29
S078-SCX-013-02	1-1.5	grab 🟨	2.80
S078-SCX-013-03	2.5-3	grab 🟨	51.50

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

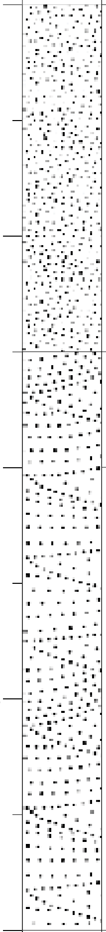
NAVAJO NATION
AUM Environmental Response Trust-First Phase

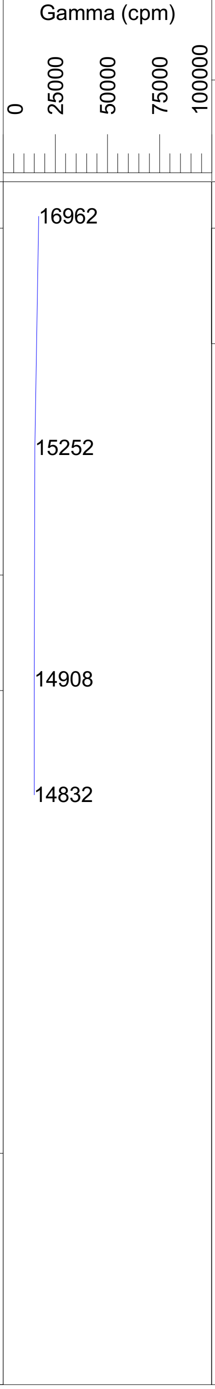
BOREHOLE ID: **S078-SCX-014**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599539.54 NORTHING: 4011780.47
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 4 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): light brown (7.5 YR 6/4), fine to coarse sand, loose, dry, unconsolidated.
1.5	SANDSTONE: light gray, moderately weathered (W2), moderately hard (H4), strong (R4).
2	becoming fresh (W1), hard (H3), very strong (R3), very pale brown.
4	Terminated borehole at 4 ft. below ground surface in bedrock.





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-014-01	0-0.5	grab 🟨	2.77

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

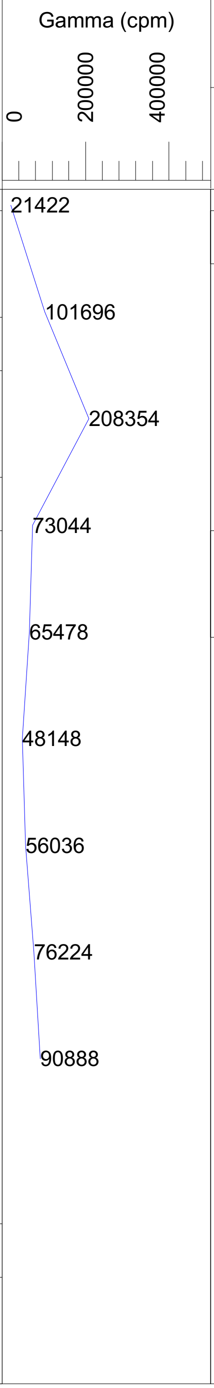
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-015**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599513.14 NORTHING: 4011758.27
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 10 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): light brown (7.5 YR 6/4), fine to coarse sand, loose, dry, unconsolidated.
1	SANDSTONE: pinkish gray, moderately weathered (W3), hard to moderately hard (H3-H4), strong (R4).
1.5	COAL: black, moderate to slight weathering (W2-W3), moderately soft (H5), weak (R2).
2.5	SANDSTONE: grayish brown, moderately weathered (W3), moderately hard (H4), moderately strong (R3).
3	color changes to pale brown.
9.5	becoming fresh (W1) and hard (H4).
10	Terminated borehole at 10 ft. below ground surface in bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-015-01	0-0.5	grab	1.48
S078-SCX-015-02 S078-SCX-215-02	3-4	grab	17.60 17.70

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

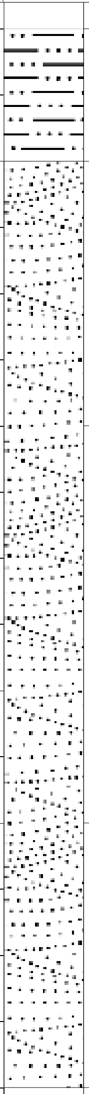
BOREHOLE ID: **S078-SCX-016**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

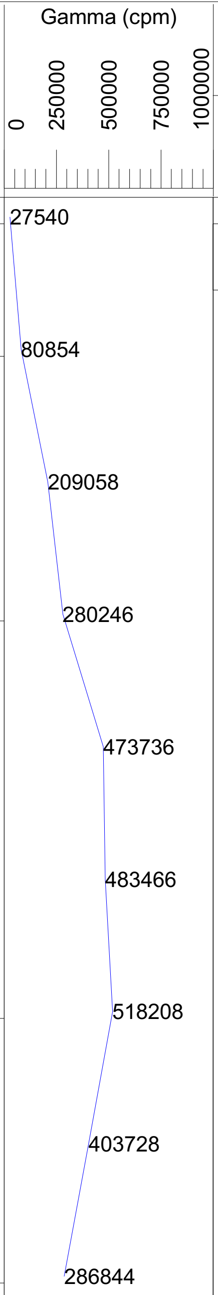
DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599490.49 NORTHING: 4011758.99
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 8 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): pinkish gray (7.5 YR 6/2), loose, dry, unconsolidated, fine to medium grained sand, angular to subangular gravels, roots and organics.
1	SANDSTONE: pinkish gray, highly weathered (W4), moderately hard (H4), medium strong (R3).
2	
3	color changes to very dark gray with trace white.
4	
5	
6	SANDSTONE: dark gray with trace white, fresh (W1), hard (H3), very strong (R5).
7	
8	Terminated borehole at 8 ft. below ground surface in bedrock.
9	

LITHOLOGICAL GRAPHIC





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-016-01	0-0.5	grab 🟨	1.95

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

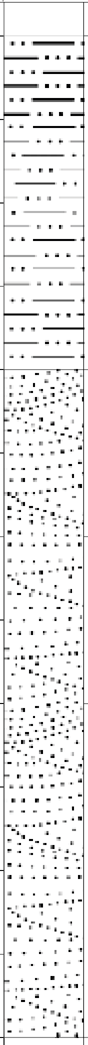
BOREHOLE ID: **S078-SCX-017**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

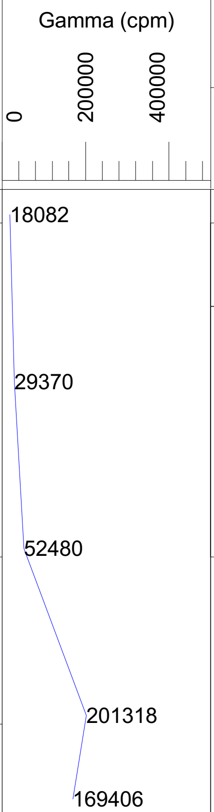
DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599494.43 NORTHING: 4011722.86
DATE STARTED: 10/11/2017 DATE STARTED: 10/11/2017
TOTAL DEPTH (ft.): 6 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): pinkish gray (7.5 YR 6/2), loose, dry, unconsolidated, fine to medium grained sand, angular to subangular gravels, roots and organics.
2	SANDSTONE: pinkish gray, highly weathered (W4), moderately hard (H4), medium strong (R3).
3	color changes to very dark gray with trace white.
4	SANDSTONE: dark gray with trace white, fresh (W1), hard (H3), very strong (R5).
6	Terminated borehole at 6 ft. below ground surface in bedrock.

LITHOLOGICAL GRAPHIC





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-017-01	0-0.5	grab	1.64
S078-SCX-017-02	0.5-2	comp	3.02

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

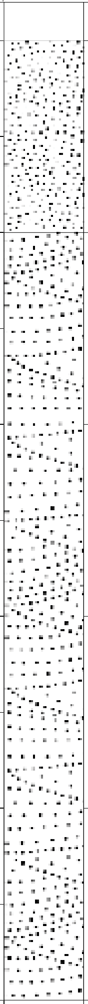
BOREHOLE ID: **S078-SCX-018**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

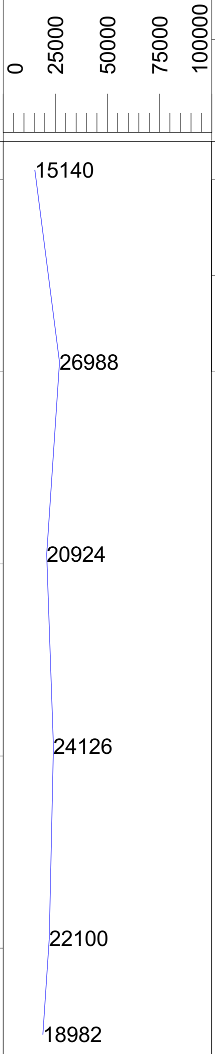
COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599566.25 NORTHING: 4011793.96
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVELS (SP): light brown (7.5 YR 6/3), fine to medium sands, gravels are angular to sub rounded, loose, dry.
1	SANDSTONE: light gray, highly weathered (W4), medium hard (H4), medium strong (R3), dry.
2	pale yellow.
3	grayish brown.
4	SANDSTONE: pale yellow, fresh (W1), hard (H3), very strong (R5).
5	Terminated borehole at 5 ft. below ground surface in bedrock.
6	

LITHOLOGICAL GRAPHIC



Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-018-01	0-0.5	grab	2.36
S078-SCX-018-02	0.5-1	grab	16.60

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

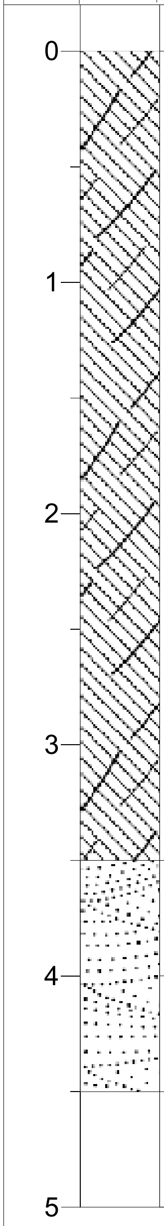
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-019**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599581.53 NORTHING: 4011746.78
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 4.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC | LITHOLOGICAL DESCRIPTION

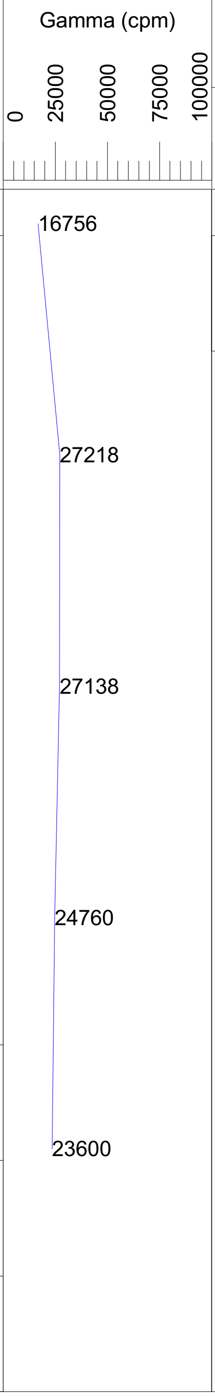


SHALE: brown very thick highly weathered (W4), soft (H6), weak (R2), brittle, flakey, with some interebedded calcium carbonate, dry.

SANDSTONE: light yellowish brown, moderately weathered (W3), moderately hard (H4), strong (R4).

hard fresh to slightly weathered (W1-W2), very hard (H2), very strong (R5).

Terminated borehole at 4.5 ft. below ground surface in bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-019-01	0-0.5	grab 🟨	2.02

Notes: cpm = counts per minute
pCi/g = picocuries per gram

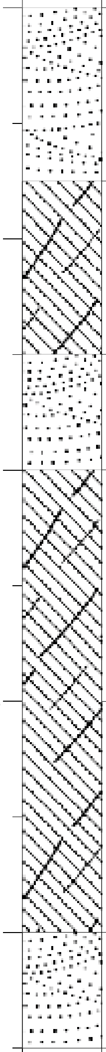
grab = grab sample
comp = composite sample

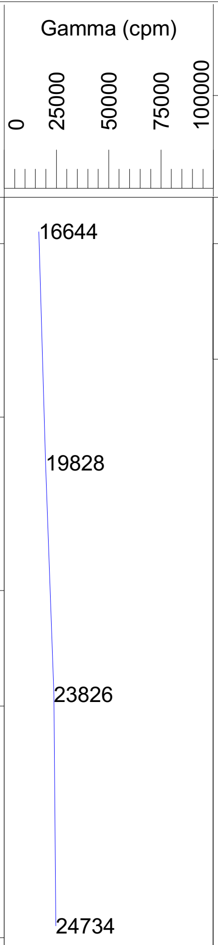
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-020**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599609.99 NORTHING: 4011715.1
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 4.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward





DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SUBSURFACE SAMPLE INFORMATION			
			SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	SANDSTONE: brownish yellow, moderately weathered (W3), hard (H3), strong (R4) medium grained sandstone.	16644	S078-SCX-020-01	0-0.5	grab	0.94
1	SHALE: dark grayish brown, medium thickness, slightly weathered (W3), moderately soft (H6), weak (R2), weakly bedded.	19828				
	SANDSTONE: brownish yellow, moderately weathered (W3), hard (H3), strong (R4) medium grained sandstone.					
2	SHALE: dark grayish brown, medium thickness, slightly weathered (W3), moderately soft (H6), weak (R2), weakly bedded.	23826				
3	with calcium carbonate staining	24734				
4	SANDSTONE: dark yellowish brown, slightly weathered (W2), very hard (H2), very strong (R5), medium grained sandstone.					
	Terminated borehole at 4.5 ft. below ground surface in bedrock.					
5						

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

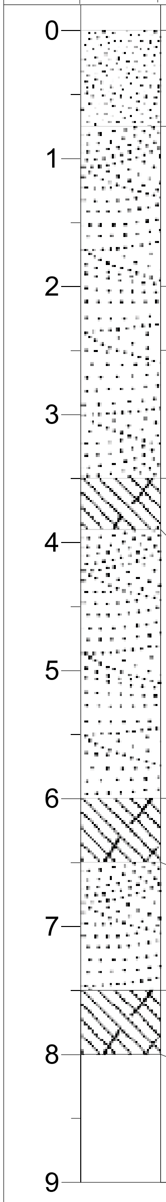
BOREHOLE ID:	**S078-SCX-021**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599633.31	NORTHING:	4011711.36
DATE STARTED:	10/12/2017	DATE STARTED:	10/12/2017
TOTAL DEPTH (ft.):	8	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		

DEPTH (feet)

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL AND COBBLES (SP): brown (7.5 YR 4/4), dry, loose, unconsolidated fine to coarse sands, angular to subangular sandstone cobble and gravels.

SANDSTONE: very pale brown, slightly weathered (W2), hard (H3), very strong (R4), fine to medium grained sandstone.

brownish yellow

very pale brown

SHALE: very dark grayish brown, slightly weathered (W2), moderately soft (H5), weak (R2), lenses, mottled 1 inch or medium bedding thickness.

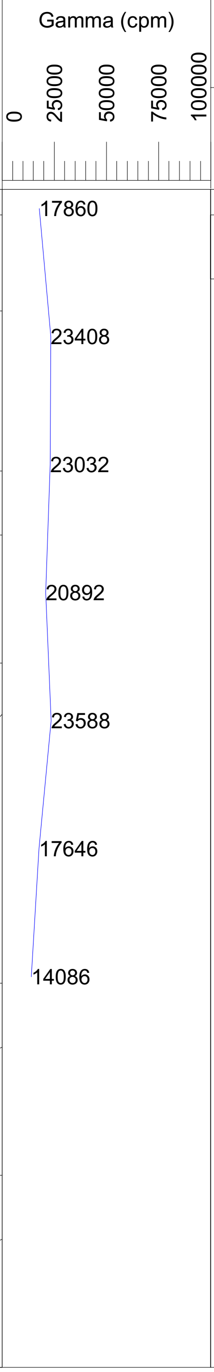
SANDSTONE: light yellowish brown, fresh (W1), hard to very hard (H2-H3), strong (R4).

SHALE: very dark grayish brown, slightly weathered (W2), moderately soft (H5), weak (R2), lenses, mottled 1 inch or medium bedding thickness.

SANDSTONE: light yellowish brown, fresh (W1), hard to very hard (H2-H3), strong (R4).

SHALE: very dark grayish brown, slightly weathered (W2), moderately soft (H5), weak (R2), lenses, mottled 1 inch or medium bedding thickness.

Terminated borehole at 8 ft. below ground surface in alternating bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-021-01	0-0.5	grab	🟨	2.31

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

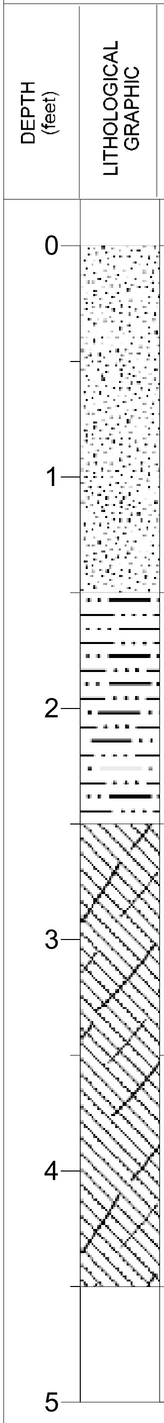
- - - - = approximate contact

Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-022**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599688.73 NORTHING: 4011860.16
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 4.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

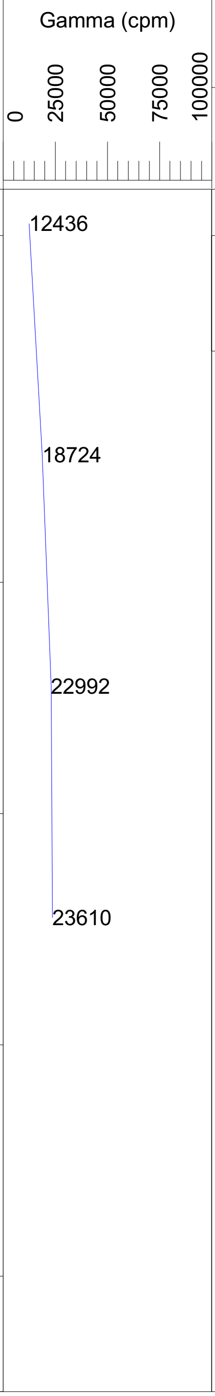
POORLY GRADED SAND GRAVEL (SP): light brown (7.5 YR 6/3), medium to coarse sand grains, loose, dry, with some roots.

POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): light brown (7.5 YR 6/3), fine to coarse sand grains, clays, loose, dry, with some roots.

SHALE: brown, moderately weathered (W4), moderately soft (H5), weak (R2), massive bedding.

SHALE: very dark grayish brown, moderately weathered (W4), moderately soft (H5), weak (R2), massive bedding.

Terminated borehole at 4.5 ft. below ground surface in shale bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-022-01	0-0.5	grab	1.70

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

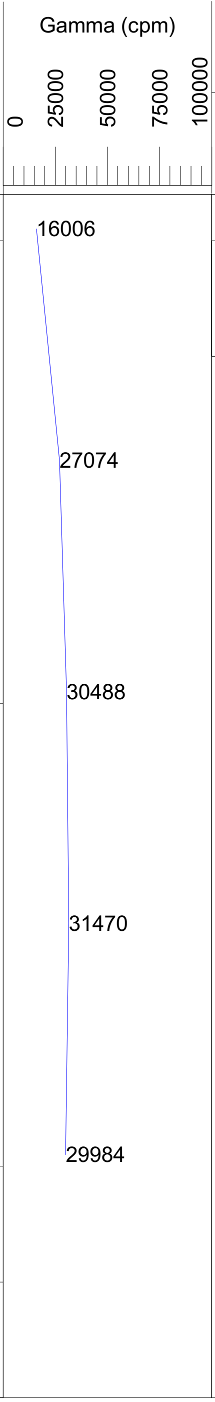
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-023**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599687.75 NORTHING: 4011860.77
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 4.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION
0	▨	SHALE: light brownish gray, moderately soft (H5), weak (R2), massive bedding.
2	▨	SHALE: light brownish gray, slightly weathered to fresh (W1-W2), moderately hard (H4), massive bedding.
4	▨	trace gypsum <1% becoming dusky red and dark yellowish brown with mottled bedding.
4.5		Terminated borehole at 4.5 ft. below ground surface in shale bedrock.
5		



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-023-01	0-0.5	grab	2.55

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

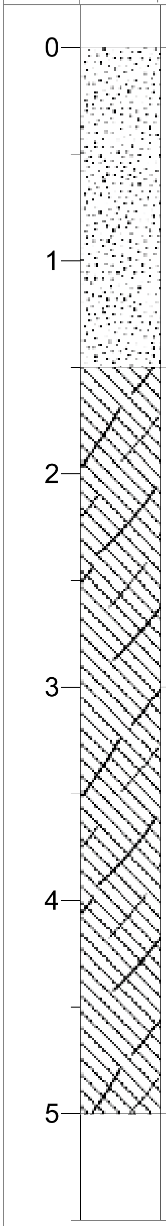
BOREHOLE ID: **S078-SCX-024**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599705.91 NORTHING: 4011779.18
DATE STARTED: 10/12/2017 DATE STARTED: 10/12/2017
TOTAL DEPTH (ft.): 5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC



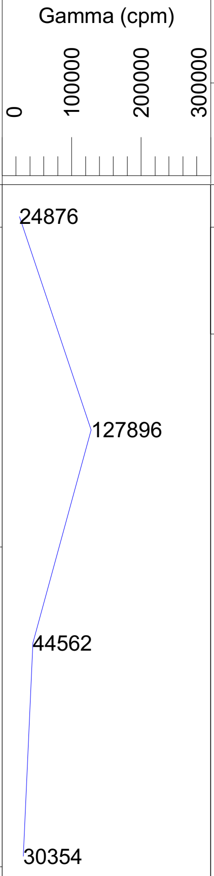
LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse sands, dry, loose, unconsolidated. Fill material from a berm on the east side of mesa top. Fill used for berm to divert water draining from the east.

SHALE: grayish brown, moderately weathered (W3), moderately soft (H5), weak (R2).

SHALE: brownish yellow, fresh (W1), moderately soft (H5), weak (R2).

Terminated borehole at 5 ft. below ground surface in shale bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-024-01 S078-SCX-224-01	0-0.5	grab	24.80 22.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

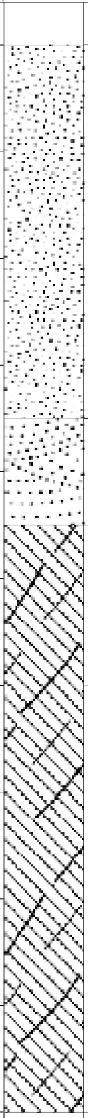
BOREHOLE ID:	**S078-SCX-025**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599627.27	NORTHING:	4011796.32
DATE STARTED:	10/12/2017	DATE STARTED:	10/12/2017
TOTAL DEPTH (ft.):	5	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		

DEPTH (feet)

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

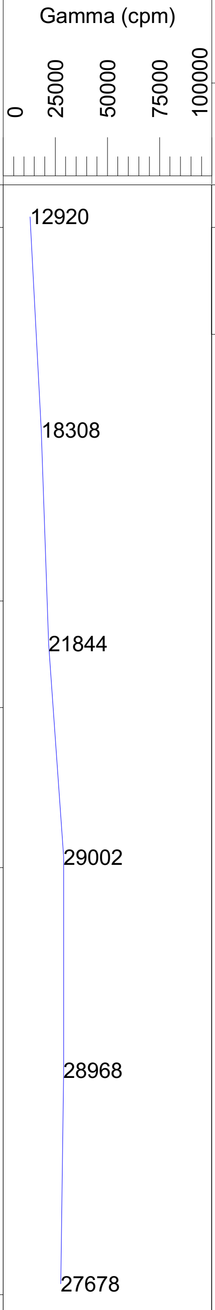
POORLY GRADED SAND WITH GRAVEL (SP): light yellowish brown (10 YR 6/4), dry, loose, fine to coarse grained sands, mostly medium grained.

SANDSTONE: boulder.

SHALE: yellowish brown, moderately weathered (W3), moderately soft (H5), weak (R2).

SHALE: gray with trace reddish yellow, fresh (W1), moderately hard (H4), medium strong (R3).

Terminated borehole at 5 ft. below ground surface in shale bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-025-01	0-0.5	grab	2.80

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

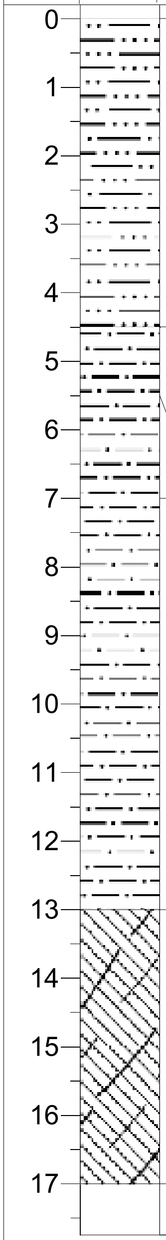
BOREHOLE ID: **S078-SCX-026**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599638.17 NORTHING: 4011635.6
DATE STARTED: 10/13/2017 DATE STARTED: 10/13/2017
TOTAL DEPTH (ft.): 17 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): fill, assorted colors, predominantly brown (7.5 YR 4/3), loose, moist, unconsolidated, fine to coarse sands, angular to subangular mostly medium grained sands, gravels assorted colors.

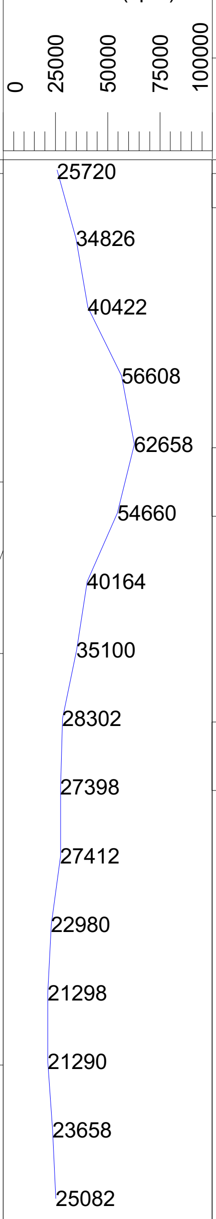
POORLY GRADED SAND WITH CLAYS AND GRAVELS (SP-SC): fill, assorted colors, predominantly brown (7.5 YR 4/3), loose, moist, unconsolidated, fine to coarse sands, angular to subangular mostly fine grained sands with clay.
secondary color, black (7.5 YR 2.5/1)

becoming darker in color, very dark grey (10 YR 3/1) and some reddish yellow, (7.5 YR 6/8), oxidized, moist.

SHALE: brown, highly weathered (W4), soft (H6), weak (R2), massive bedding with medium to thin interbedded lenses, varying colors, mottled, calcium carbonate.

Terminated borehole at 17 ft. below ground surface in shale bedrock.

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-026-01	0-0.5	grab	🟨	5.31
S078-SCX-026-02	4-5	grab	🟨	12.60
S078-SCX-026-03	8-9	grab	🟨	5.91

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

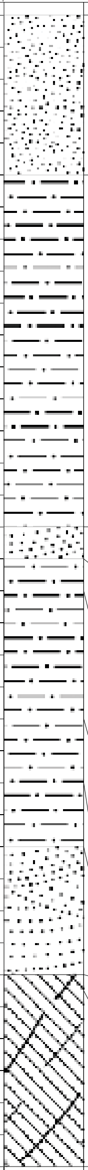
BOREHOLE ID: **S078-SCX-027**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599622.11 NORTHING: 4011607.35
DATE STARTED: 10/13/2017 DATE STARTED: 10/13/2017
TOTAL DEPTH (ft.): 18 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): gray (7.5 YR 6/1), fine to coarse sands, loose, dry, unconsolidated, assorted gravel types including sandstone and siltstone, small gravels and roots.

POORLY GRADED SAND WITH SILTS AND GRAVEL (SP-SC): gray (7.5 YR 6/1), fine to coarse sands, loose, dry, unconsolidated, assorted gravel types including sandstone and siltstone, small gravels.

SANDSTONE: cobble, yellowish brown (10 YR 5/8), medium grained sand matrix.

POORLY GRADED SAND WITH SILTS AND GRAVEL (SP-SC): gray (7.5 YR 6/1), fine to coarse sands, loose, dry, unconsolidated, assorted gravel types including sandstone and siltstone, small gravels.

POORLY GRADED SAND WITH SILTS AND GRAVEL (SP-SC): red (2.5 YR 5/8), fine to coarse sands, loose, dry, unconsolidated, assorted gravel types including sandstone and siltstone, trace large gravels and cobbles.

POORLY GRADED SAND WITH SILTS AND GRAVEL (SP-SC): red (2.5 YR 5/8), fine to coarse sands, loose, dry, unconsolidated, assorted gravel types including sandstone, coal, and siltstone, trace large gravels and cobbles.

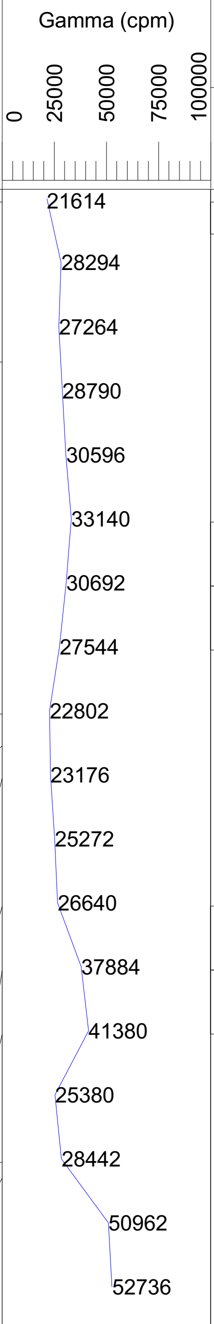
becoming very dense, consolidated.

SANDSTONE: very pale brown, fresh (W1), very hard (H2), very strong (R5) medium grained matrix.

SHALE: black (10 YR 2/1) moderately weathered (W3), moderately soft (H5), weak (R2), thin bedding.

SHALE: grayish brown (10 YR 5/2), slightly weathered grading to fresh (W2-W1), moderately soft (H5), medium strong (R3), massive bedding

Terminated borehole at 18 ft. below ground surface in shale bedrock.



SUBSURFACE SAMPLE INFORMATION

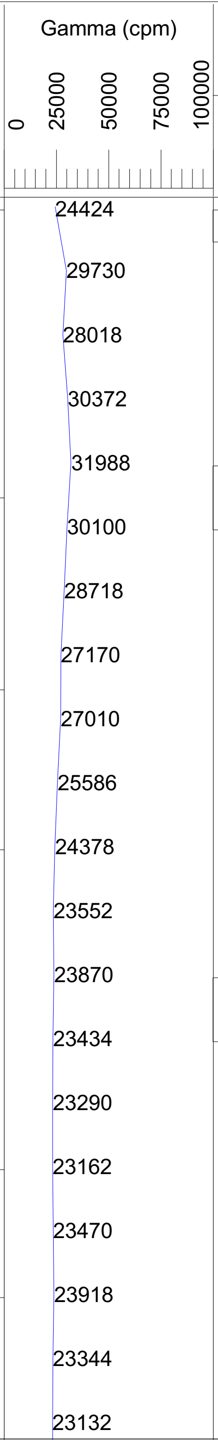
SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-027-01	0-0.5	grab	3.34
S078-SCX-027-02	5-6	grab	4.72
S078-SCX-027-03	6-7	grab	2.72
S078-SCX-027-04	11-12	grab	2.28
S078-SCX-027-05	12-13	grab	4.14

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-028**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599622.54 NORTHING: 4011588.49
DATE STARTED: 10/14/2017 DATE STARTED: 10/14/2017
TOTAL DEPTH (ft.): 36.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



SUBSURFACE SAMPLE INFORMATION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): light brownish gray (10 YR 6/2), loose, dry, fine to medium grained sand, gravels are angular to subrounded, trace roots, unconsolidated.	24424	S078-SCX-028-01 S078-SCX-228-01	0-0.5	grab	🟨	3.11 2.71
1		29730					
2		28018					
3		30372					
4		31988	S078-SCX-028-02	4-5	grab	🟨	2.47
5	becoming more consolidated increase in silts and clays, trace white.	30100					
6		28718					
7		27170					
8	gravels becoming small.	27010					
9		25586					
10	increase in gravel size to large gravels composed of sandstone and siltstone	24378					
11		23552					
12		23870	S078-SCX-028-03	12-13	grab	🟨	2.11
13		23434					
14		23290					
15	POORLY GRADED SAND WITH GRAVEL AND SILTS (SP-SM): very dark brown (10 YR 2/2), with trace black (10 YR 2/1), consolidated, dry, fine to medium grained sand, gravels are angular to subrounded.	23162					
16		23470					
17	increase in consolidation.	23918					
18		23344					
19		23132					

Notes: cpm = counts per minute
pCi/g = picocuries per gram

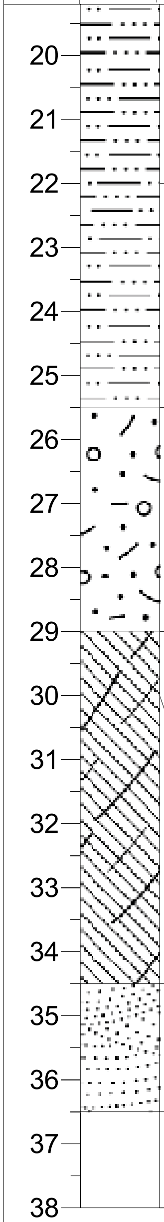
grab = grab sample
comp = composite sample

- - - - = approximate contact

BOREHOLE ID: **S078-SCX-028**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599622.54 NORTHING: 4011588.49
DATE STARTED: 10/14/2017 DATE STARTED: 10/14/2017
TOTAL DEPTH (ft.): 36.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

increase in siltstone gravels, brown (7.5 YR 4/4), siltstone red (10 R 4/8) trace white (5 YR 3/1).

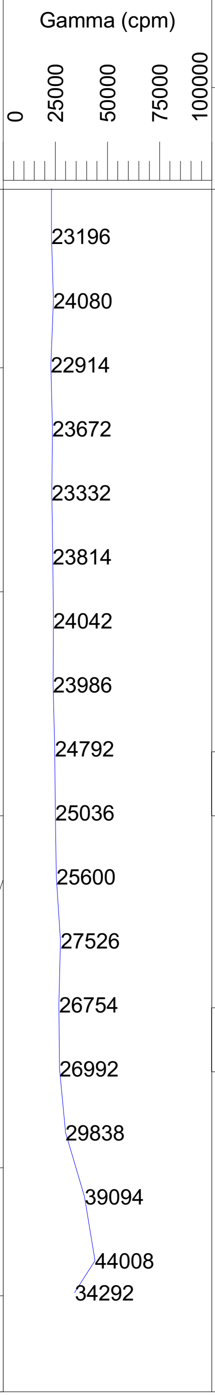
POORLY GRADED GRAVEL WITH SAND AND CLAY (GP-SC): red (10 R 4/8), gravels are angular to subangular, sands are fine to coarse, moist.

SHALE: highly weathered with gravels of various colors, predominantly dark reddish gray (5 YR 4/2), highly weathered (W4), moderately soft (H4), weak (R2), with few gravels including siltstone, sandstone, coal, some coarse sand, mottled.

shale becoming more compacted.

SANDSTONE: moderately weathered (W3), hard (H3), medium strong (R3), very pale brown (10 YR 8/3) sandstone composed of fine to coarse sand.

Terminated borehole at 36.5 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-028-04	28-29	grab 🟨	1.65
S078-SCX-028-05	32-33	grab 🟨	2.78

Notes: cpm = counts per minute
pCi/g = picocuries per gram

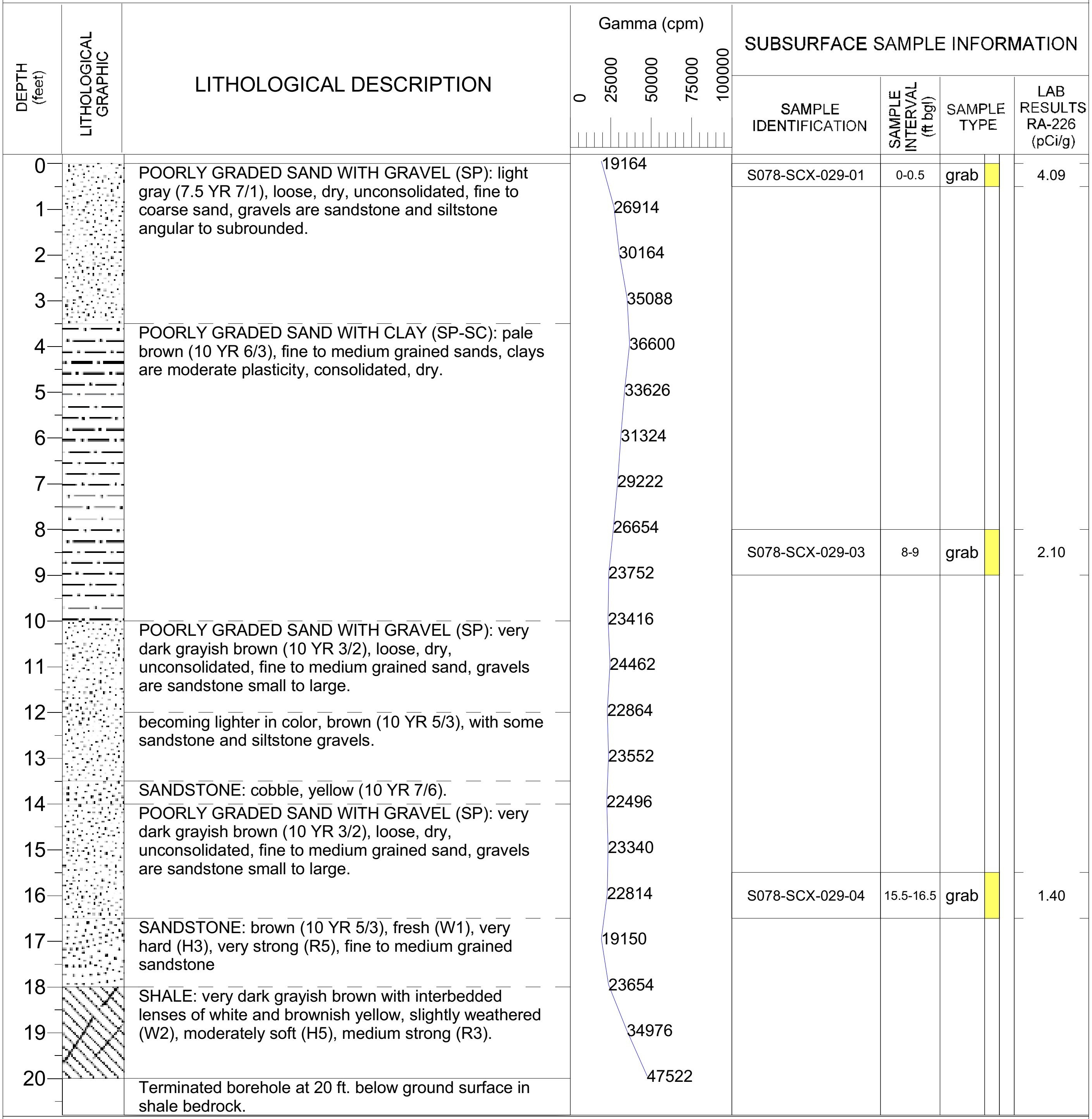
grab = grab sample
comp = composite sample

- - - - = approximate contact

BOREHOLE ID: **S078-SCX-029**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599618.36 NORTHING: 4011572.48
DATE STARTED: 10/14/2017 DATE STARTED: 10/14/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): light gray (7.5 YR 7/1), loose, dry, unconsolidated, fine to coarse sand, gravels are sandstone and siltstone angular to subrounded.

POORLY GRADED SAND WITH CLAY (SP-SC): pale brown (10 YR 6/3), fine to medium grained sands, clays are moderate plasticity, consolidated, dry.

POORLY GRADED SAND WITH GRAVEL (SP): very dark grayish brown (10 YR 3/2), loose, dry, unconsolidated, fine to medium grained sand, gravels are sandstone small to large.

becoming lighter in color, brown (10 YR 5/3), with some sandstone and siltstone gravels.

SANDSTONE: cobble, yellow (10 YR 7/6).

POORLY GRADED SAND WITH GRAVEL (SP): very dark grayish brown (10 YR 3/2), loose, dry, unconsolidated, fine to medium grained sand, gravels are sandstone small to large.

SANDSTONE: brown (10 YR 5/3), fresh (W1), very hard (H3), very strong (R5), fine to medium grained sandstone

SHALE: very dark grayish brown with interbedded lenses of white and brownish yellow, slightly weathered (W2), moderately soft (H5), medium strong (R3).

Terminated borehole at 20 ft. below ground surface in shale bedrock.

DEPTH (feet)	Gamma (cpm)
0	19164
1	26914
2	30164
3	35088
4	36600
5	33626
6	31324
7	29222
8	26654
9	23752
10	23416
11	24462
12	22864
13	23552
14	22496
15	23340
16	22814
17	19150
18	23654
19	34976
20	47522

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-029-01	0-0.5	grab	🟨	4.09
S078-SCX-029-03	8-9	grab	🟨	2.10
S078-SCX-029-04	15.5-16.5	grab	🟨	1.40

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-030**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599597.44 NORTHING: 4011602.3
DATE STARTED: 10/14/2017 DATE STARTED: 10/14/2017
TOTAL DEPTH (ft.): 25 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC

LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): light brownish gray (10 YR 6/2), loose, dry, fine to coarse sands, small to large gravels, gravels are coal and siltstone, angular to subangular, with roots and organics, unconsolidated.

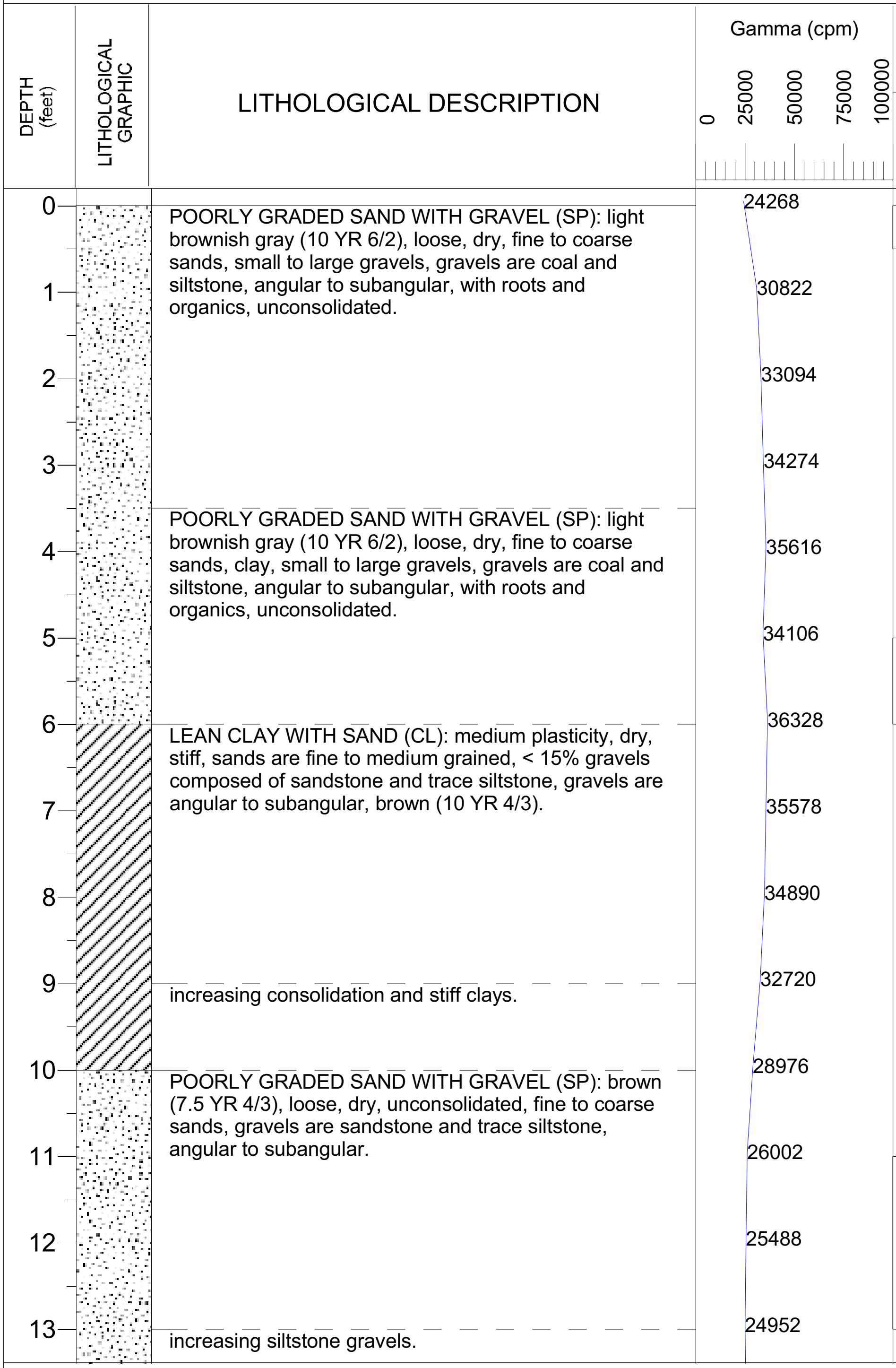
POORLY GRADED SAND WITH GRAVEL (SP): light brownish gray (10 YR 6/2), loose, dry, fine to coarse sands, clay, small to large gravels, gravels are coal and siltstone, angular to subangular, with roots and organics, unconsolidated.

LEAN CLAY WITH SAND (CL): medium plasticity, dry, stiff, sands are fine to medium grained, < 15% gravels composed of sandstone and trace siltstone, gravels are angular to subangular, brown (10 YR 4/3).

increasing consolidation and stiff clays.

POORLY GRADED SAND WITH GRAVEL (SP): brown (7.5 YR 4/3), loose, dry, unconsolidated, fine to coarse sands, gravels are sandstone and trace siltstone, angular to subangular.

increasing siltstone gravels.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-030-01 S078-SCX-230-01	0-0.5	grab	3.99 4.22
S078-SCX-030-02	5-6	grab	3.38
S078-SCX-030-03	11-13	comp	1.99

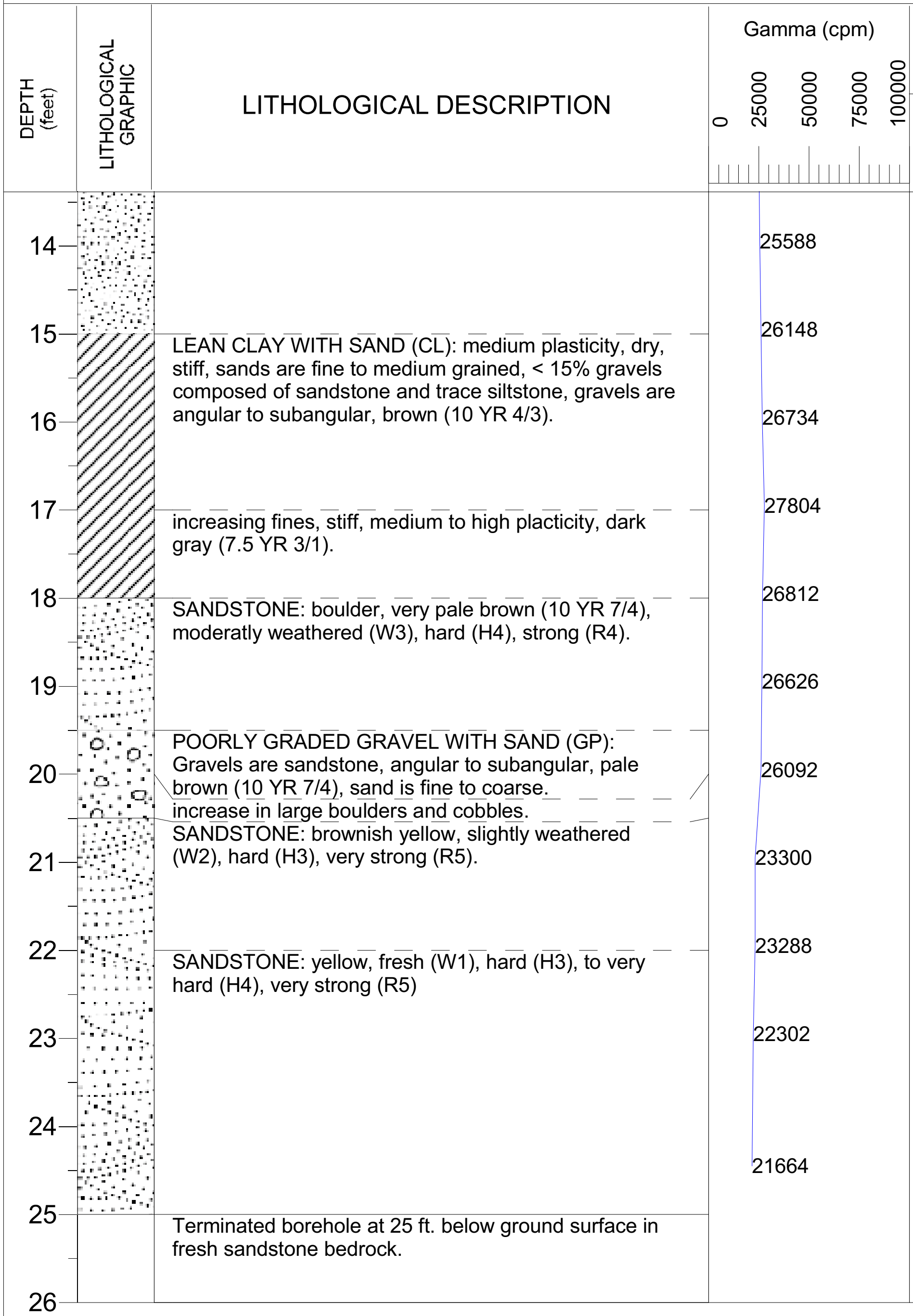
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-030**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599597.44 NORTHING: 4011602.3
DATE STARTED: 10/14/2017 DATE STARTED: 10/14/2017
TOTAL DEPTH (ft.): 25 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL GRAPHIC	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
14			25588				
15		LEAN CLAY WITH SAND (CL): medium plasticity, dry, stiff, sands are fine to medium grained, < 15% gravels composed of sandstone and trace siltstone, gravels are angular to subangular, brown (10 YR 4/3).	26148				
16			26734				
17		increasing fines, stiff, medium to high placticity, dark gray (7.5 YR 3/1).	27804				
18		SANDSTONE: boulder, very pale brown (10 YR 7/4), moderatly weathered (W3), hard (H4), strong (R4).	26812				
19			26626				
19.5		POORLY GRADED GRAVEL WITH SAND (GP): Gravels are sandstone, angular to subangular, pale brown (10 YR 7/4), sand is fine to coarse.					
20		increase in large boulders and cobbles.	26092				
20.5		SANDSTONE: brownish yellow, slightly weathered (W2), hard (H3), very strong (R5).					
21			23300				
22		SANDSTONE: yellow, fresh (W1), hard (H3), to very hard (H4), very strong (R5)	23288				
23			22302				
24			21664				
25		Terminated borehole at 25 ft. below ground surface in fresh sandstone bedrock.					
26							



Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

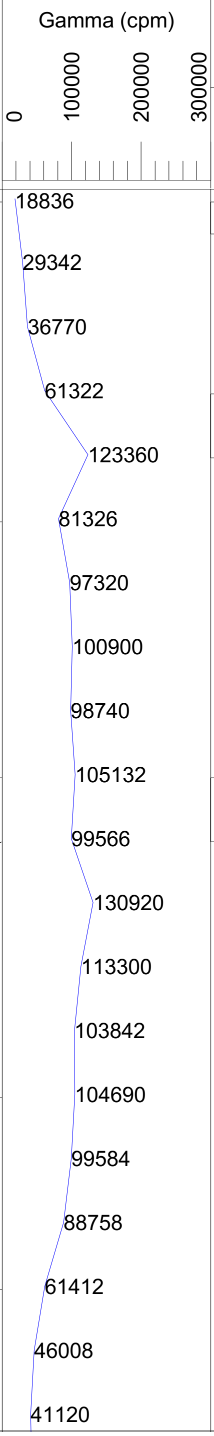
Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-031**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599586.26 NORTHING: 4011545.64
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 35 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): gray (10 YR 5/1), fine to coarse sand, gravels are angular to subrounded, loose, dry, unconsolidated. Borehole located in wastepile.
5	gravels changing to sandstone of assorted colors.
9	POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): fine to coarse sand, consolidated, dry, some cohesive soils.
10	NO RECOVERY
14	POORLY GRADED SAND WITH GRAVELS (SP): dark gray (10 YR 4/1), fine to coarse sands, loose, dry, unconsolidated, sandstone gravels of assorted colors, coal.
*17	POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): fine to medium grained sands, partialy consolidated, gravels are siltsone, angular to subangular, some cohesive soils.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-031-01	0-0.5	grab	🟨	2.91
S078-SCX-031-05	3-4	grab	🟨	8.00
S078-SCX-031-02	9-10	grab	🟨	17.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample comp = composite sample

- - - - = approximate contact

* Based on field observations, waste material was estimated to extend up to 17 ft. BGS.

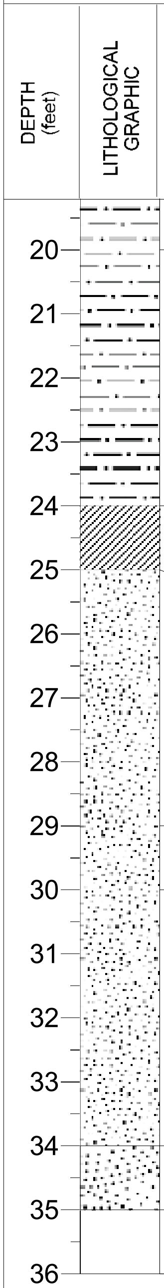
BOREHOLE ID:	**S078-SCX-031**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

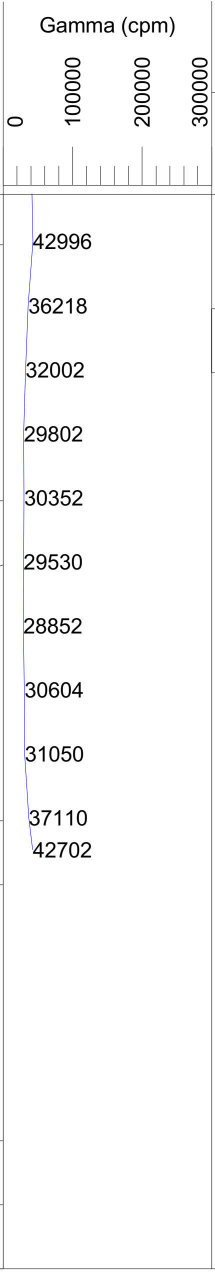
COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599586.26 NORTHING: 4011545.64
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 35 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
20	increase in consolidation, no siltsone gravels, some small goal gravels.
24	FAT CLAY WITH SAND (CH): grayish brown (10 YR 5/2), stiff, medium to high plasticity, dry, some sands fine to medium grained, traces of small gravels.
25	POORLY GRADED SAND WITH GRAVELS (SP): Brown (10 YR 4/3), fine to coarse sand, loose dry, unconsolidated, some cobbles and boulders.
29	with clays and fines.
30	increasing sandstone boulders.
34	SANDSTONE: yellow, fresh (W1), hard (H3), strong (R4).
35	Terminated borehole at 35 ft. below ground surface in fresh sandstone bedrock.

LITHOLOGICAL GRAPHIC



Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-031-04	21-22	grab 🟨	8.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

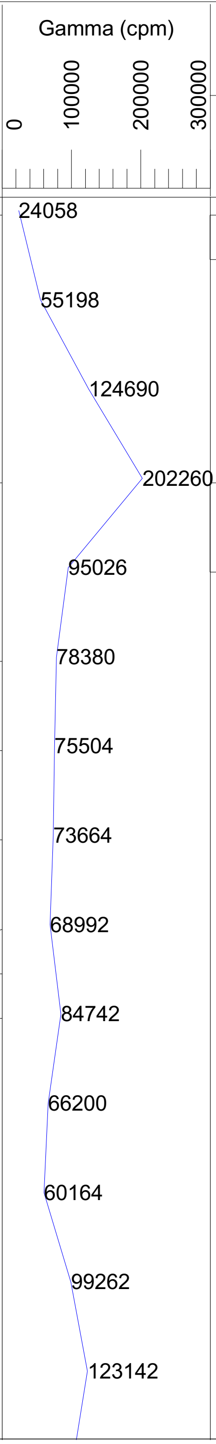
BOREHOLE ID: **S078-SCX-032**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599603.88 NORTHING: 4011534.55
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 27 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): dark yellowish brown (10 YR 4/4), loose, dry, fine to coarse sands, unconsolidated, gravels small to large, assorted rock types, sandstone, siltstone, angular to subangular.
3	SANDSTONE: boulder.
5	POORLY GRADED SAND WITH GRAVEL AND CLAYS (SP-SC): becoming consolidated, low to medium plasticity.
6	cobbles
7	POORLY GRADED SAND WITH GRAVEL (SP): very dark gray (10 YR 3/1), loose, dry, fine to coarse sands, unconsolidated, gravels small to large, assorted rock types, sandstone, siltstone, coal, angular to subangular.
8	grayish brown (10 YR 5/2).
8.5	very dark gray (10 YR 3/1).
9	grayish brown (10 YR 5/2).

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-032-01	0-0.5	grab	3.23
S078-SCX-032-02	3-4	grab	47.70

Notes: cpm = counts per minute
pCi/g = picocuries per gram

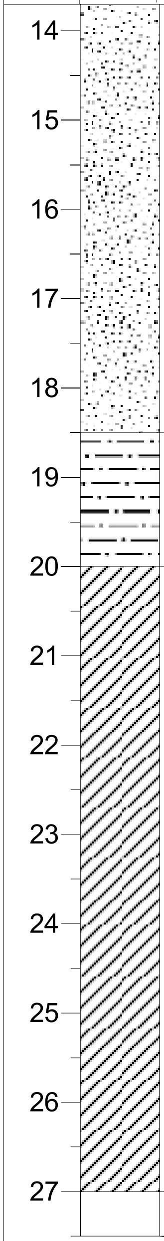
grab = grab sample
comp = composite sample

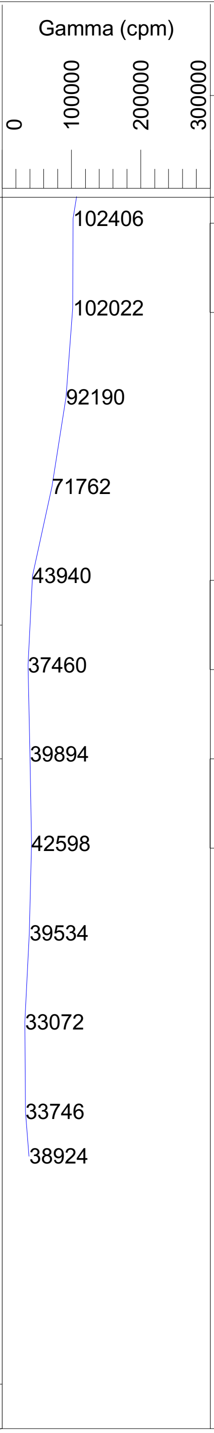
- - - - = approximate contact

BOREHOLE ID:	**S078-SCX-032**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling	COORDINATE SYSTEM:	NAD 1983 UTM Zone 12N		
DRILLING METHOD:	Rotary Sonic	EASTING:	599603.88	NORTHING:	4011534.55
DRILLING EQUIPMENT:	Geoprobe 8140LC	DATE STARTED:	10/16/2017	DATE STARTED:	10/16/2017
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter	TOTAL DEPTH (ft.):	27	BOREHOLE ANGLE:	90 degrees
		LOGGED BY:	Michael Ward		

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
18.5–20	POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): fine to coarse sand, consolidated, dry, low plasticity, low density.
20–27	LEAN CLAY WITH SAND (CL): low plasticity, medium stiff, dry, with trace gravels, grayish brown (10 YR 5/2), with thin black lenses of clay. Lenses are less than 3.0 mm wide, variable.
27	Terminated borehole due to collapse 27 ft. below ground surface.





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-032-03	14-15	grab	4.74
S078-SCX-032-04	18-19	grab	2.47
S078-SCX-032-05	20-21	grab	15.90

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

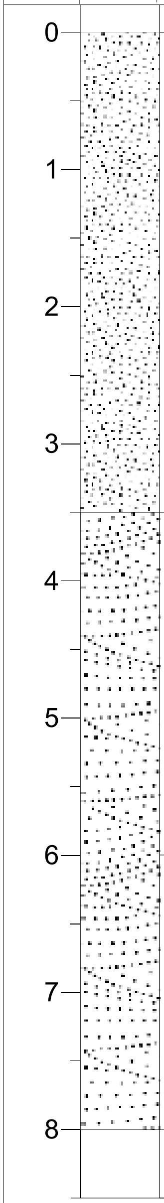
NAVAJO NATION
AUM Environmental Response Trust-First Phase

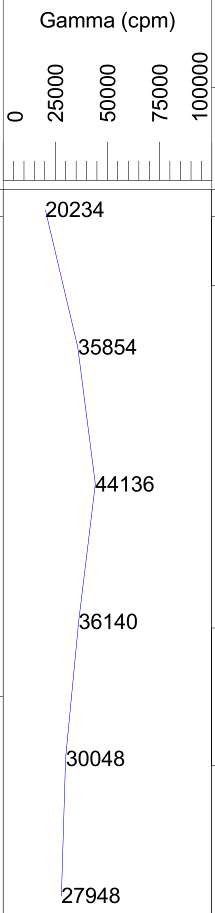
BOREHOLE ID: **S078-SCX-033**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599602.89 NORTHING: 4011524.26
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 8 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): grayish brown (10 YR 5/2), fine to coarse sands, loose, dry, gravels are sandstone, shale.
3.5	SANDSTONE: yellow (10 YR 8/6), slightly weathered (W2), moderate to hard (H4-H3), medium strong (R3).
6	becoming fresh (W1), hard (H3), very strong (R5).
8	Terminated borehole at 8 ft. below ground surface in sandstone bedrock.





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-033-01	0-0.5	grab	2.76
S078-SCX-033-02 S078-SCX-233-02	3-4	grab	2.88 3.08

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

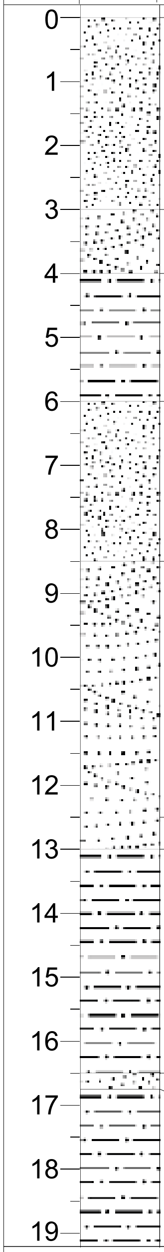
BOREHOLE ID: **S078-SCX-034**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599610.08 NORTHING: 4011542.99
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 35 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): brown (10 YR 5/3), sand fine to coarse, dry, loose, unconsolidated, gravels are angular to subrounded, with roots.

SANDSTONE: cobble.

POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): grayish-brown (10 YR 5/2), consolidated, slightly dense, low plasticity fines, gravels are sandstone, rounded to angular.

POORLY GRADED SAND WITH GRAVEL (SP): dark gray (10 YR 4/1), loose, fine to coarse grains are assorted type and color, sandstone, calcium carbonate stains.

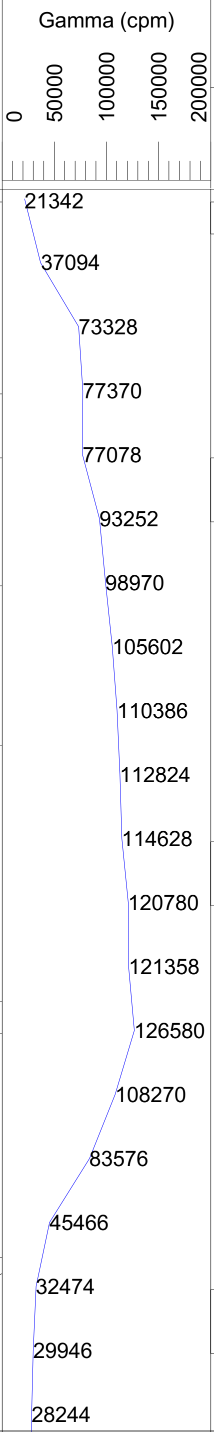
SANDSTONE: boulder.

SANDSTONE: boulder (12.5-13.0).

POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): dark gray (10 YR 4/2), fine to coarse sands, semi consolidated, trace siltstone gravels.

SANDSTONE: boulder.

POORLY GRADED SANDS WITH GRAVEL AND CLAYS (SP-SC): fine to medium grained sands, consolidated, low density, low plasticity, gravels are siltstone, sandstone, coal, assorted color, yellowish brown (10 YR) 5/4).



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-034-01	0-0.5	grab	🟨	3.81
S078-SCX-034-02	4-5	grab	🟨	23.90
S078-SCX-034-03	10-11	grab	🟨	19.90
S078-SCX-034-04	17-18	grab	🟨	3.02

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

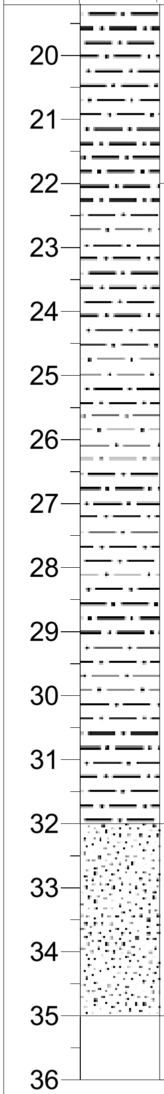
Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-034**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599610.08 NORTHING: 4011542.99
DATE STARTED: 10/16/2017 DATE STARTED: 10/16/2017
TOTAL DEPTH (ft.): 35 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

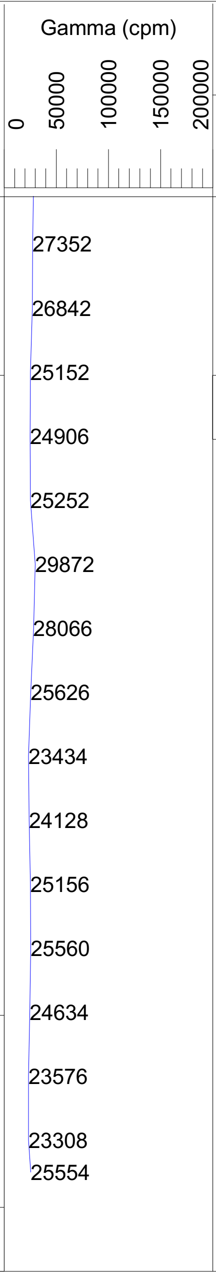


LITHOLOGICAL DESCRIPTION

22 ft: Clays becoming more dense, brown (10 YR 5/3), some observed black lenses, thin 3 mm from 22-30 ft. below ground surface.

32 ft: POORLY GRADED SAND WITH GRAVEL (SP): yellowish brown (10 YR 5/4), fine to coarse sands, loose, dry, unconsolidated gravels are mostly sandstone, trace siltstone.

35 ft: Terminated borehole at 35 ft. below ground surface in lower gamma measurements.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-034-05	22-23	grab	1.90

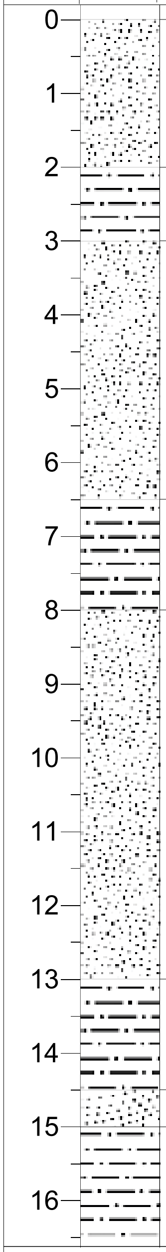
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-035**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599645.47 NORTHING: 4011514.95
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 30 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVELS (SP): brown (10 YR 4/3), fine to coarse sand, loose, dry, unconsolidated, assorted gravel types, sandstone and siltstone, angular to subrounded.

POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): consolidated, variable trace colors, white (10 YR 8/1), red (2.5 YR 5/6), low plasticity.

POORLY GRADED SAND WITH GRAVELS (SP): brown (10 YR 4/3), fine to coarse sand, loose, dry, unconsolidated, assorted gravel types, sandstone and siltstone, angular to subrounded.

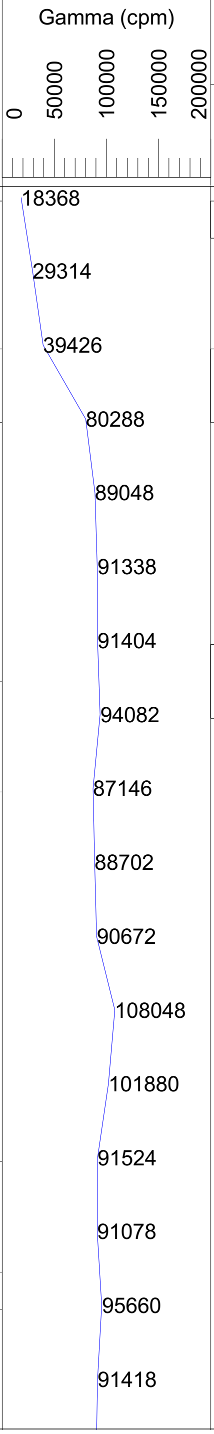
POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): consolidated, variable trace colors, white (10 YR 8/1), red (2.5 YR 5/6), low plasticity.

POORLY GRADED SAND WITH GRAVELS (SP): brown (10 YR 4/3), fine to coarse sand, loose, dry, unconsolidated, assorted gravel types, sandstone and siltstone, angular to subrounded, sandstone cobbles and boulders.

POORLY GRADED SAND WITH GRAVELS AND CLAY (SP-SC): consolidated, variable trace colors, white (10 YR 8/1), red (2.5 YR 5/6), low plasticity.

SANDSTONE: boulder.

POORLY GRADED SAND WITH CLAYS (SP-SC): dark gray (10 YR 4/1), fine to medium grained sands, consolidated, low density, low plasticity, some thin black silt/coal lenses.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-035-01	0-0.5	grab	🟨	2.37
S078-SCX-035-05	2-3	grab	🟨	21.70
S078-SCX-035-02	6-7	grab	🟨	13.60

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

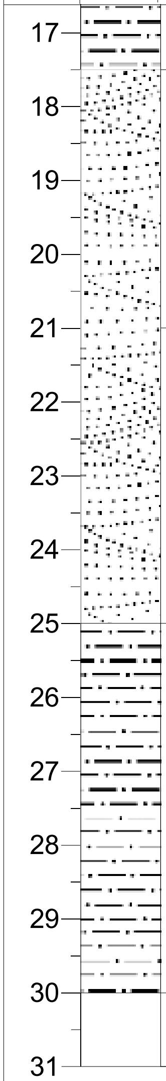
BOREHOLE ID: **S078-SCX-035**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599645.47 NORTHING: 4011514.95
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 30 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC



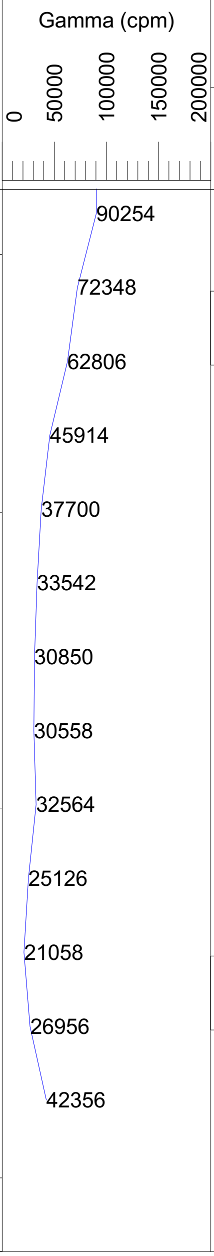
LITHOLOGICAL DESCRIPTION

SANDSTONE: boulder, very pale brown (10 YR 7/4), highly weathered (W4), moderately hard (H4), weak (R2).

SANDSTONE: boulder, yellow (10 YR 8/8), slightly weathered (W2), hard (H3), strong (R4).

POORLY GRADED SAND WITH CLAYS (SP-SC): dark gray (10 YR 4/2), sands fine to coarse, consolidated, low density, low plasticity clays, thin black lenses, trace siltsone gravels, small gravels.

Terminated borehole at 30 ft. below ground surface. Field geologist terminated boring within undisturbed native material.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-035-03	18-19	grab	1.68
S078-SCX-035-04	27-28	grab	2.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

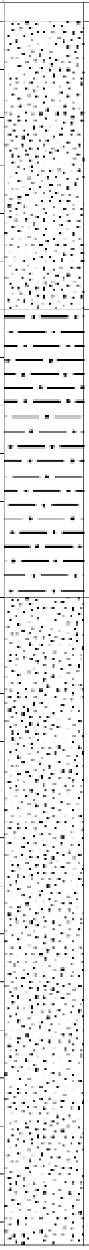
BOREHOLE ID: **S078-SCX-036**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599644.49 NORTHING: 4011515.57
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

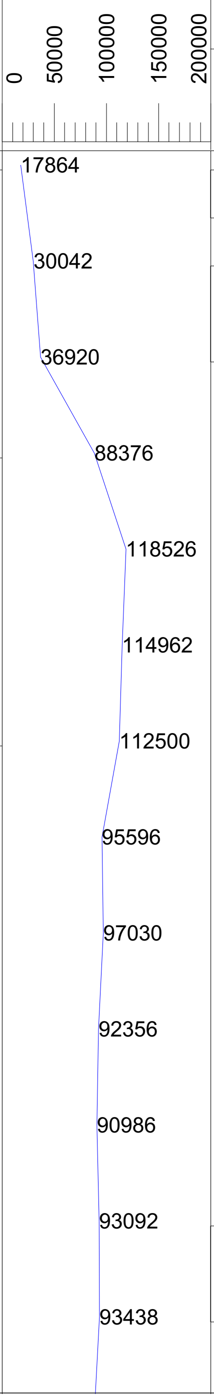
LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): gray (10 YR 5/1), fine to coarse sand, loose, dry, unconsolidated, gravels are angular to subangular, gravels are small to large.
3	POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): very dark gray (10 YR 3/1), fine to coarse sands, loose, dry, unconsolidated, increase in fines with clays, low plasticity.
6	POORLY GRADED SAND WITH GRAVEL (SP): gray (10 YR 5/1), fine to coarse sand, loose, dry, unconsolidated, gravels are angular to subangular, gravels are small to large, few cobbles.

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-036-01	0-0.5	grab	2.59
S078-SCX-036-02 S078-SCX-236-02	1-2	grab	3.06 3.01
S078-SCX-036-03	11-12	grab	8.20

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

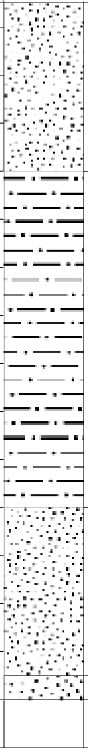
BOREHOLE ID: **S078-SCX-036**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

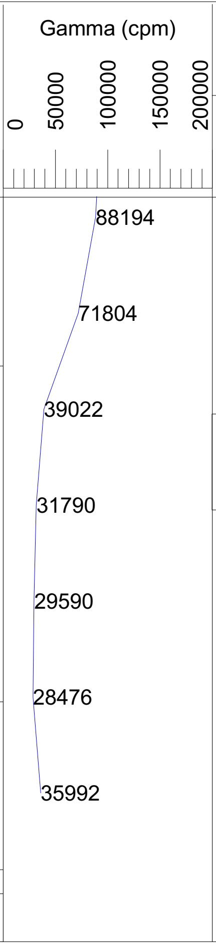
DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599644.49 NORTHING: 4011515.57
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
13	
14	
14.5	POORLY GRADED SAND WITH CLAYS (SP-SC): fine to medium grained sands, semi consolidated, low density, some thin black lenses, grayish brown (10 YR 5/2), trace gravels are mainly black coal, small size.
15	
16	
17	
18	POORLY GRADED SAND WITH GRAVELS (SP): brown gray (10 YR 5/2), fine to coarse sands, loose, dry, unconsolidated gravels are mostly sandstone with some black coals.
19	
19.75	SANDSTONE: cobbles.
20	Terminated borehole at 20 ft. below ground surface in native material.

LITHOLOGICAL GRAPHIC





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-036-04	15-16	grab	1.74

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

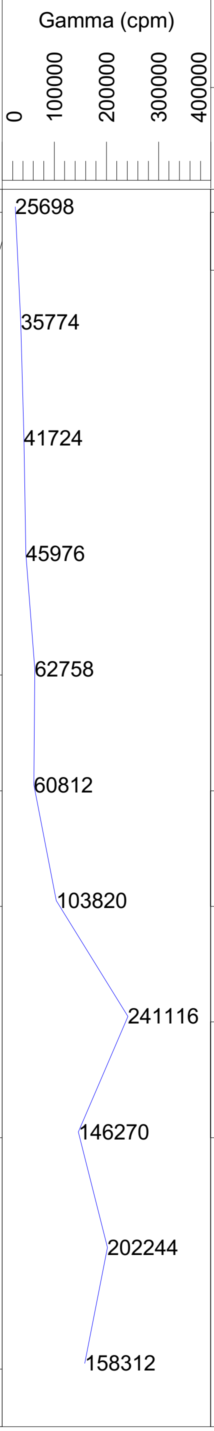
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-037**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599560.83 NORTHING: 4011622.29
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 10 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL AND COBBLES (SP): yellowish brown (10 YR 5/4), fine to coarse sand, loose, dry, unconsolidated organics and roots.
0.8	SANDSTONE: cobbles and gravels, angular to subangular.
4	POORLY GRADED SAND WITH GRAVELS AND CLAY (SP-SC): brown (10 YR 4/3), dry, semi consolidated, low to no plasticity in clays, low density.
5	gray (10 YR 6/1).
6	increase in clay content, light browish-gray (10 YR 6/2), consolidated, low density.
8	SANDSTONE: pale brown (10 YR 6/3), high to moderately weathered (W3-W4), moderately hard (W4), medium strong (R3), medium to coarse gained matrix sandstone.
10	Terminated borehole at 10 ft. below ground surface in sandstone bedrock.



Depth (feet)	Gamma (cpm)
0	25698
1	35774
2	41724
3	45976
4	62758
5	60812
6	103820
7	241116
8	146270
9	202244
10	158312

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-037-01	0.5	grab	4.77
S078-SCX-037-02	5-6	grab	134.00
S078-SCX-037-03	7-8	grab	13.4

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

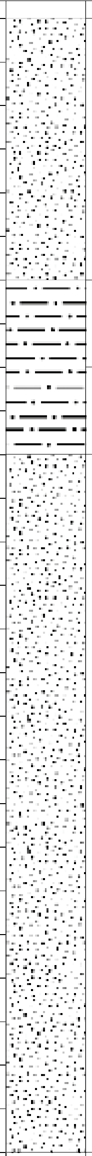
NAVAJO NATION
AUM Environmental Response Trust-First Phase

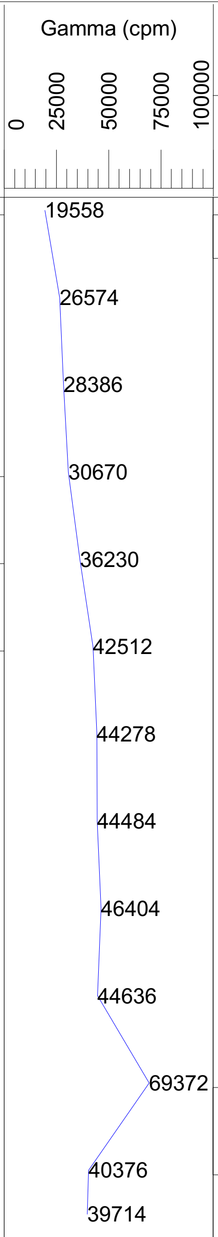
BOREHOLE ID: **S078-SCX-038**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599509.63 NORTHING: 4011558.06
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 13 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND WITH GRAVEL (SP): yellowish brown (10 YR 5/4), loose, dry, unconsolidated, fine to coarse sands, mostly sandstone gravels.
3	POORLY GRADED SAND WITH GRAVEL AND CLAYS (SP-SC): fine to coarse sands, semi consolidated, low density, with sandstone cobbles, yellow (10 YR 5/4).
4	light yellowish brown (10 YR 6/4), low to medium density, gravels are siltstone, coal, trace white calcium carbonate.
5	POORLY GRADED SAND WITH GRAVEL (SP): yellowish brown (10 YR 5/4), loose, dry, unconsolidated, fine to coarse sands, increasing gravel matrix, sandstone and siltstone gravels.
13	Terminated borehole at 13 ft. below ground surface. Field geologist terminated boring within undisturbed native material.





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-038-01 S078-SCX-238-01	0-0.5	grab	2.01 2.30
S078-SCX-038-02	10-11	grab	6.47

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

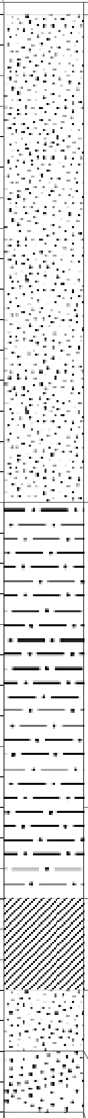
Stantec

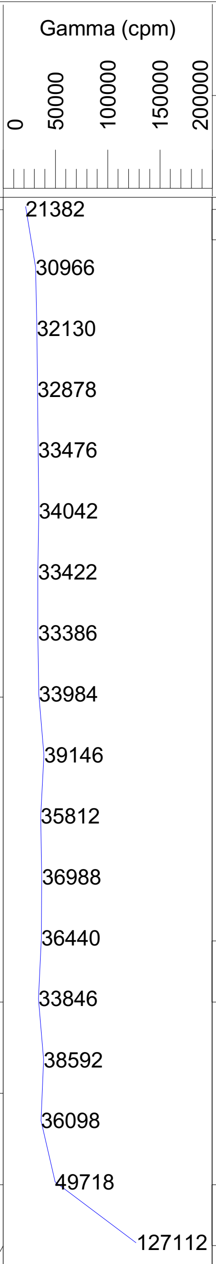
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-039**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599446.44 NORTHING: 4011549.72
DATE STARTED: 10/17/2017 DATE STARTED: 10/17/2017
TOTAL DEPTH (ft.): 18 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward





SUBSURFACE SAMPLE INFORMATION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown (10 YR 5/8), loose, dry, unconsolidated, fine sands, trace gravels, gravels are sandstone and siltstone, some organics and roots.	21382	S078-SCX-039-01	0-0.5	grab	3.24
1		30966				
2		32130				
3		32878				
4		33476				
5		34042				
6		33422				
7		33386				
8	POORLY GRADED SAND WITH CLAY (SP-SC): semi consolidated, low density, low plasticity, trace gravels.	33984				
9		39146				
10		35812				
11		36988				
12		36440	S078-SCX-039-03	12-13	grab	5.05
13	increasing clay content, moderately dense.	33846				
14		38592				
15	FAT CLAY WITH SAND (CH): pale brown (10 YR 6/3), high plasticity, stiff, sands are fine to medium grained.	36098				
16	POORLY GRADED SAND (SP): pale brown (10 YR 6/3), fine to medium grained sand, loose, moist, trace gravels, sandstone and siltstone, subangular to subrounded.	49718	S078-SCX-039-02	16-17	grab	6.94
17		127112				
18	SANDSTONE: light brownish gray (10 YR 6/2), moderately weather (W3), moderately hard (H4), medium strong (R3), sandstone medium grained matrix with some trace interbedded black fines.					
19	Terminated borehole at 18 ft. below ground surface in sandstone bedrock.					
20						

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

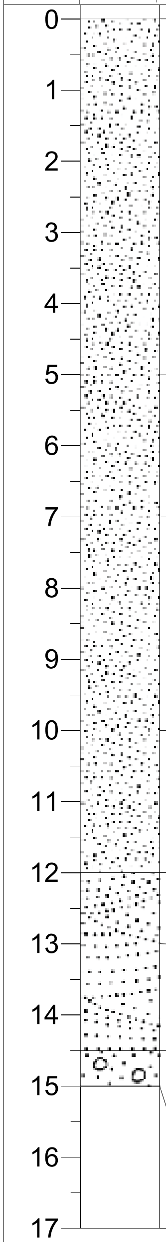
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-040**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599381.03 NORTHING: 4011565.07
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 15 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND (SP): brown (10 YR 5/3), loose, dry, unconsolidated, fine to coarse, mostly fine, trace small gravels.

increasing gravels to 10%, small to large, subangular to subrounded.

decrease in gravels to less than 5%.

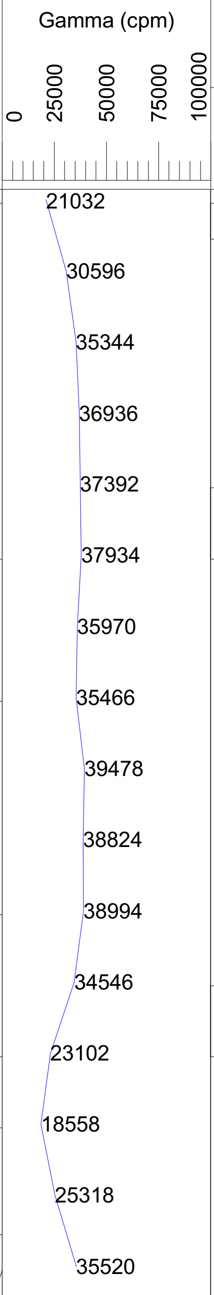
increase in gravels, small to large, cobbles are angular to rounded.

SANDSTONE: boulder, very pale brown (10 YR 8/2), slightly weathered (W2), then fresh after 6 inches (W1), hard (H3), very strong (R5).

yellow (10 YR 7/6).

POORLY GRADED GRAVEL WITH SAND (GP): small to large gravels, angular to subangular, loose, sandstone gravels, fine to coarse sand, light yellowish brown (10 YR 6/4).

Terminated borehole at 15 ft. below ground surface. Field geologist terminated boring within undisturbed native material.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-040-01	0-0.5	grab	4.54
S078-SCX-040-02	4-5	grab	4.69
S078-SCX-040-03	11-12	grab	2.49

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

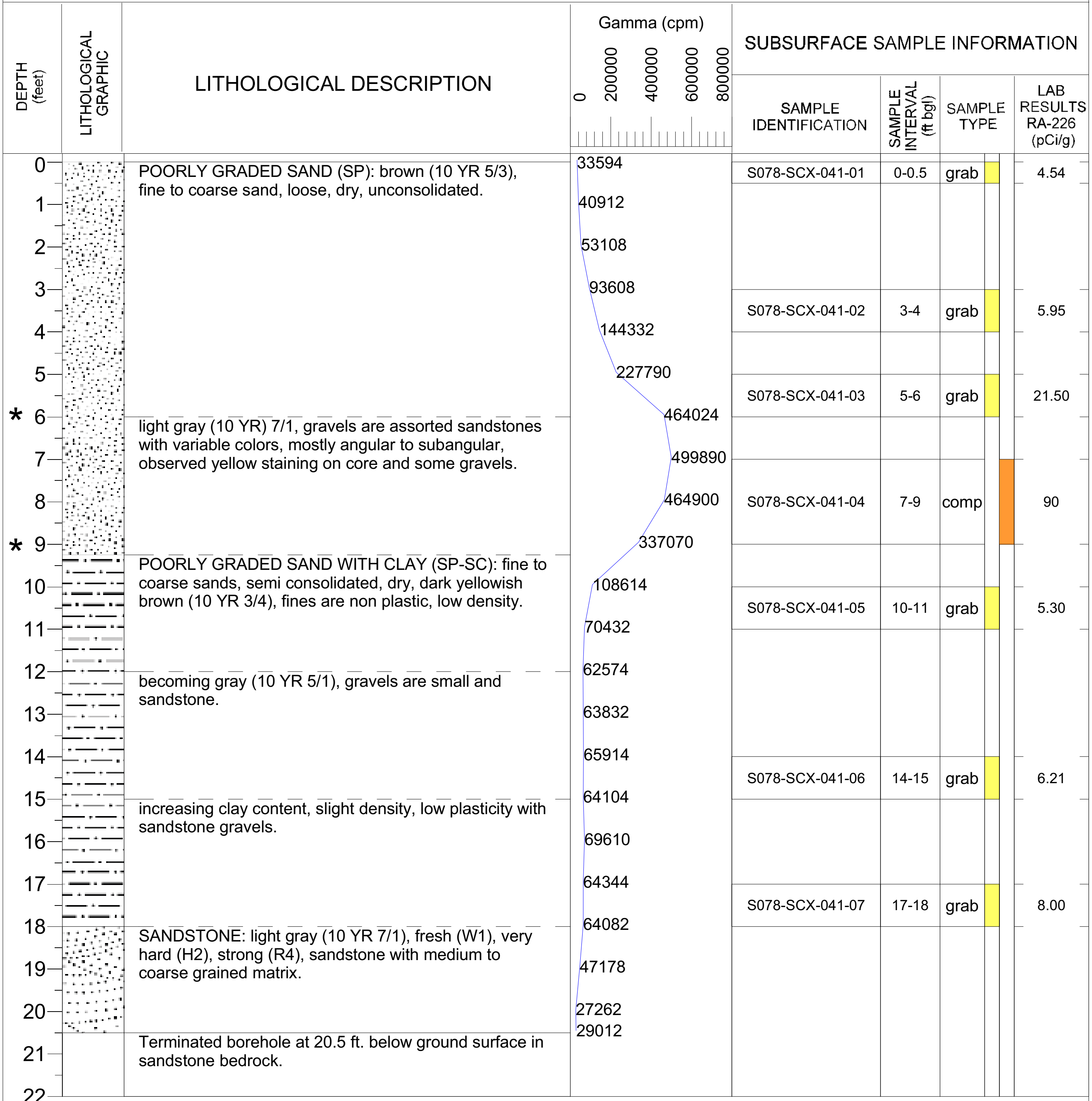
Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-041**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599373.42 NORTHING: 4011530.83
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 20.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to coarse sand, loose, dry, unconsolidated.

light gray (10 YR) 7/1, gravels are assorted sandstones with variable colors, mostly angular to subangular, observed yellow staining on core and some gravels.

POORLY GRADED SAND WITH CLAY (SP-SC): fine to coarse sands, semi consolidated, dry, dark yellowish brown (10 YR 3/4), fines are non plastic, low density.

becoming gray (10 YR 5/1), gravels are small and sandstone.

increasing clay content, slight density, low plasticity with sandstone gravels.

SANDSTONE: light gray (10 YR 7/1), fresh (W1), very hard (H2), strong (R4), sandstone with medium to coarse grained matrix.

Terminated borehole at 20.5 ft. below ground surface in sandstone bedrock.

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE			LAB RESULTS RA-226 (pCi/g)
S078-SCX-041-01	0-0.5	grab	🟨		4.54
S078-SCX-041-02	3-4	grab	🟨		5.95
S078-SCX-041-03	5-6	grab	🟨		21.50
S078-SCX-041-04	7-9	comp		🟧	90
S078-SCX-041-05	10-11	grab	🟨		5.30
S078-SCX-041-06	14-15	grab	🟨		6.21
S078-SCX-041-07	17-18	grab	🟨		8.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact
* Observed waste pile estimated from 6 to 9 ft. BGS.

Stantec

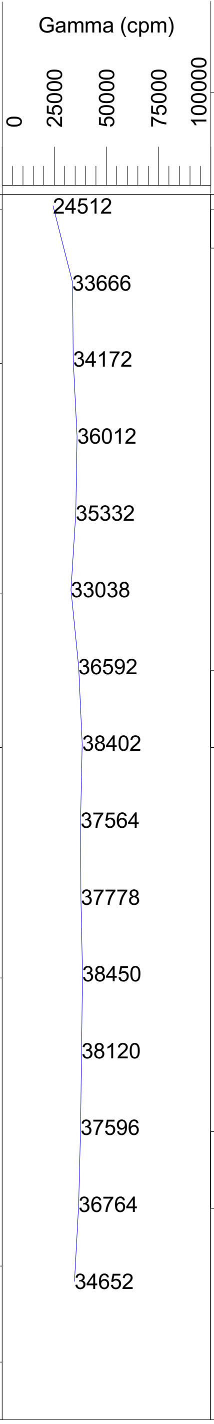
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-042**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599356.35 NORTHING: 4011530.21
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 15 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, trace gravel, sandstone gravel, organics and roots.
2	trace clays, low consolidation.
5	increasing gravel, angular to subrounded.
7	POORLY GRADED SAND WITH GRAVEL (SP): light gray (10 YR 7/1), fine to coarse sand, loose, dry, gravels are sandstone, angular to subangular, variable colors, trace yellow.
10	increasing gravels, sandstone gravels.
13.75	SANDSTONE: very pale brown (10 YR 8/4), fresh (W1), hard (H3), very strong (R5), fine to coarse sand grained matrix in sandstone.
15	Terminated borehole at 15 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-042-01	0-0.5	grab	5.20
S078-SCX-042-02	6-7	grab	3.10
S078-SCX-042-03	12-13	grab	3.57

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

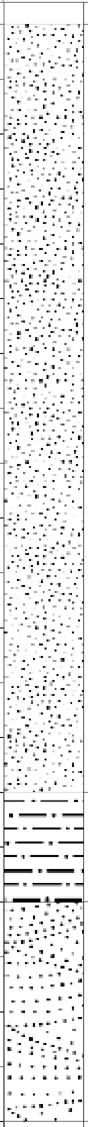
Stantec

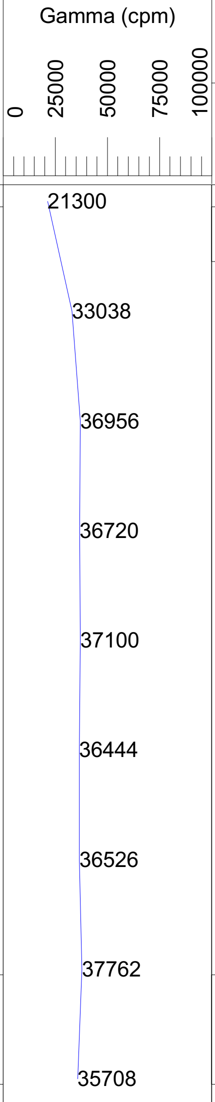
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-043**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599370.16 NORTHING: 4011515.3
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 10 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward





SUBSURFACE SAMPLE INFORMATION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to coarse sands, loose, dry, unconsolidated with roots and organics.	S078-SCX-043-01 S078-SCX-243-01	0-0.5	grab	4.88 4.15
7	POORLY GRADED SAND WITH GRAVELS AND CLAY (SP-SC): fine to coarse sand, semi consolidated, low density, gravels are small, sandstone and trace siltstone, low plasticity, trace white.	S078-SCX-043-02	7-8	grab	2.96
8	SANDSTONE: yellow (10 YR 8/6), fresh (W1), hard (H2), strong (R4), medium grained sand matrix in sandstone.				
10	Terminated borehole at 10 ft. below ground surface in sandstone bedrock.				
11					

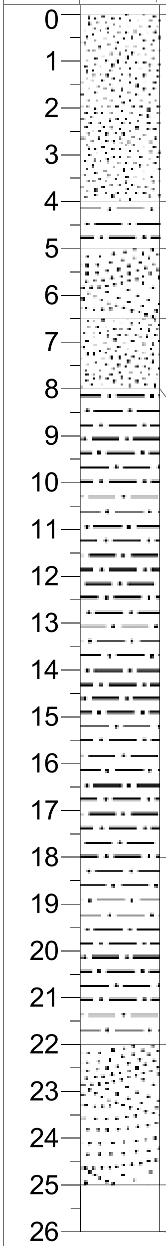
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-044**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599331.53 NORTHING: 4011525.39
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 25 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet) | LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, trace gravel sandstone.

POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), fine to medium grained sand, loose, dry.

SANDSTONE: boulder

POORLY GRADED SAND WITH GRAVEL (SP): pale brown (10 YR 6/5), loose, dry, fine to coarse sands, gravels are mostly small, angular to subangular, sandstone gravels.

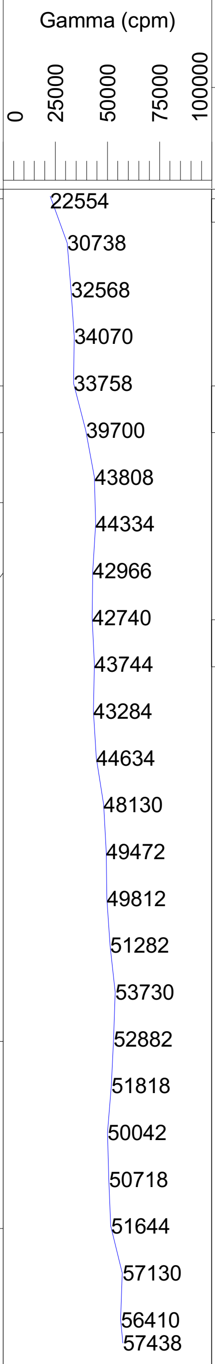
POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): pale brown (10 YR 6/5), loose, dry, fine to coarse sands, gravels are mostly small, low density, non plastic with some trace white (10 YR 8/1).

becoming moderately dense.

SANDSTONE: very pale brown (10 YR 8/2), hard.

Terminated borehole at 25 ft. below ground surface in bedrock.

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-044-01	0-0.5	grab 🟨	3.76
S078-SCX-044-02	4-5	grab 🟨	3.17
S078-SCX-044-03	9-10	grab 🟨	4.14

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

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NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-045**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599360.48 NORTHING: 4011586.89
DATE STARTED: 10/18/2017 DATE STARTED: 10/18/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

LITHOLOGICAL GRAPHIC

LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to coarse sand, dry, loose, unconsolidated.

POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), fine to medium grained sand, loose, dry, low density, non plastic, semi consolidated.

POORLY GRADED SAND WITH GRAVEL (SP): light brownish gray (10 YR 6/2), loose, dry, unconsolidated.

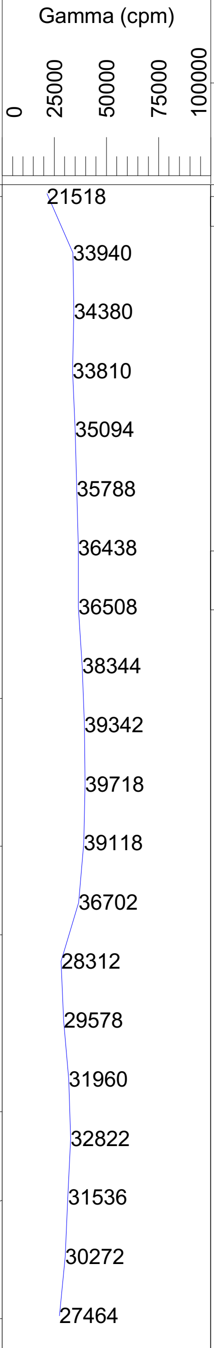
SANDSTONE: boulder.

POORLY GRADED SAND WITH GRAVELS AND CLAYS (SP-SC): light yellowish brown (10 YR 6/4), fine to coarse sands, dry, semi consolidated, gravels are sandstone, angular to subangular.

SANDSTONE: very pale brown (10 YR 8/4), moderately weathered (W3), hard (H3), strong, (R4), medium to coarse grained sand matrix.

becoming fresh (W1).

Terminated borehole at 20 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-045-01	0-0.5	grab 🟨	5.56
S078-SCX-045-02	6-7	grab 🟨	4.16

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

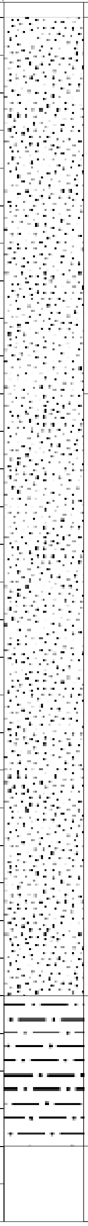
NAVAJO NATION
AUM Environmental Response Trust-First Phase

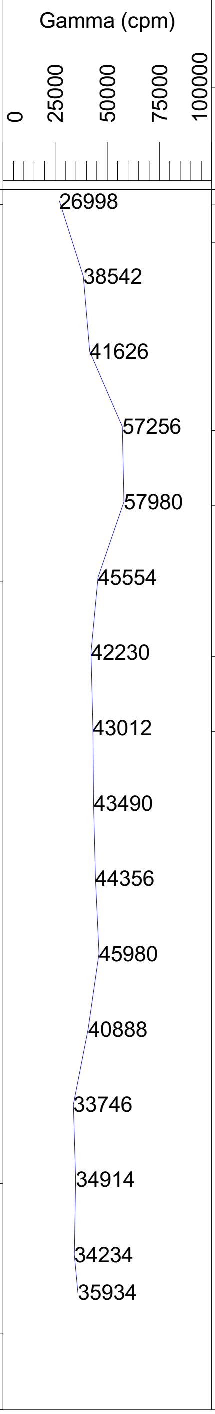
BOREHOLE ID: **S078-SCX-046**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599373.37 NORTHING: 4011540.48
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 15 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), loose, dry, unconsolidated, fine to medium grained sand, organics and roots.
5	increasing gravel content, gravels are sandstone, coal, shales, angular to subrounded, assorted colors, small to medium size.
13	POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): (10 YR 5/3), loose, dry, semi consolidated, fine to medium grained sand, with trace white, nonplastic, low density.
15	Terminated borehole at 15 ft. below ground surface. Termination depth was below observed waste from S078-SCX-041.





SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-046-01	0-0.5	grab 🟨	5.02
S078-SCX-046-02	3-4	grab 🟨	4.43
S078-SCX-046-03	6-7	grab 🟨	3.66

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

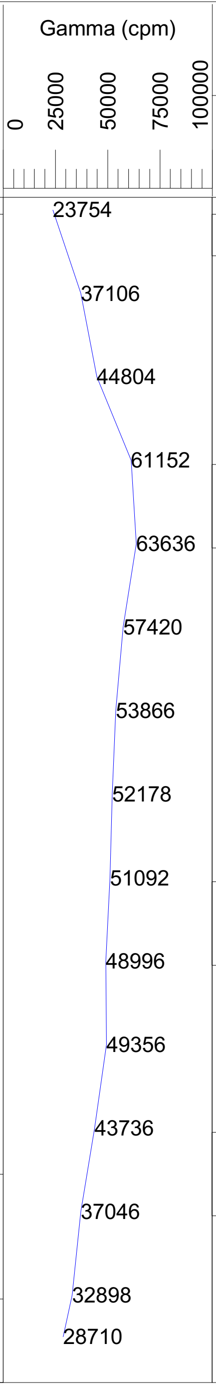
BOREHOLE ID:	**S078-SCX-047**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599375.2	NORTHING:	4011532.48
DATE STARTED:	10/19/2017	DATE STARTED:	10/19/2017
TOTAL DEPTH (ft.):	13	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		

LITHOLOGICAL DESCRIPTION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), loose, dry, unconsolidated, fine to medium grained sand, roots and organics, trace gravels, sandstone, angular to subrounded.
11.5	SANDSTONE: yellow (10 YR 7/6), moderately weather (W3), moderately hard (H4), strong (R4), medium to coarse grained sand matrix.
13	Terminated borehole at 13 ft. below ground surface in hard sandstone.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-047-01	0-0.5	grab	5.14
S078-SCX-047-02	3-4	grab	5.97
S078-SCX-047-03	8-9	grab	4.07
S078-SCX-047-04	11-12	grab	2.67

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

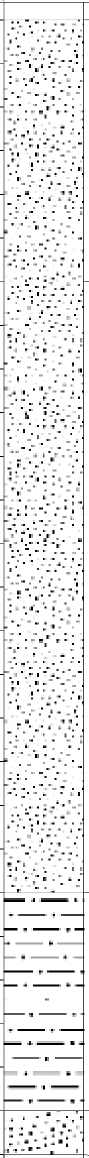
BOREHOLE ID:	**S078-SCX-048**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

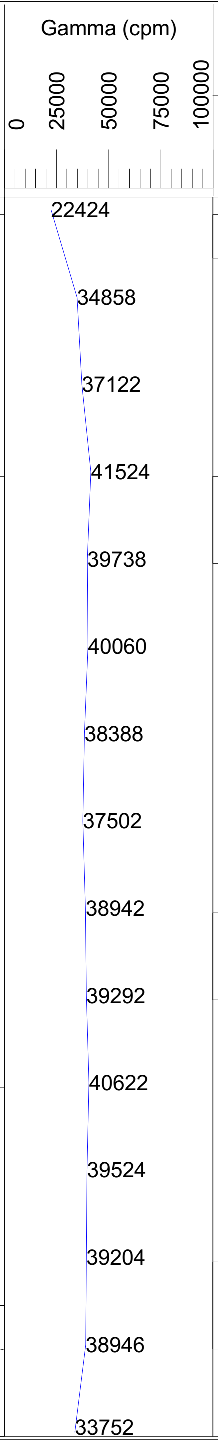
COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599370.99	NORTHING:	4011522.09
DATE STARTED:	10/19/2017	DATE STARTED:	10/19/2017
TOTAL DEPTH (ft.):	13	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to coarse sands, loose, dry, unconsolidated, roots and organics, trace gravel.
3	increase in gravels, poorly graded sand with gravels, gravels are sandstone, siltstone, angular to subrounded, mostly small gravels.
10	POORLY GRADED SAND WITH GRAVELS AND CLAY (SP-SC): brown (10 YR 5/6), trace white (10 YR 8/1), fine to coarse, semi consolidated, dry, gravels are small to large, variable types including sandstone, siltsone, and shales.
12.5	SANDSTONE: very pale brown (10 YR 7/3), moderately weathered (W3), hard (H3), strong (R4).
13	Terminated borehole at 13 ft. below ground surface in sandstone bedrock. Termination depth was below observed waste from S078-SCX-041.

LITHOLOGICAL GRAPHIC



Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-048-01	0-0.5	grab	6.89
S078-SCX-048-02	3-4	grab	5.49
S078-SCX-048-03	8-9	grab	4.28
S078-SCX-048-04	12-13	grab	5.01

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

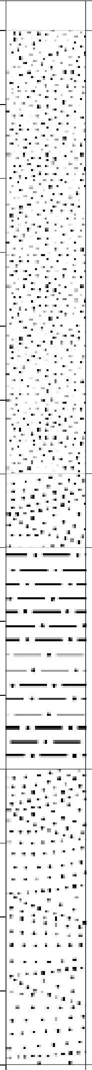
NAVAJO NATION
AUM Environmental Response Trust-First Phase

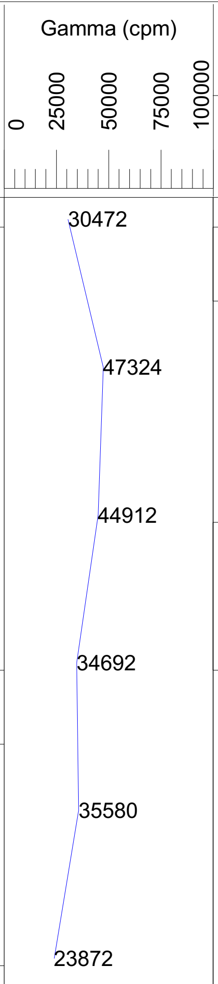
BOREHOLE ID: **S078-SCX-049**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599367.22 NORTHING: 4011530.72
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 7 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sands, loose, dry, unconsolidated, some roots and organics.
3	SANDSTONE: boulder, brownish yellow (10 YR 6/6).
3.5	POORLY GRADED SAND WITH GRAVELS AND CLAY (SP-SC): light grayish brown (10 YR 6/4), fine to medium grained sands, semi consolidated, low density, non plastic, gravels are sandstone.
5	SANDSTONE: yellow (10 YR 8/6), fresh (W1), hard (H3), strong (R4), fine to medium grained sandstone matrix.
7	Terminated borehole at 7 ft. below ground surface in hard sandstone.





SUBSURFACE SAMPLE INFORMATION

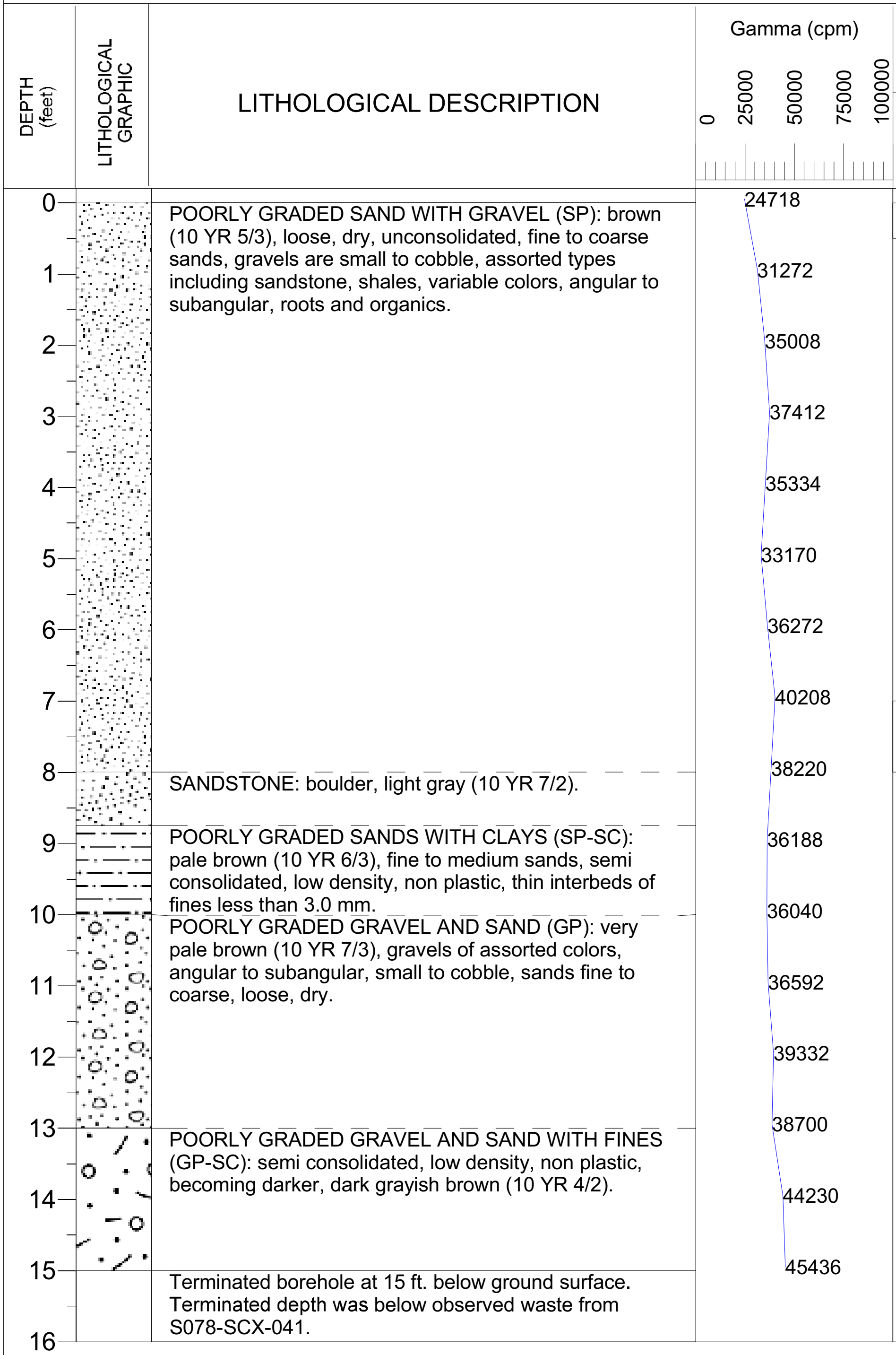
SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-049-01 S078-SCX-249-01	0-0.5	grab	5.25 7.81
S078-SCX-049-02	2-3	grab	4.14

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-050**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599360.78 NORTHING: 4011538.64
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 15 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



LITHOLOGICAL DESCRIPTION

POORLY GRADED SAND WITH GRAVEL (SP): brown (10 YR 5/3), loose, dry, unconsolidated, fine to coarse sands, gravels are small to cobble, assorted types including sandstone, shales, variable colors, angular to subangular, roots and organics.

SANDSTONE: boulder, light gray (10 YR 7/2).

POORLY GRADED SANDS WITH CLAYS (SP-SC): pale brown (10 YR 6/3), fine to medium sands, semi consolidated, low density, non plastic, thin interbeds of fines less than 3.0 mm.

POORLY GRADED GRAVEL AND SAND (GP): very pale brown (10 YR 7/3), gravels of assorted colors, angular to subangular, small to cobble, sands fine to coarse, loose, dry.

POORLY GRADED GRAVEL AND SAND WITH FINES (GP-SC): semi consolidated, low density, non plastic, becoming darker, dark grayish brown (10 YR 4/2).

Terminated borehole at 15 ft. below ground surface. Terminated depth was below observed waste from S078-SCX-041.

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-050-01	0-0.5	grab	🟨	4.18
S078-SCX-050-02	7-8	grab	🟨	6.44

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

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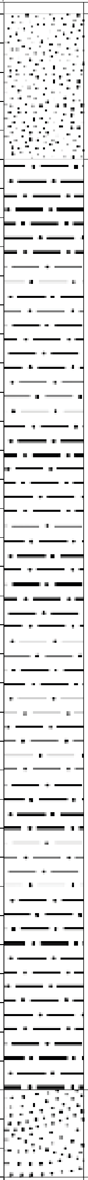
NAVAJO NATION
AUM Environmental Response Trust-First Phase

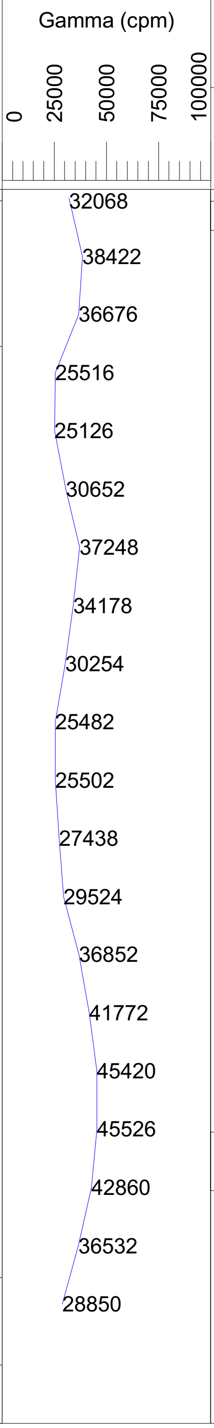
BOREHOLE ID: **S078-SCX-051**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599362.05 NORTHING: 4011619.09
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0–2.5	POORLY GRADED SAND WITH GRAVEL (SP): brown (10 YR 5/3), fine to medium sand, loose, dry, gravels are sandstone, angular to subrounded, roots and organics.
2.5–18.5	POORLY GRADED SAND WITH CLAYS (SP-SC): brown (10 YR 5/5), fine to medium sand, semi consolidated, low density, non plastic, trace gravels consisting of sandstone and coal.
18.5–20	SANDSTONE: pale brown (10 YR 8/2), slightly weathered (W2), hard (H5), strong (R4), fine to medium sand matrix.
20	Terminated borehole at 20 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-051-01	0-0.5	grab	14.40
S078-SCX-051-02	16-17	grab	4.53

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

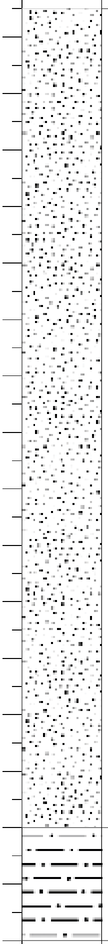
NAVAJO NATION
AUM Environmental Response Trust-First Phase

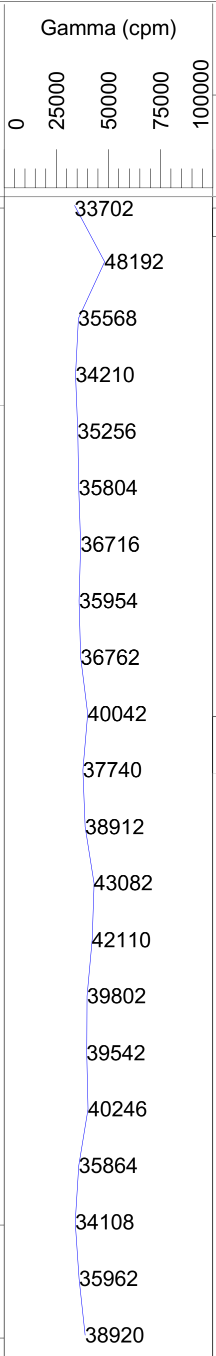
BOREHOLE ID: **S078-SCX-052**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599361.08 NORTHING: 4011619.7
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 20 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	No recovery 0 ft. to 3.5 ft. below ground surface.
3.5	POORLY GRADED SAND WITH GRAVEL (SP): brown (10 YR 5/3), fine to coarse sands, loose, dry.
18	POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): brown (10 YR 5/3), non plastic, low density, trace white and black, gravels are coal or shale.
20	Terminated borehole at 20 ft. below ground surface. Field geologist terminated boring within undisturbed native material.


LITHOLOGICAL GRAPHIC



DEPTH (feet)	Gamma (cpm)
0	33702
1	48192
2	35568
3	34210
4	35256
5	35804
6	36716
7	35954
8	36762
9	40042
10	37740
11	38912
12	43082
13	42110
14	39802
15	39542
16	40246
17	35864
18	34108
19	35962
20	38920

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-052-01	0-0.5	grab	9.40
S078-SCX-052-02	9-10	grab	5.79

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

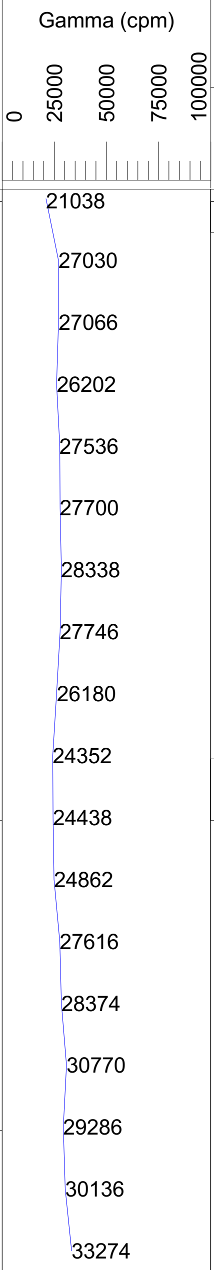
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-053**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599360.14 NORTHING: 4011652.57
DATE STARTED: 10/19/2017 DATE STARTED: 10/19/2017
TOTAL DEPTH (ft.): 18 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sands, loose, dry, unconsolidated, some roots and organics.
10	SANDSTONE: yellow (10 YR 7/8), weathered bedrock.
15	SANDSTONE: yellow (10 YR 7/3), moderately weathered (W3), moderately hard (H3), medium strong (R3), fine to medium grained sand matrix.
18	Terminated borehole at 18 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-053-01	0-0.5	grab 🟨	2.70
S078-SCX-053-02	9-10	grab 🟨	2.01

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

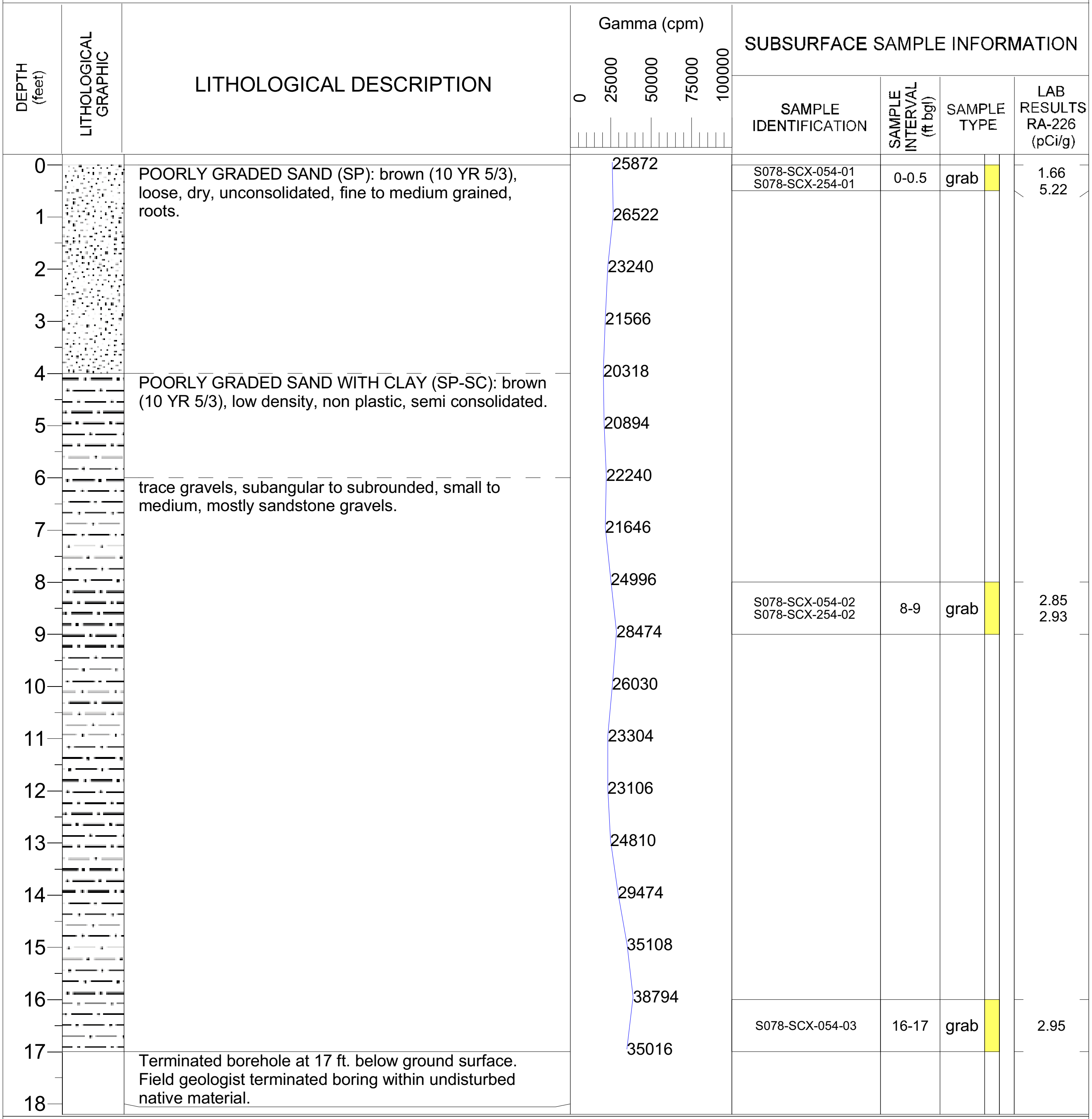
- - - - = approximate contact

Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-054**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599328.52 NORTHING: 4011644.68
DATE STARTED: 10/20/2017 DATE STARTED: 10/20/2017
TOTAL DEPTH (ft.): 17 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward



DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), loose, dry, unconsolidated, fine to medium grained, roots.	25872
1		26522
2		23240
3		21566
4	POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), low density, non plastic, semi consolidated.	20318
5		20894
6	trace gravels, subangular to subrounded, small to medium, mostly sandstone gravels.	22240
7		21646
8		24996
9		28474
10		26030
11		23304
12		23106
13		24810
14		29474
15		35108
16		38794
17	Terminated borehole at 17 ft. below ground surface. Field geologist terminated boring within undisturbed native material.	35016
18		

SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-054-01 S078-SCX-254-01	0-0.5	grab	1.66 5.22
S078-SCX-054-02 S078-SCX-254-02	8-9	grab	2.85 2.93
S078-SCX-054-03	16-17	grab	2.95

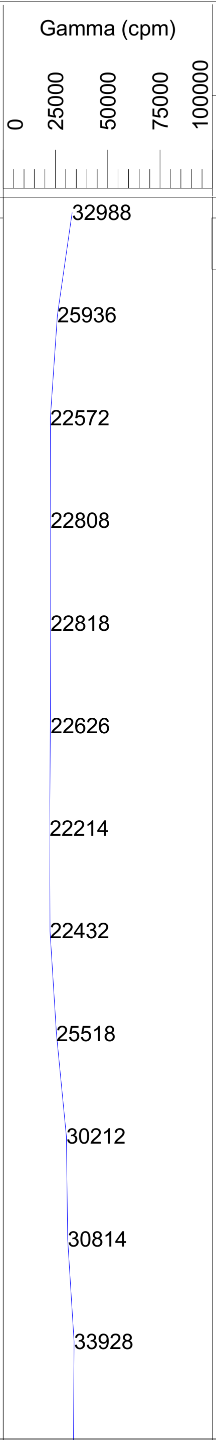
Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-055**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599272.03 NORTHING: 4011523.88
DATE STARTED: 10/20/2017 DATE STARTED: 10/20/2017
TOTAL DEPTH (ft.): 23 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, unconsolidated, roots.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-055-01 S078-SCX-255-01	0-0.5	grab 🟨	15.90 10.00

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

Stantec

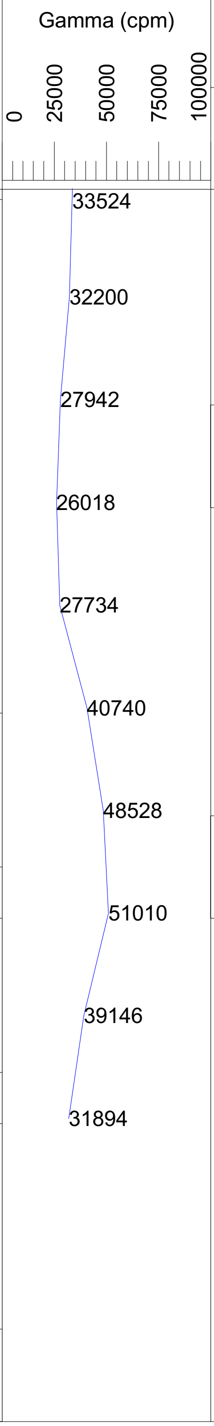
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID:	**S078-SCX-055**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599272.03	NORTHING:	4011523.88
DATE STARTED:	10/20/2017	DATE STARTED:	10/20/2017
TOTAL DEPTH (ft.):	23	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
12	POORLY GRADED SAND WITH CLAY (SP-SC): light brown (10 YR 6/4), fine sands, semi consolidated, non plastic, low density, some bedding, roots, trace white interbeded thin lenses.
17	SANDSTONE: very pale brown (10 YR 7/3), moderately weathered (W3), hard (H3), strong (R3), fine grained sand matrix.
	darker in color dark grayish brown (10 YR 4/2).
19	very pale brown (10 YR 8/2) and some yellow (10 YR 7/8).
	grayish brown (10 YR 4/2).
21	fresh (W1), hard (H3), strong (R4).
23	Terminated borehole at 23 ft. below ground surface in sandstone bedrock.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-055-02	14-15	grab	3.07
S078-SCX-055-03	18-19	grab	5.31

Notes: cpm = counts per minute
pCi/g = picocuries per gram

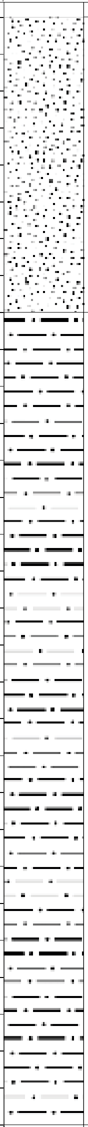
grab = grab sample
comp = composite sample

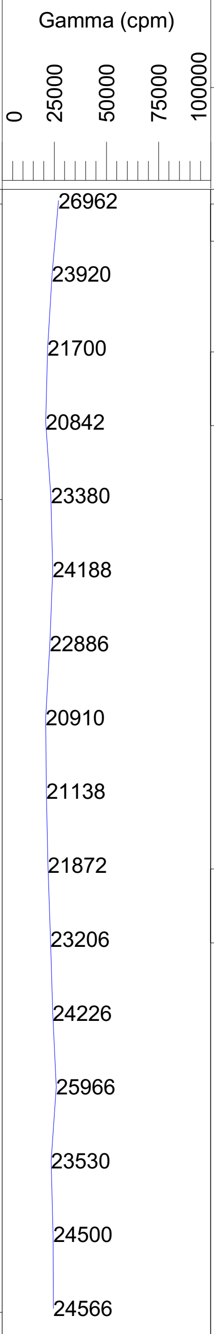
- - - - = approximate contact

BOREHOLE ID: **S078-SCX-056**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599245.86 NORTHING: 4011477.2
DATE STARTED: 10/20/2017 DATE STARTED: 10/20/2017
TOTAL DEPTH (ft.): 15 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward





DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, unconsolidated, roots.	26962	S078-SCX-056-01	0-0.5	grab	2.14
1		23920				
2		21700	S078-SCX-056-02	2-3	grab	1.20
3		20842				
4	POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), fine to medium grained sand, loose, dry, non plastic, low density, semi consolidated.	23380				
5		24188				
6		22886				
7		20910				
8		21138				
9		21872	S078-SCX-056-03	9-10	grab	1.80
10		23206				
11		24226				
12		25966				
13		23530				
14		24500				
15	Terminated borehole at 15 ft. below ground surface in native material.	24566				
16						

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-057**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

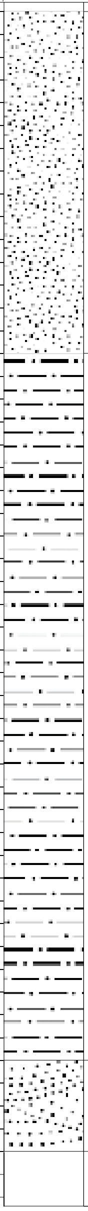
DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599232.36 NORTHING: 4011447.67
DATE STARTED: 10/20/2017 DATE STARTED: 10/20/2017
TOTAL DEPTH (ft.): 25 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

LITHOLOGICAL GRAPHIC



LITHOLOGICAL DESCRIPTION

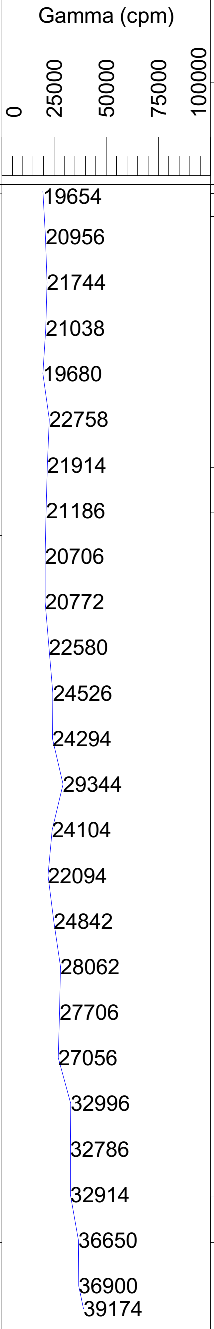
POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, unconsolidated, roots, trace gravel sandstone, coal, siltstones, angular to subrounded, mostly subrounded and planar.

POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), fine to medium grained sand, loose, dry, semi consolidated, low density, non plastic, no gravel.

SANDSTONE: yellowish brown (10 YR 5/4), moderately weathered (W3), moderately hard (H4), strong (R2), medium grained sand matrix.

Terminated borehole at 25 ft. below ground surface in weathered sandstone bedrock.

Gamma (cpm)



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE		LAB RESULTS RA-226 (pCi/g)
S078-SCX-057-01	0-0.5	grab	🟨	2.32
S078-SCX-057-02	6-7	grab	🟨	1.17
S078-SCX-057-03	22-23	grab	🟨	2.88

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

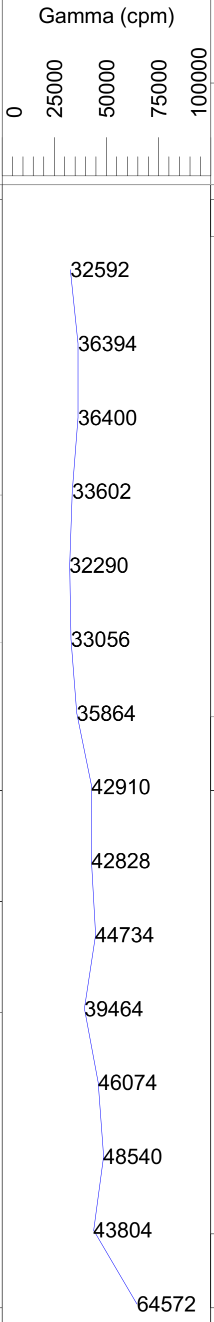
Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID:	**S078-SCX-058**
CLIENT:	NNAUMERT
PROJECT:	Removal Site Evaluation
SITE LOCATION:	Claim 28

DRILLING CONTRACTOR:	Cascade Drilling
DRILLING METHOD:	Rotary Sonic
DRILLING EQUIPMENT:	Geoprobe 8140LC
SAMPLING METHOD:	Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM:		NAD 1983 UTM Zone 12N	
EASTING:	599318.9	NORTHING:	4011484.62
DATE STARTED:	10/20/2017	DATE STARTED:	10/20/2017
TOTAL DEPTH (ft.):	15	BOREHOLE ANGLE:	90 degrees
LOGGED BY:	Michael Ward		



DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm)	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, unconsolidated, roots, trace gravel.		S078-SCX-058-01	0-0.5	grab	3.62
1		32592				
2		36394				
3		36400				
4	with trace clays	33602				
5		32290				
6	POORLY GRADED SAND WITH CLAY (SP-SC): brown (10 YR 5/3), fine to medium grained sand, loose, dry, semi consolidated, low density, non plastic.	33056				
7		35864	S078-SCX-058-02	7-8	grab	4.71
8	POORLY GRADED SAND WITH GRAVEL (SP): yellowish brown (10 YR 5/4).	42910				
9		42828				
9.5	SANDSTONE: very pale brown (10 YR 8/2), highly weathered (W4), moderately hard (H4), medium strong (R3).					
10		44734				
11	fresh (W1), hard (H3), strong (R4), medium to coarse grained sand matrix, very pale brown (10 YR 8/2).	39464				
12		46074				
13		48540				
14		43804	S078-SCX-058-03 S078-SCX-258-03	14-15	grab	8.00 7.80
15	Terminated borehole at 15 ft. below ground surface in sandstone bedrock.	64572				
16						

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

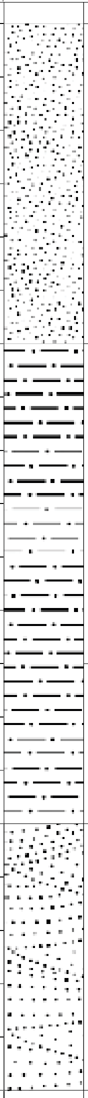
Stantec

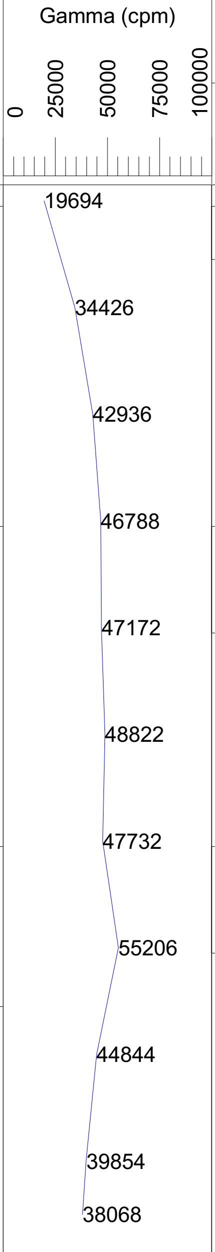
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-059**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Cascade Drilling
DRILLING METHOD: Rotary Sonic
DRILLING EQUIPMENT: Geoprobe 8140LC
SAMPLING METHOD: Sonic Core Barrel, 4 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599361.85 NORTHING: 4011489.69
DATE STARTED: 10/20/2017 DATE STARTED: 10/20/2017
TOTAL DEPTH (ft.): 10 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward





SUBSURFACE SAMPLE INFORMATION

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND WITH GRAVEL (SP): light gray (10 YR 7/1), fine to coarse sand, loose, dry, unconsolidated, roots.	S078-SCX-059-01	0-0.5	grab	5.12
3	POORLY GRADED SAND WITH GRAVEL AND CLAY (SP-SC): light gray (10 YR 7/1), fine to coarse sands, loose, non plastic, low density.	S078-SCX-059-02	3-4	grab	6.63
6	increasing gravels.	S078-SCX-059-03	6-7	grab	5.40
	SANDSTONE: pale brown (10 YR 8/2), moderately weathered (W3), moderately hard (H4), strong (R4), fine to medium grained with some yellow (10 YR 7/8).				
10	Terminated borehole at 10 ft. below ground surface in sandstone bedrock.				
11					

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact

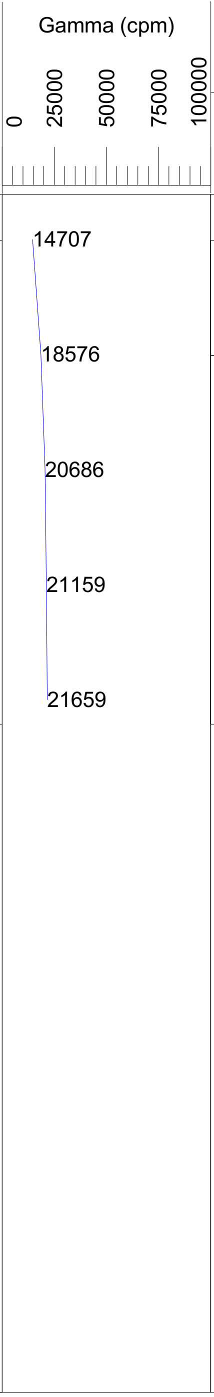
Stantec | NAVAJO NATION AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-060**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599282.44 NORTHING: 4011645.66
DATE STARTED: 10/21/2017 DATE STARTED: 10/21/2017
TOTAL DEPTH (ft.): 2.1 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0–2.1	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sand, loose, dry, unconsolidated, roots, trace sandstone gravels, subrounded.
2.1	Terminated hand auger borehole at 2.1 ft. below ground surface. No refusal. Field geologist terminated boring within undisturbed native material.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-060-01	0-0.5	grab	1.19
S078-SCX-060-02	0.5-2.1	comp	1.29

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

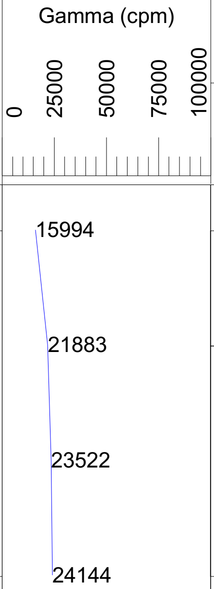
NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-061**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599231.91 NORTHING: 4011488.14
DATE STARTED: 10/21/2017 DATE STARTED: 10/21/2017
TOTAL DEPTH (ft.): 1.5 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Michael Ward

DEPTH (feet)	LITHOLOGICAL DESCRIPTION
0	POORLY GRADED SAND (SP): brown (10 YR 5/3), fine to medium grained sands, loose, dry, roots.
1.5	Terminated hand auger borehole at 1.5 ft. below ground surface. No refusal. Field geologist terminated boring within undisturbed native material.



SUBSURFACE SAMPLE INFORMATION

SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
S078-SCX-061-01	0-0.5	grab	1.94
S078-SCX-061-02 S078-SCX-261-02	0.5-1.5	grab	1.87 1.58

Notes: cpm = counts per minute
pCi/g = picocuries per gram
grab = grab sample
comp = composite sample
- - - - = approximate contact

Stantec

NAVAJO NATION
AUM Environmental Response Trust-First Phase

BOREHOLE ID: **S078-SCX-062**
CLIENT: NNAUMERT
PROJECT: Removal Site Evaluation
SITE LOCATION: Claim 28

DRILLING CONTRACTOR: Stantec
DRILLING METHOD: Hand auger
DRILLING EQUIPMENT: Hand auger
SAMPLING METHOD: Regular hand auger, 3 inch diameter

COORDINATE SYSTEM: NAD 1983 UTM Zone 12N
EASTING: 599114.35 NORTHING: 4011962.06
DATE STARTED: 10/13/2017 DATE STARTED: 10/13/2017
TOTAL DEPTH (ft.): 0.8 BOREHOLE ANGLE: 90 degrees
LOGGED BY: Justin Peterson

DEPTH (feet)	LITHOLOGICAL DESCRIPTION	Gamma (cpm) 0 25000 50000 75000 100000	SAMPLE IDENTIFICATION	SAMPLE INTERVAL (ft bgl)	SAMPLE TYPE	LAB RESULTS RA-226 (pCi/g)
0	POORLY GRADED SAND (SP): very dark gray, dry, medium dense, fine to medium sand, trace organics, silt, weathered coal and sandstone.	14039	*S078-SCX-062-01	0-0.5	grab	5.89
	tree roots and organic layer.	20157				
	POORLY GRADED SAND WITH SILT (SP-SM): weathered shale at bottom of boring	20869				
	Terminated hand auger borehole at 0.8 ft. below ground surface. Refusal on sandstone bedrock.					
1						
2						
3						
4						
5						

Notes: cpm = counts per minute
pCi/g = picocuries per gram

grab = grab sample
comp = composite sample

- - - - = approximate contact
* sample originally labeled as S078-BG2-011-01

C.3 Water Sample Field Forms

WATER SAMPLE COLLECTION FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 10/ 19 /2016 **Arrival Time** 1020

Field Personnel

J. Kester, K. Johnson

Entered 12/20/2016

SITE DESCRIPTION

Surface Water ☒ **Well Water** ☐

Station Name Claim 28 POND **Station Number**

Site Description Pond across road from mine area. Large-med – ~50 ft across, sampled by dipping cup ~12ft from shore

Water Characteristics (color, odor, appearance): Cloudy, murky, water is odorless, yellow brown.

SAMPLE COLLECTION

Collection Method: 1L bottle, Horizontal-bottle, Swing-sampler, Other([✓ Dip]) Up-stream / Across-stream

Sample ID: S078-WS-001 **Sample Time:** 1040

Field Measurements			
Parameter	Sample 1 (normal sample)	Sample 2 (field dup or MS)	Sample 3 (MSD)
Time	10:40		
pH	8:45		
Conductivity (µS/cm)	468.9	10/19/2016	
Turbidity (NTU)	33.2		
Water Temperature (°C)	8.6		
Salinity	0.33		
Oxidation Reduction Potential (mV)	95.9		

SURFACE WATER FLOW MEASUREMENT FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 10/ 19 /2016 **Time** 1040 **Station Number** Claim 28 POND

Field Personnel: J. Kester K. Johnson

Flow by Capture Method

Measurement Number	Time (sec)	Volume (L)
POND	NA	

WATER SAMPLE COLLECTION FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 11 / 05 / 2016 **Arrival Time** 11:00

Field Personnel

C. Lee, W. Campbell, K. Johnson

Entered 12/20/2016

SITE DESCRIPTION

Surface Water ☒ **Well Water** ☐

Station Name Claim 28 seep **Station Number** ______

Site Description Seep along contact on steep slope where haul road was formerly located (obliterated). Seeps occur along contact for 50 - 100 ft.

Water Characteristics (color, odor, appearance): Clear, slight sulfur

SAMPLE COLLECTION

Collection Method: 1L bottle, Horizontal-bottle, Swing-sampler, Other(pump), Up-stream / Across-stream

Sample ID: S028-WS-001 002 KSJ **Sample Time:** 11:35

Field Measurements			
Parameter	Sample 1 (normal sample)	Sample 2 (field dup or MS)	Sample 3 (MSD)
Time	11:25		
pH	3.67		
Conductivity (µS/cm)	4057		
Turbidity (NTU)	9.09		
Water Temperature (°C)	15.2		
Salinity	2.71		
Oxidation Reduction Potential (mV)	194.8		

SURFACE WATER FLOW MEASUREMENT FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 11 / 05 / 2016 **Time** 1220 **Station Number** Claim 28 seep

Field Personnel: C. Lee, W. Campbell K. Johnson

Flow by Capture Method

Measurement Number	Time (sec)	Volume (~~L~~) mL	
1	40	650	0.975
2	36	500	0.83
3	40	500	0.75
4	35	450	0.77

Entered 12/20/2016

Avg = 0.783 ~~m~~L/min

47 L/h

WATER SAMPLE COLLECTION FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 10/19/16 **Arrival Time** 0835

Field Personnel

J. Kester, K. Johnson

SITE DESCRIPTION

Entered 12/20/2016

Surface Water ☐ **Well Water** ☒

Station Name Claim 28 windmill Well **Station Number** 04T-386

Site Description Windmill with 2 tanks ~1 mile from Claim 28. Valve is broken on trough - continuous slow flow, livestock in area

Water Characteristics (color, odor, appearance): Clear, odorless

SAMPLE COLLECTION

Collection Method: [✓ 1L bottle], Horizontal-bottle, Swing-sampler, Other( ). Up-stream / Across-stream

Sample ID: 5078-WL-001, 5078-WL-201 **Sample Time:** 08:50/09:00

Field Measurements

Parameter	Sample 1 (normal sample)	Sample 2 (field dup or MS)	Sample 3 (MSD)
Time	0845		
pH	7.6	10/19/2016	
Conductivity (µS/cm)	2314		
Turbidity (NTU)	1.02		
Water Temperature (°C)	13.1°C		
Salinity (PPT)	1.57		
Oxidation Reduction Potential (mV)	90.0		

SURFACE WATER FLOW MEASUREMENT FORM

Project: Removal Site Evaluation Navajo Nation AUM Environmental Response Trust – First Phase

Date 10 / 19 /2016 **Time** 0835 **Station Number** 04T-386
Claim 28 windmill well

Field Personnel: J. Kester K. Johnson

Flow by Capture Method

Measurement Number	Time (sec)	Volume (L)
NA	well /	TROUGH

Appendix D Evaluation of RSE Data

D.1 Background Reference Area Selection

D.2 Statistical Evaluation

BACKGROUND REFERENCE AREA SELECTION

1.0 INTRODUCTION

This appendix presents the rationale for selection of the background reference areas for the Claim 28 Site (Site). To select the background reference areas for the Site, personnel considered geology, predominant wind direction, distance from the Site, hydrologic influence, similarities of vegetation and ground cover, and visual evidence of impacts due to mining (or other anthropogenic sources) in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual – Appendix A* ([MARSSIM] USEPA, 2000).

2.0 POTENTIAL BACKGROUND REFERENCE AREAS

The potential background reference area study was initiated during the Site Clearance desktop study and field investigations. In May 2016, two potential background reference areas (BG-1 and BG-2) were identified to represent the geologic formations at the Site where mining-impacted material was assumed to be present. These background reference areas and formations include: (1) BG-1 to represent the Mancos Shale on the lower mesa sidewall, foothills, and the area where the Mancos Shale transitions to undifferentiated Quaternary deposits valley bottom; and (2) BG-2 to represent the Toreva Formation on the mesa top, mesa bench, and upper mesa sidewall (refer to Figures D.1-1 and D.1-2). The gamma surveys at BG-1 and BG-2 were completed in May 2016 and surface soil samples were collected in October 2016. A hand auger borehole (S078-BG1-013) and an additional surface soil sample was completed at BG-1 in November 2016. A hand auger borehole was not completed in BG-2 due to shallow sediment depth throughout the background reference area.

Quaternary deposits are present on the valley bottom (refer to Figure D.1-1). In review of site characterization data, it was determined that mining-related impacts extend further along the valley bottom than was originally assumed and the lack of a background reference area for the Quaternary deposits is identified as a data gap in the RSE Report.

The locations of the two potential background reference areas (BG-1 and BG-2) are shown along with the site geology and predominant wind direction in Figure D.1-1. The potential background reference areas are described below.

- BG-1 encompasses an area of 816 square feet [ft^2] (approximately 0.02 acres), is located 1,170 feet (ft) west of claim #79, is cross-wind and hydrologically cross-gradient from the Site, and is across a drainage divide. The soils, limited colluvium, and bedrock outcrops represent the lower mesa sidewall and foothills areas of the Site and the transition to undifferentiated Quaternary deposits on the valley floor. BG-1 represents the portions of the survey area that are within the Mancos Shale. The vegetation and ground cover at BG-1 are similar to the Site.

- BG-2 encompasses an area of 1,229 ft^2 (approximately 0.03 acres), is located 1,220 ft northwest of claim #79, and is cross-wind and hydrologically cross-gradient from the Site. The thin soils, colluvium, and bedrock outcrops represent the Toreva Formation. The vegetation and ground cover at BG-2 are similar to the mesa top, mesa bench, and portions of the mesa sidewall.

The potential background reference area evaluation included surface gamma surveys, surface static gamma measurements, subsurface static gamma measurements, and collection of surface and subsurface soil/sediment samples, as described below:

- BG-1 - 12 surface soil grab samples were collected from 12 locations and two subsurface soil grab samples and surface and subsurface static gamma measurements were collected from borehole location S078-BG1-013
- BG-2 - 10 surface soil grab samples were collected from 10 locations; a borehole was not advanced due to shallow soils on bedrock; so, no subsurface soil samples or static gamma measurements were collected in BG-2

The sample locations and surface gamma survey data for BG-1 and BG-2 are shown in Figure D.1-3. Samples were categorized as surface soil/sediment samples where sample depths were up to 0.5 ft below ground surface (bgs) and as subsurface samples where sample depths were greater than 0.5 ft bgs. Static gamma measurements were categorized as surface where static gamma was measured at ground surface and as subsurface where static gamma was measured at or greater than 0.1 ft bgs due to the different geometric effects for subsurface static gamma measurements. Table 4-1 in the RSE Report provides the results of the sample analyses, and Tables D.1-1 and D.1-2 provide descriptive statistics for the metals/Ra-226 concentrations and the surface gamma measurements, respectively. Field forms, including borehole logs, are provided in Appendix C of the RSE Report.

The equipment used for the surface gamma survey were also used for static one-minute gamma measurements at the ground surface and for subsurface gamma measurements at the borehole location. Soil/sediment samples and gamma measurements were collected according to the methods described in the *Removal Site Evaluation Work Plan* (MWH, 2016).

3.0 SELECTION OF BACKGROUND REFERENCE AREAS

Background reference areas were needed to represent two geologic formations present at or near the Site where mining-related impacts may have occurred: BG-1 was selected to represent the area within the Mancos Shale, and BG-2 was selected to represent the area within the Toreva Formation. Gamma survey measurements and soil sample results collected from BG-1 and BG-2, and the subsurface static gamma measurement collected at BG-1 were used for the remainder of the Removal Site Evaluation of the Site.

While reviewing potential subsurface hand auger locations at BG-1, the cultural resources subcontractor recommended that the hand auger borehole location should be stepped out from BG-1 to avoid a nearby archeological finding. Therefore, the subsurface background location (S078-BG1-013) was advanced southwest of BG-1, as shown in Figure D.1-3. A surface soil sample (S078-BG1-011) was also collected in the area of S078-BG1-013. The initial borehole attempt (S078-BG1-012) met refusal at 0.6 feet below ground surface and samples were not collected due to more favorable auger results achieved at S078-BG1-013.

4.0 REFERENCES

MWH, 2016. *Navajo Nation AUM Environmental Response Trust – First Phase Removal Site Evaluation Work Plan*. October.

USEPA, 2000. *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), EPA 402-R-97-016, Rev. 1.

Table D.1-1
Soil and Sediment Sampling Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase
Page 1 of 1

Statistic	Arsenic (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
Background Reference Area Study - Background Area 1 - Mancos Shale and Quaternary deposits						
Total Number of Observations	12	12	12	12	12	12
Percent Non-Detects	--	33%	83%	--	--	--
Minimum[1]	1.30	--	--	0.510	5.80	1.39
Minimum Detect[2]	--	0.200	0.930	--	--	--
Mean[1]	1.89	--	--	1.27	7.77	2.07
Mean Detects[2]	--	0.299	0.935	--	--	--
Median[1]	1.95	--	--	1.07	7.45	1.92
Median Detects[2]	--	0.320	0.935	--	--	--
Maximum[1]	3.00	--	--	2.40	9.90	3.14
Maximum Detect[2]	--	0.350	0.940	--	--	--
Distribution	Normal	Normal	Normal	Normal	Normal	Normal
Coefficient of Variation[1]	0.282	--	--	0.558	0.209	0.269
CV Detects[2]	--	0.189	0.008	--	--	--
UCL Type	95% Student's-t UCL	95% KM (t) UCL	95% KM (t) UCL	95% Student's-t UCL	95% Student's-t UCL	95% Student's-t UCL
UCL Result	2.17	0.284	0.445	1.64	8.61	2.35
UTL Type	UTL Normal	UTL KM Normal	UTL KM Normal	UTL Normal	UTL Normal	UTL Normal
UTL Result	3.35	0.568	1.10	3.21	12.2	3.59
Background Reference Area Study - Background Area 2 - Toreva Formation						
Total Number of Observations	10	10	10	10	10	10
Percent Non-Detects	--	--	80%	--	--	--
Minimum[1]	3.20	0.220	--	0.570	9.80	1.23
Minimum Detect[2]	--	--	1.00	--	--	--
Mean[1]	5.70	0.263	--	0.863	13.0	1.53
Mean Detects[2]	--	--	1.00	--	--	--
Median[1]	4.10	0.260	--	0.845	12.0	1.55
Maximum[1]	14.0	0.350	--	1.20	19.0	1.79
Maximum Detect[2]	--	--	1.00	--	--	--
Distribution	Gamma	Normal	Not Calculated	Normal	Normal	Normal
Coefficient of Variation[1]	0.624	0.141	--	0.237	0.245	0.110
UCL Type	95% Adjusted Gamma UCL	95% Student's-t UCL	Not Calculated	95% Student's-t UCL	95% Student's-t UCL	95% Student's-t UCL
UCL Result	8.49	0.285	Not Calculated	0.981	14.8	1.63
UTL Type	UTL Gamma WH	UTL Normal	Not Calculated	UTL Normal	UTL Normal	UTL Normal
UTL Result	18.6	0.371	Not Calculated	1.46	22.3	2.02

Notes

[1] This statistic is reported by ProUCL when the dataset contains 100 percent detections.

[2] This statistic is reported by ProUCL when non-detect values exist in the dataset. The value reported is calculated using detections only.

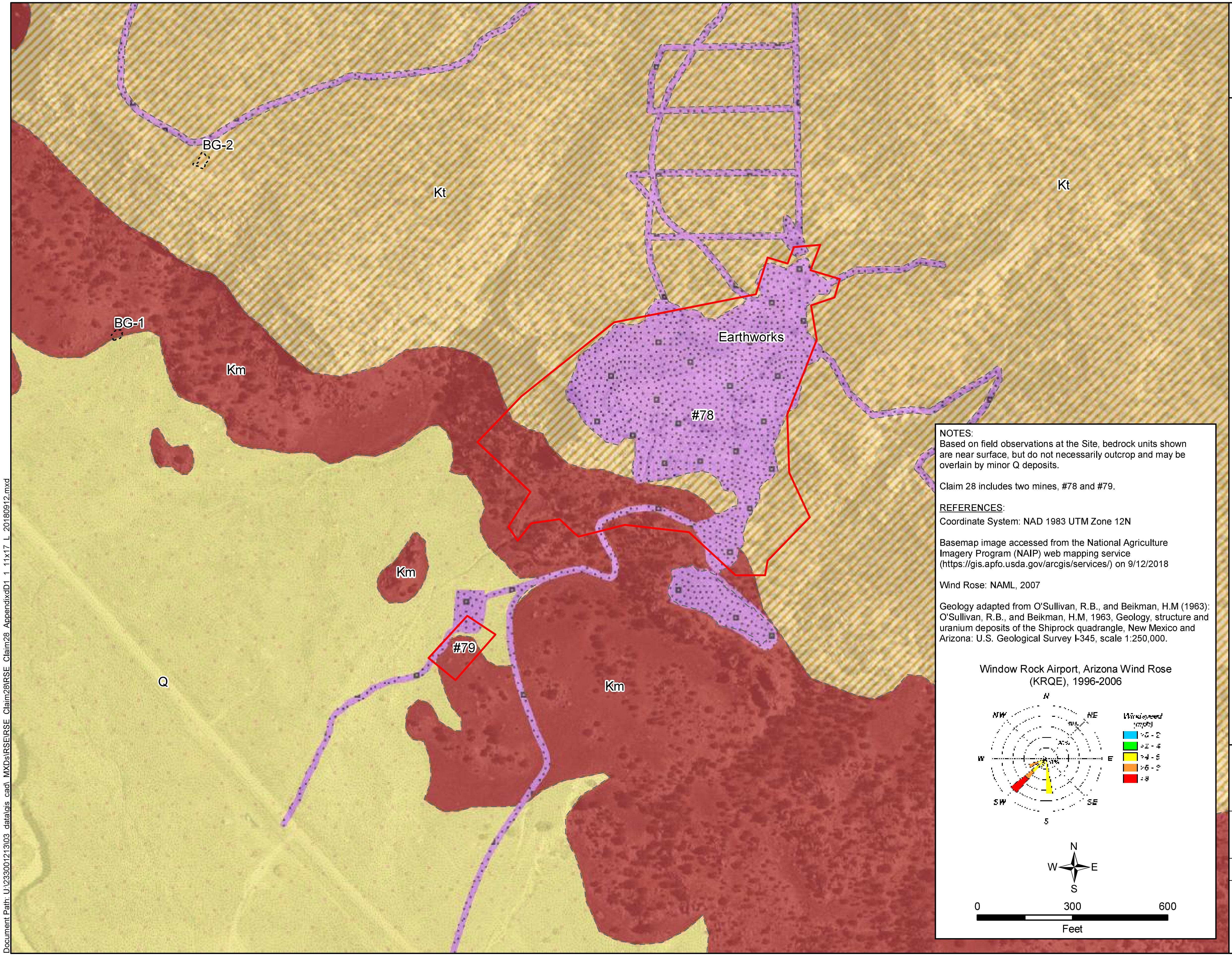
CV	Coefficient of variation
KM	Kaplan Meier
mg/kg	Milligrams per kilogram
--	Not applicable
pCi/g	Picocuries per gram

Table D.1-2
Surface Gamma Survey Summary
Claim 28
Removal Site Evaluation Report - Final
Navajo Nation AUM Environmental Response Trust - First Phase
Page 1 of 1

Statistic	Background Reference Area 1 (BG-1)	Background Reference Area 2 (BG-2)
Total Number of Observations	237	338
Minimum	15,584	10,048
Mean	18,165	12,709
Median	17,880	12,518
Maximum	22,609	16,423
Distribution	Normal	Normal
Coefficient of Variation	0.076	0.088
UCL Type	95% Student's-t UCL	95% Student's-t UCL
UCL Result	18,313	12,809
UTL Type	UTL Normal	UTL Normal
UTL Result	20,677	14,707

Notes

cpm	Counts per minute
UCL	Upper confidence limit
UTL	Upper tolerance limit



NOTES:
Based on field observations at the Site, bedrock units shown are near surface, but do not necessarily outcrop and may be overlain by minor Q deposits.

Claim 28 includes two mines, #78 and #79.

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image accessed from the National Agriculture Imagery Program (NAIP) web mapping service (https://gis.apfo.usda.gov/arcgis/services/) on 9/12/2018

Wind Rose: NAML, 2007

Geology adapted from O'Sullivan, R.B., and Beikman, H.M (1963): O'Sullivan, R.B., and Beikman, H.M, 1963, Geology, structure and uranium deposits of the Shiprock quadrangle, New Mexico and Arizona: U.S. Geological Survey I-345, scale 1:250,000.

NAVAJO
NATION
AUM Environmental
Response Trust-First Phase

LEGEND

⬚ Potential Background Reference Area

🟥 Claim Boundary

Geologic Contact (Inferred)

Site Geology

HOLOCENE / PLEISTOCENE

▨ Earthworks: Human-caused disturbance of the land surface related to mining or reclamation.

▨ Q: Quaternary Deposits – Undifferentiated (Pleistocene and Holocene) – includes sandy to gravelly colluvial and alluvial deposits, and eolian sand deposits.

CRETACEOUS

▨ Kt: Toreva Formation (Upper Cretaceous). Light-brown and yellowish-gray fine- to coarse-grained sandstone and lesser amounts of gray siltstone and carbonaceous shale.

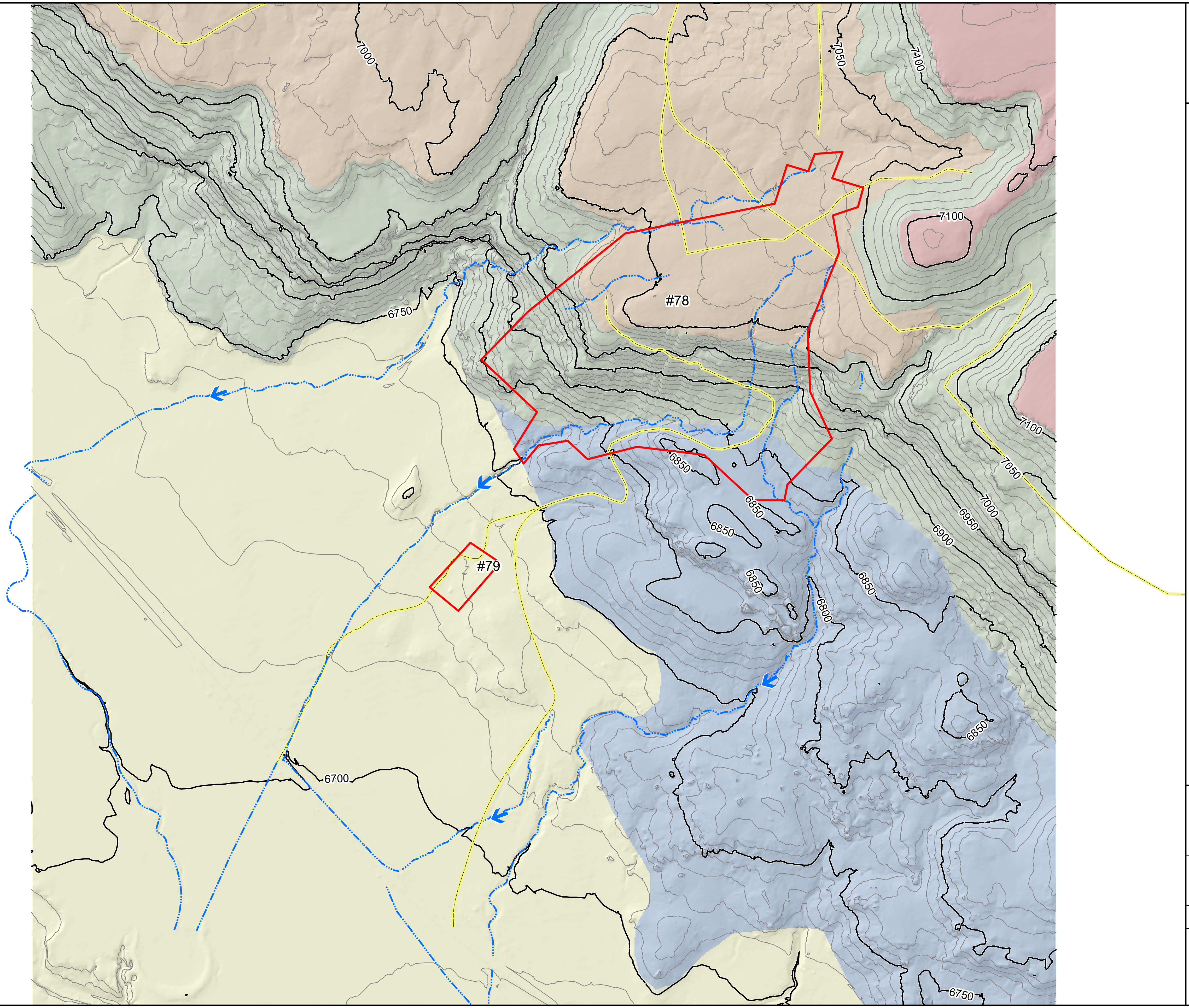
🟥 Km: Mancos Shale – undifferentiated (Lower and Upper Cretaceous). Predominantly light- to dark-gray marine shale with subordinate tan fine-grained sandstone and siltstone and bedded or concretionary limestone. Locally discontinuous coal seams.

TITLE:
Geologic Map and Potential
Background Reference Areas

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/12/2018
DOCUMENT NAME: Removal Site Evaluation Report
Stantec
AUTHOR: EDZ
REVIEWER: CBB
FIGURE: D.1-1

Document Path: U:\233001213\03_data\gis_cad_MXDs\RSE\RSE_Claim28\RSE_Claim28_AppendixdD1_1_11x17_L_20180912.mxd



NAVAJO NATION
AUM Environmental Response Trust-First Phase

LEGEND

↑	Flow Direction
-·-·-	Drainage
- - -	Potential Haul Road
～	Index Contour (50 ft Interval)
～	Intermediate Contour (10 ft Interval)
🟥	Claim Boundary

Geomorphology Features

■	Mesa Top
■	Mesa Bench
■	Mesa Sidewall
■	Foothills
■	Valley Bottom

NOTES:
The extent of the base map is based on the Cooper aerial surveys conducted on June 16, 2017.

Claim 28 includes two mines, #78 and #79.

REFERENCES:
Site-specific contours were generated as part of aerial surveys conducted on June 16, 2017.

Coordinate System: NAD 1983 UTM Zone 12N

N
W E
S

0 300 600
Feet

TITLE:

Site Topography

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/12/2018

DOCUMENT NAME: Removal Site Evaluation Report

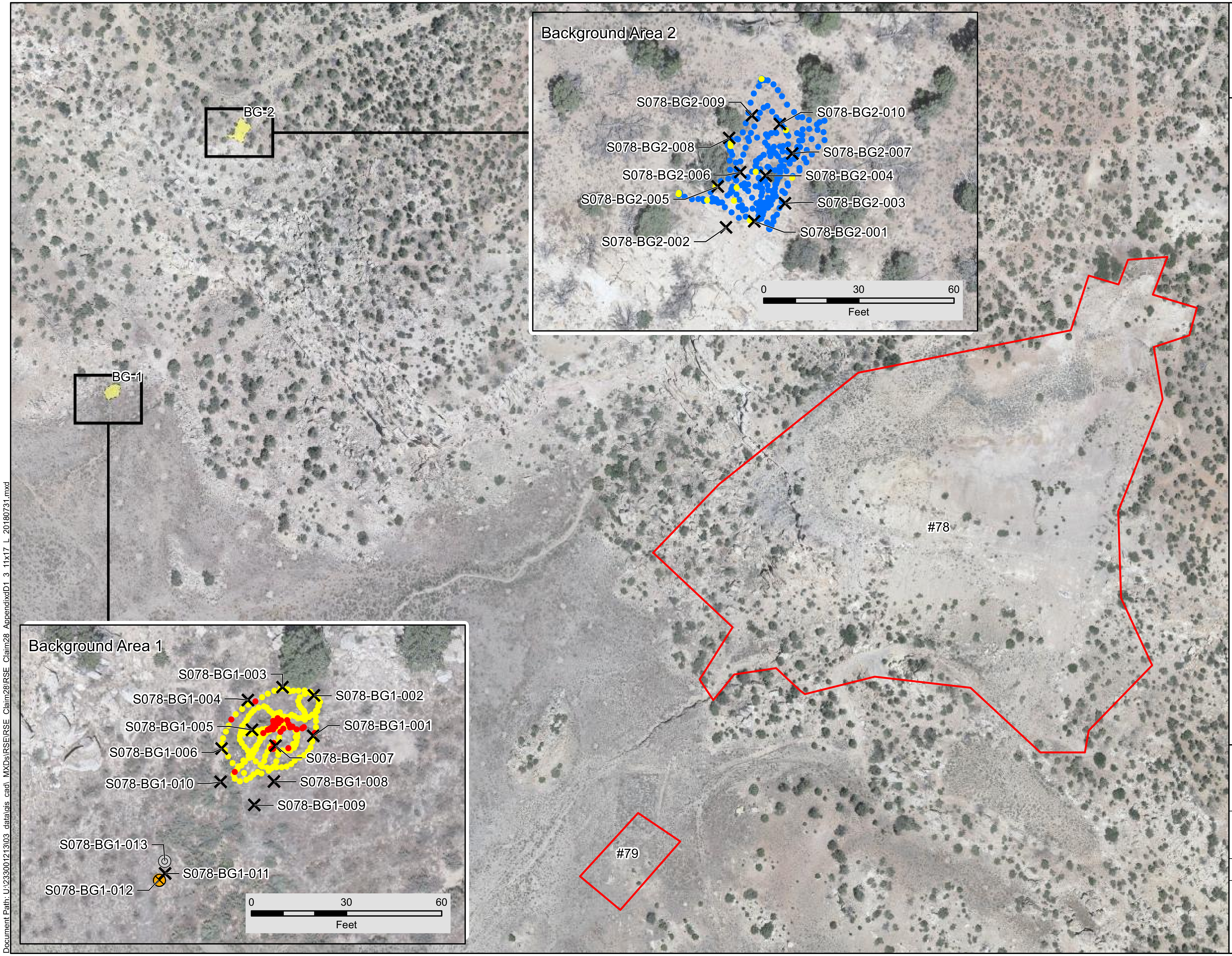
Stantec

AUTHOR: EDZ

REVIEWER: CBB

FIGURE: D.1-2

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 AppendixdD1 2 11x17 L 20180731.mxd



NAVAJO NATION

AUM Environmental Response Trust-First Phase

LEGEND

×	Surface Sample Location
◎	Surface Borehole Location for Background Reference
⊗	Attempted Borehole Location
▨	Potential Background Reference Area
☐	Claim Boundary

Gamma Survey

Counts pe Minute (CPM)

●	10,048 - 15,000
●	15,001 - 20,000
●	20,001 - 22,609

NOTE:
Claim 28 includes two mines, #78 and #79

REFERENCES:
Coordinate System: NAD 1983 UTM Zone 12N

Basemap image flown by Cooper Aerial Surveys Co. on June 16, 2017.

N
W E
S

0 200 400
Feet

TITLE:
Potential Background Reference Area
Gamma Radiation Survey Results and
Soil Sample Locations

PROJECT:
Removal Site Evaluation
Claim 28 Mine Site

DATE: 9/12/2018

DOCUMENT NAME: Removal Site Evaluation Report

AUTHOR: CBB

REVIEWER: EDZ

Stantec

FIGURE: D.1-3

Document Path: U:\233001213\03 data\gis cad\ MXDs\RSE\RSE Claim28\RSE Claim28 AppendixdD1 3 11x17 L 20180731.mxd

STATISTICAL EVALUATION

1.0 INTRODUCTION

This statistical evaluation presents the methods used in, and results of, statistical analyses performed on gamma radiation survey results and soil sample analytical results collected from the Claim 28 Site (Site). The evaluation includes comparing background reference area and Survey Area data distributions, and documents the decision process followed to select site-specific investigation levels (ILs). The ILs are used to confirm contaminants of potential concern (COPCs) listed in the *RSE Work Plan*, and to support identification of technologically enhanced naturally occurring radioactive materials (TENORM) at the Site.

2.0 EVALUATIONS

The evaluation process included compiling the results for gamma radiation surveys and soil sample analytical results from two background reference areas and two Survey Areas. These areas are designated Background Reference Area 1 (BG-1), Background Reference Area 2 (BG-2), Survey Area A, and Survey Area B. The Background Reference Areas BG-1 and BG-2 were selected to represent the Site's natural conditions as described in Appendix D.1. The gamma radiation survey data and soil sample analytical results for the background reference areas and Survey Areas were evaluated to determine the appropriate ILs for the Site as follows:

1. Identify and examine potential outlier values. Potential outlier values were identified statistically and, if justified upon further examination, removed from a dataset prior to further evaluation and calculations. No data were removed from the dataset for the calculations presented in this appendix.

2. Compare data populations between BG-1 and Survey Area A, and BG-2 and Survey Area B (box plots, probability plots, hypothesis testing with Wilcoxon Mann-Whitney test). Soil sample and gamma radiation survey results were compared between BG-1 and Survey Area A, and BG-2 and Survey Area B qualitatively and quantitatively to evaluate similarity or difference in data distributions between the areas, and as a component of evaluating background area adequacy and representativeness.

3. Develop descriptive statistics. Descriptive statistics for gamma survey results and soil sample analytical results (e.g., number of observations, mean, maximum, median, etc.) were generated to facilitate qualitative comparisons of soil sample and gamma radiation survey results from one area to another.

4. Select ILs for the Site based on the results of the statistical evaluations.

3.0 RESULTS

The following sections present the evaluation of potential outlier values in the dataset, calculated descriptive statistics, and comparison of data populations between groups in support of determining ILs for use at the Site.

3.1 POTENTIAL OUTLIER VALUES

A potential outlier is a data point within a random sample of a population that is different enough from the majority of other values in the sample as to be considered potentially unrepresentative of the population, and therefore requires further inspection and evaluation. Unrepresentative values in a dataset have potential to yield distorted estimates of population parameters of interest (e.g., means, upper confidence limits, upper percentiles). Therefore, potential outliers in the Site data were evaluated further prior to performing data comparisons (Section 3.2) and developing the descriptive statistics (Section 3.3). In the context of this statistical evaluation, extreme values and statistical outliers are referred to as potential outliers.

A potential outlier value in a sample may be a true representative value in the test population (not a “discrepant” value), simply representing a degree of inherent variation present in the population. Furthermore, a statistical determination of one or more potential outliers does not indicate that the measurements are actually discrepant from the rest of the data set. Therefore, general statistical guidance does not recommend that extreme values (potential outliers) be removed from an analysis solely on a statistical basis. Statistical outlier tests can provide supportive information, but a reasonable scientific rationale needs to be identified for the removal of any potential outlier values (e.g., sampling error, records error, or the potential outlier is determined to violate underlying assumptions of the sampling design, such as the targeted geology).

In the background reference areas, soil samples were collected randomly. Potential outliers in the BG-1 and BG-2 datasets were examined using box plots, probability plots, and statistical testing. Descriptive statistics were then calculated with and without the potential outliers, as applicable. Finally, the potential outlier values were evaluated to determine if a reason could be found to remove the data points before calculating the final statistics. The results of these evaluations are described in the following sections.

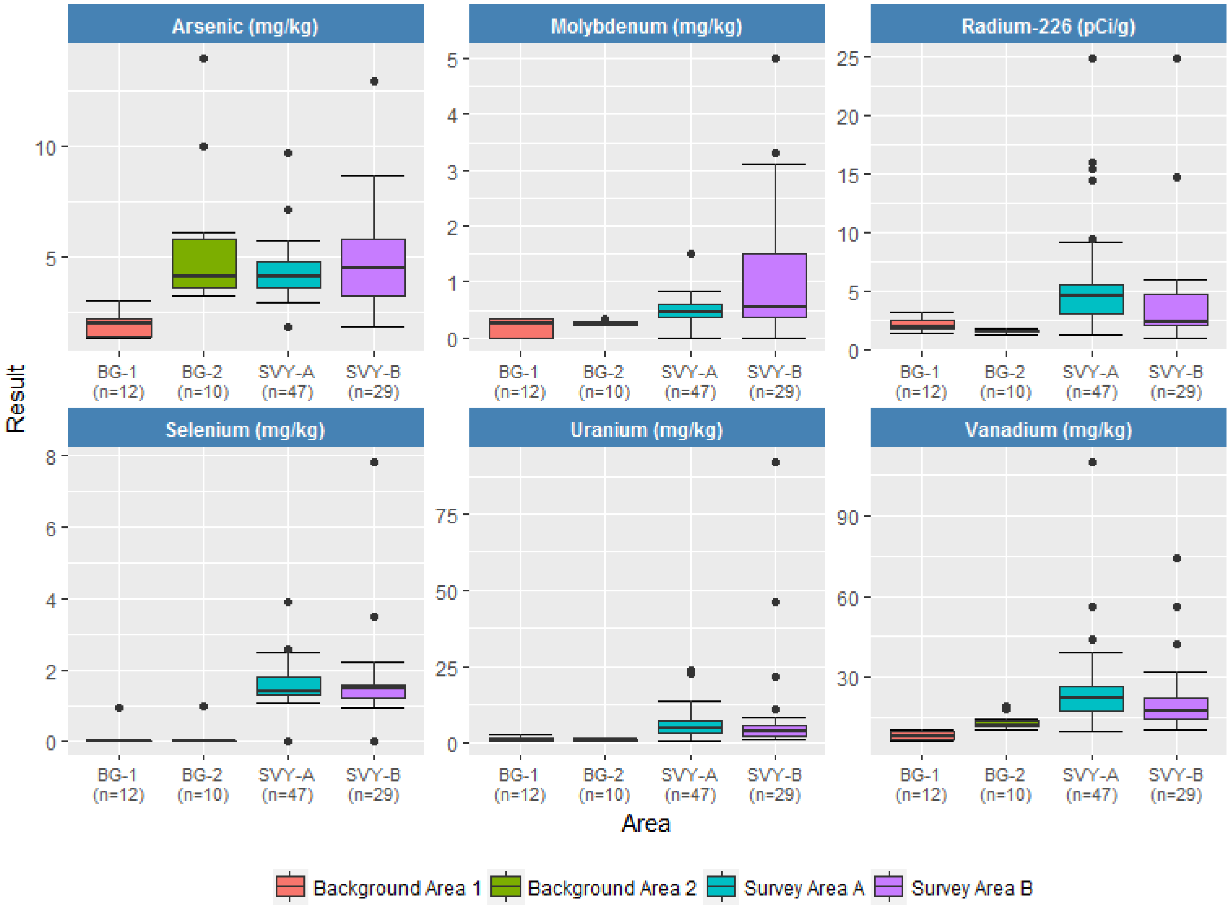
In the Survey Areas at Claim 28, soil samples were collected using a judgmental sampling approach. Specifically, some sample locations were selected to characterize areas of higher gamma radiation and, as a result, potential outlier values are not unexpected in the Survey Area sample statistics.. Potential outliers in this context mean values that are well-separated from the majority of the data set coming from the far/extreme tails of the data distribution (USEPA, 2016a). Descriptive statistics for the Survey Areas and some comparisons to background reference areas are still presented for qualitative assessment. However, potential outlier values in the Survey Areas are not evaluated further nor removed from the dataset.

3.1.1 Box Plots

Box plots depict descriptive statistics from a group of data (Figure 1A). The interquartile range is represented by the bounds of the box, the minimum and maximum values, not including potential outlier values (extreme values), are depicted by the whiskers (vertical lines), and any potential outliers are identified as singular dots. Potential outliers in this context are defined as values outside 1.5 times the interquartile range above or below the box.

3.1.1.1 Soil Sample Results Box Plots

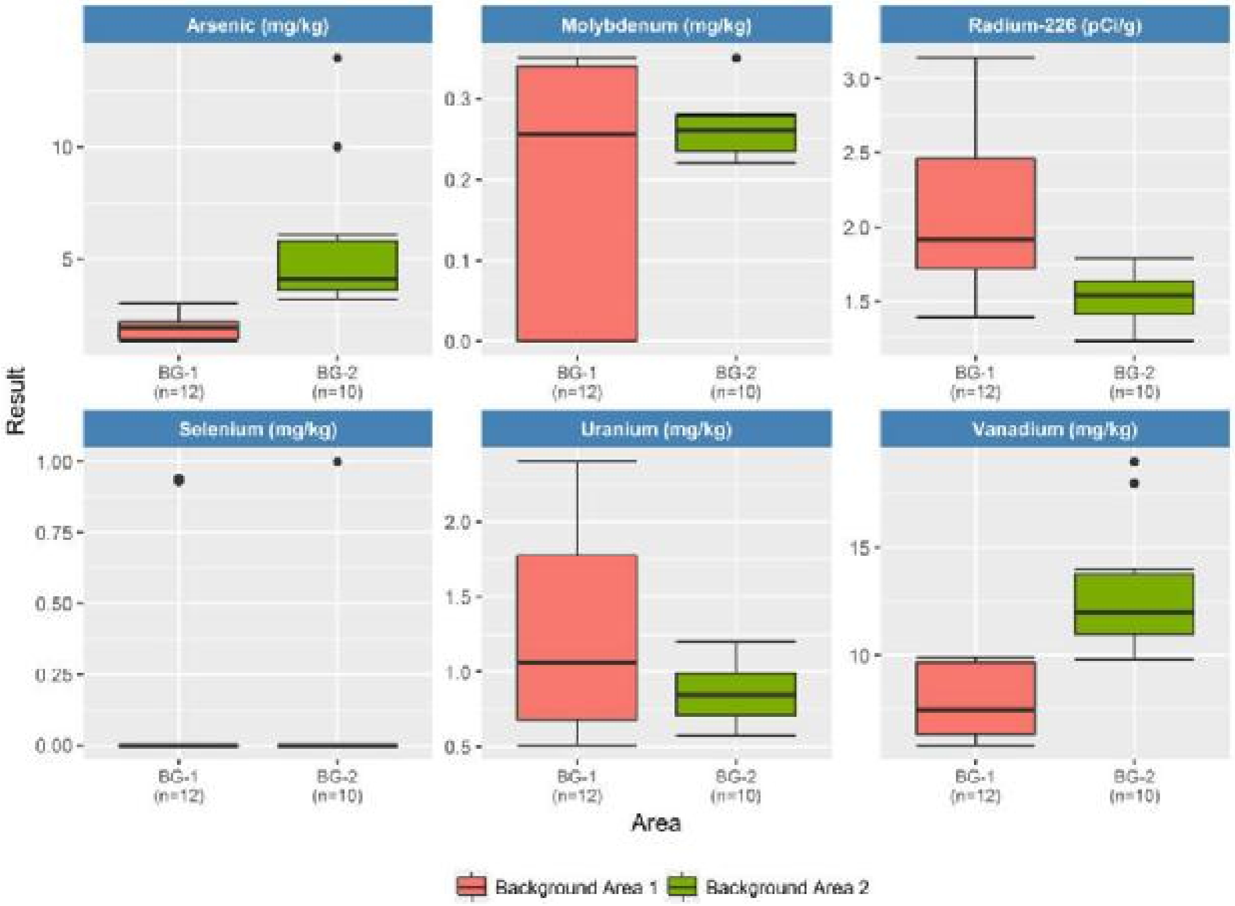
Figure 1A. Survey Areas A and B, and Background Reference Area 1 (BG-1) and 2 (BG-2) Soil Sample Box Plots



The soil sample box plots shown on Figure 1A depict differences in the data distribution for analytical constituent concentrations between BG-1, BG-2, and Survey Areas A and B. Some potential outliers are shown for BG-1, BG-2, and Survey Areas A and B.

Potential outlier values are of greatest concern in the BG-1 and BG-2 datasets as these data are used to determine the ILs. Background reference area data are presented alone in Figure 1B.

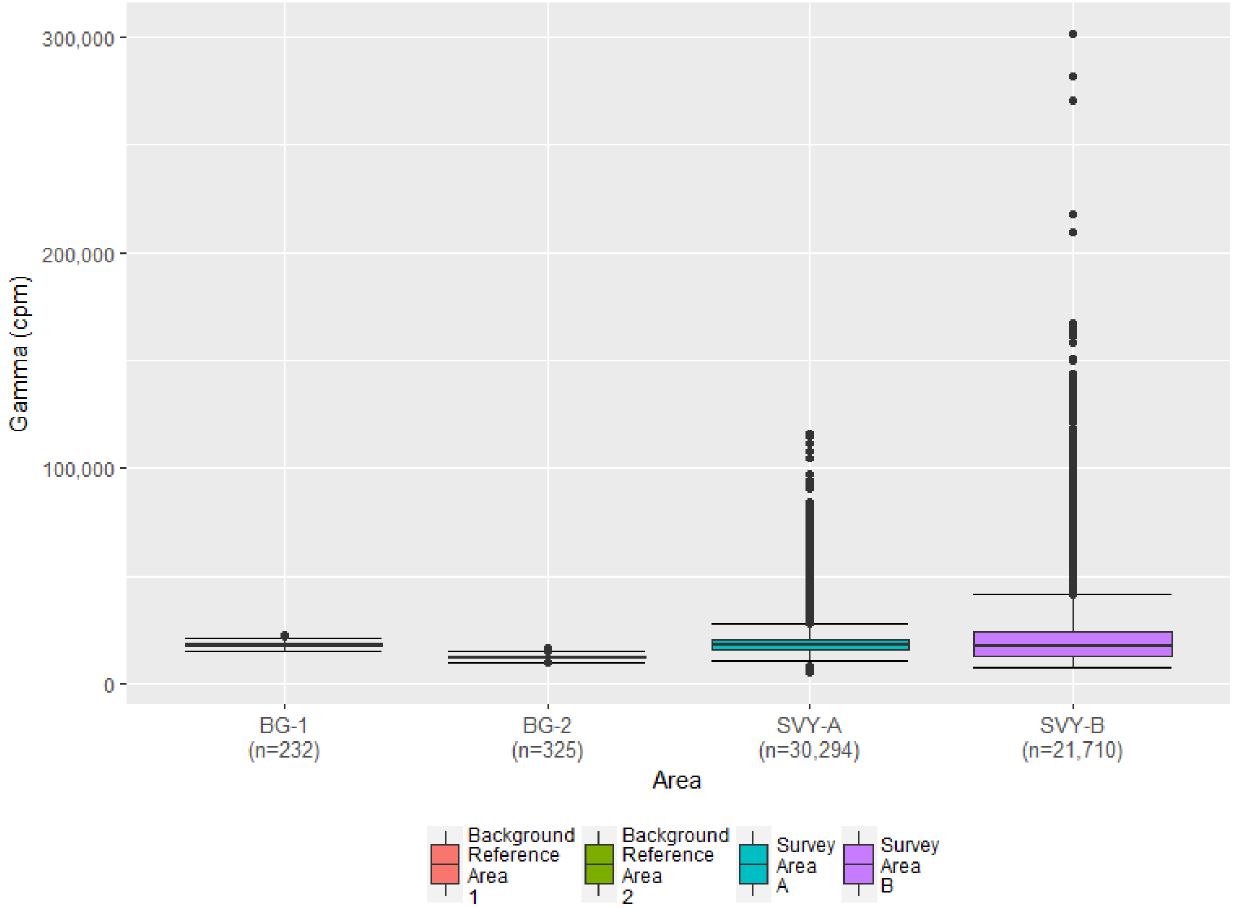
Figure 1B. Background Reference Area 1 (BG-1) and 2 (BG-2) Soil Sample Box Plots



One high value for selenium (Se) is identified as a potential outlier (i.e., above 1.5 times the interquartile range) in the BG-1 box plots in Figure 1B. Two high values for arsenic, one high value for molybdenum (Mo), one high value for selenium, and two high values for vanadium (V) are identified as potential outliers (i.e., above 1.5 times the interquartile range) in the BG-2 box plots in Figure 1B. These potential outlier values are further evaluated with the use of probability plots in Section 3.1.2 and statistical outlier testing in Section 3.1.3.

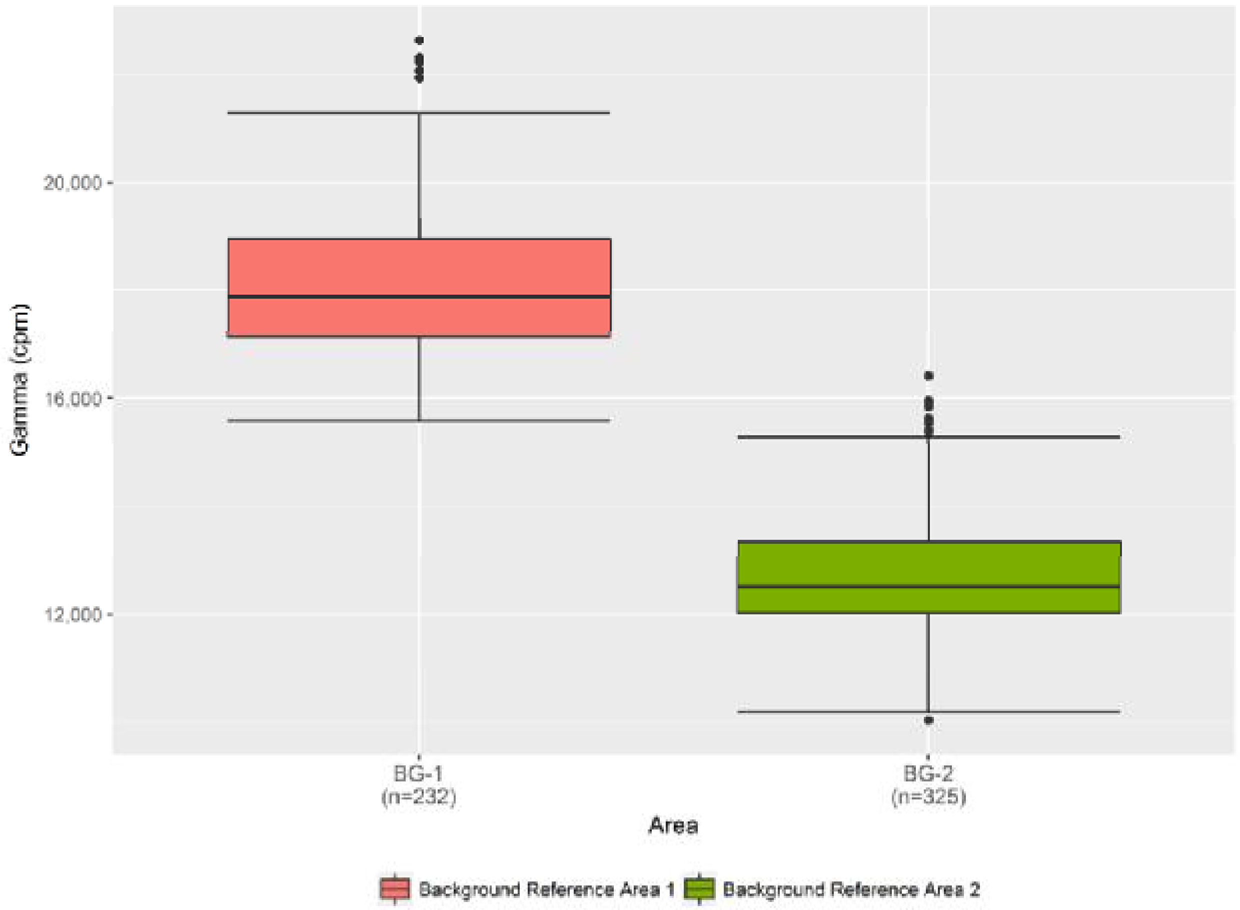
3.1.1.2 Gamma Radiation Results Box Plots

Figure 2A. Survey Areas and Background Reference Areas Gamma Radiation Box Plots



The gamma radiation survey results box plots shown on Figure 2A depict differences in the data distribution for gamma measurements between BG-1, BG-2, and Survey Areas A and B. The large number of potential outlier values in the Survey Area box plots indicate high skewness or possibly non-normally distributed data, instead of outlier values. Based on Site geology, the potential gamma radiation outlier values observed for the two Survey Area data on Figure 2A represent localized areas of higher gamma radiation with respect to other parts of each of the Survey Areas, as would be expected in areas with varying levels of mineralization, naturally occurring radioactive material (NORM), and potential TENORM.

Figure 2B. Background Reference Areas Gamma Radiation Box Plot



As shown in Figure 2B, there are five high potential outlier values shown for gamma data in the BG-1 dataset and eight potentially high and one potentially low outlier values in the BG-2 dataset. These potential outlier values do not represent skewed data as do the Survey Area results, and the gamma data are shown to be more normally distributed in BG-1 and BG-2 than in the Survey Areas.

The potential outlier values shown for BG-1 and BG-2 are most likely representative of natural variation of gamma in these areas. These observations are further evaluated with the use of probability plots in Section 3.1.2 and statistical outlier testing (potential outlier) in Section 3.1.4.

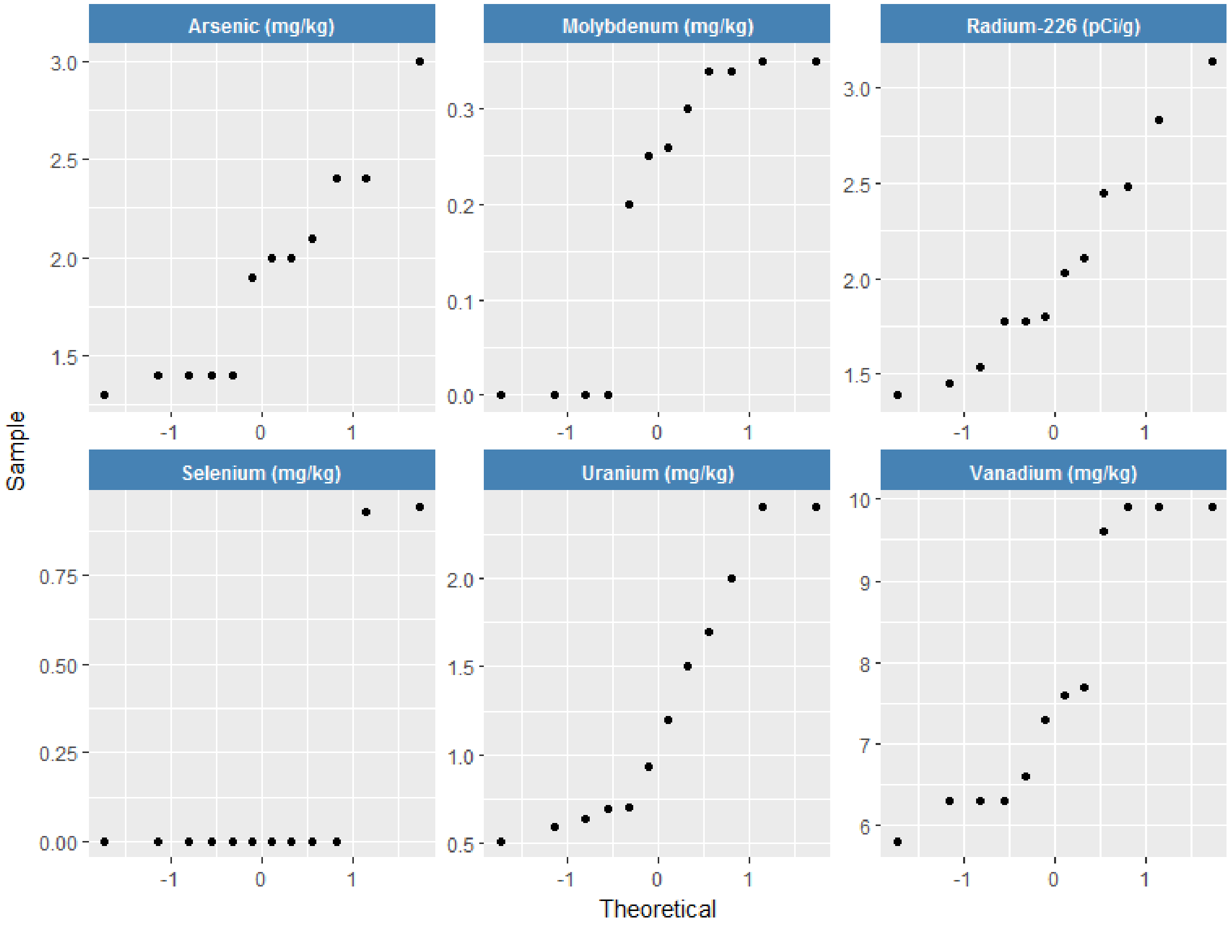
3.1.2 Probability Plots

The normal probability plot is a graphical technique for assessing whether or not a data set is approximately normally distributed and where there may be potential outlier values. The data are plotted against a theoretical normal distribution in such a way that the points, if normally distributed, should form an approximate straight line. Curved lines may indicate non-normally or log-normally distributed data, and "S"-shaped lines may indicate two distinct groups within the dataset.

3.1.2.1 Soil Sample Results Probability Plots

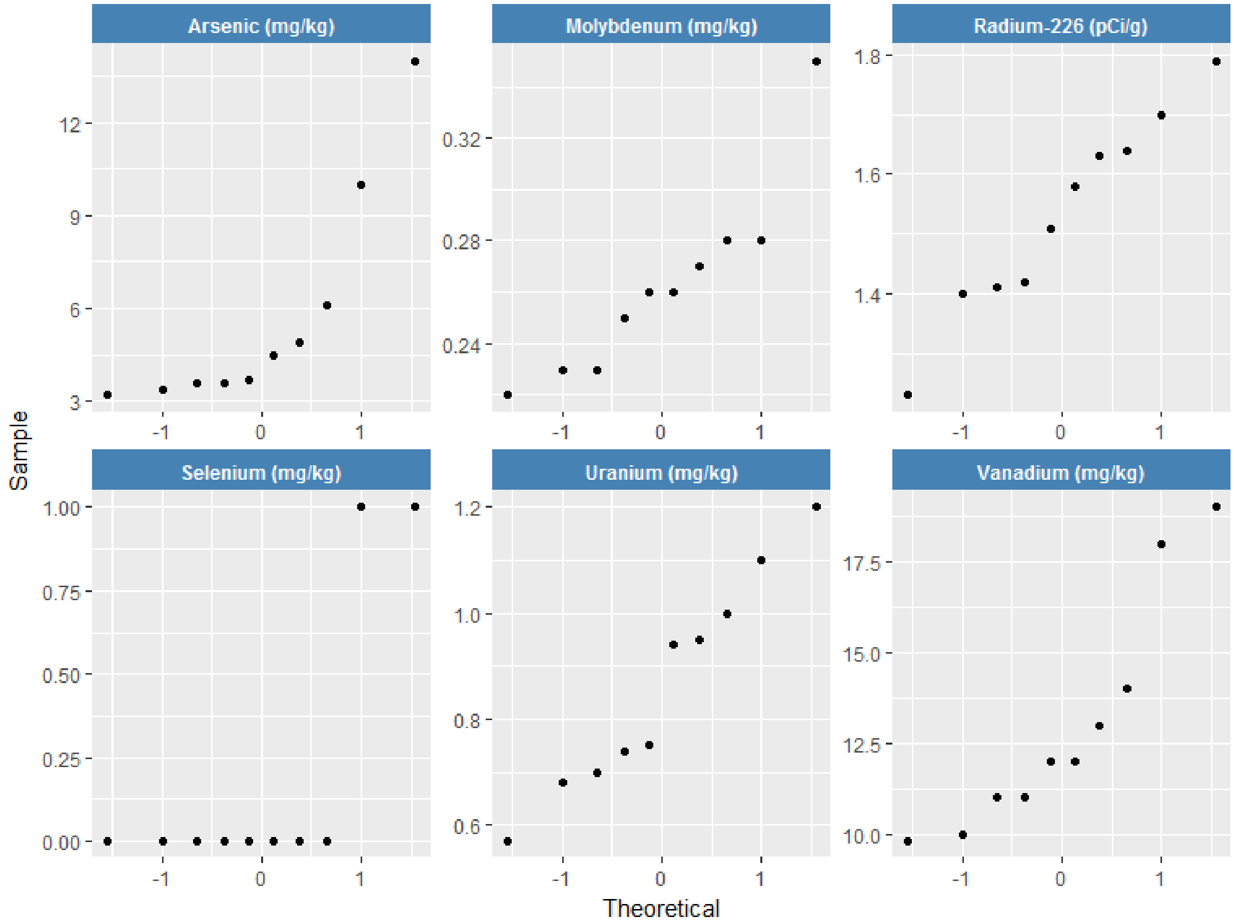
Figure 3 depicts the probability plots for metals and Ra-226 results at BG-1.

Figure 3. Background Reference Area 1 (BG-1) Soil Sample Probability Plots



One value for selenium was identified as a potential outlier (i.e., above 1.5 times the interquartile range) at BG-1 in the box plot in Figure 1B. When viewed in the probability plots in Figure 3, it is apparent that this high value represents two separate sample results; these values do appear to be higher than, and out of line with the rest of their respective datasets. However, the other 10 sample results at BG-1 were non-detect for selenium and the non-detect values were each plotted using an assigned value of 0 mg/kg. As a result, the two detected values appear artificially elevated. In addition, the two detected values (i.e., 0.930 mg/kg and 0.940 mg/kg) are well within the range of selenium concentrations typically observed in Western U.S. soils (United States Geological Survey [USGS], 1984): range <0.1 – 4.3 mg/kg. Nevertheless, these potential outlier values are further tested for statistical significance as potential outliers in Section 3.1.3.

Figure 4. Background Reference Area 2 (BG-2) Soil Sample Probability Plots

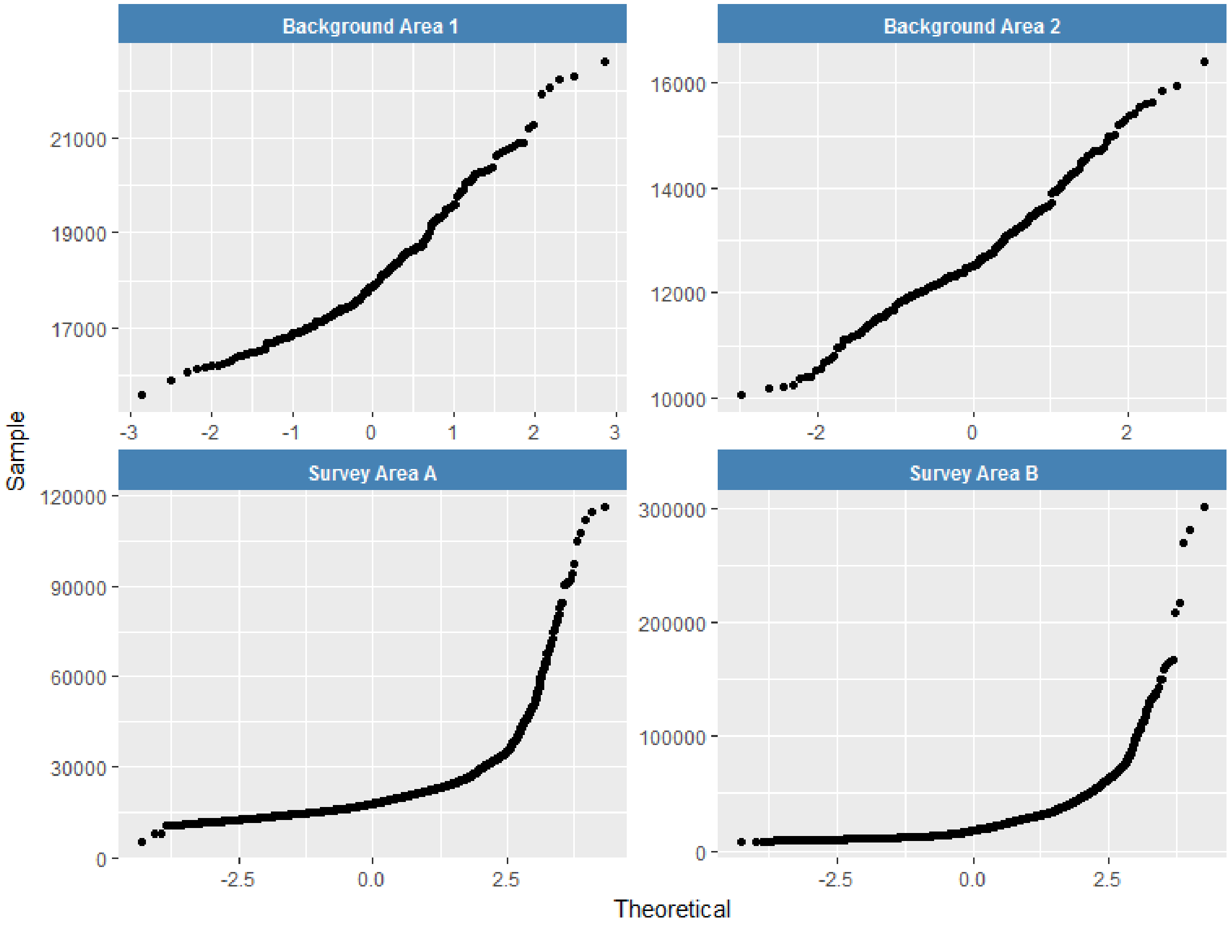


Two values for arsenic, one value for molybdenum, one value for selenium, and two values for vanadium were identified as potential outliers (i.e., above 1.5 times the interquartile range) at BG-2 in the box plots in Figure 1B. When viewed in the probability plots in Figure 4, it is apparent that the two high values for selenium represent two distinct samples; these values do appear to be higher than, and out of line with the rest of their respective datasets. However, the other eight sample results at BG-2 were non-detect for selenium and the non-detect values were each plotted using an assigned value of 0 mg/kg. As a result, the two detected values appear artificially elevated. In addition, the two detected values (both 1.00 mg/kg) are well within the range of selenium concentrations typically observed in Western U.S. soils (United States Geological Survey [USGS], 1984): range <0.1 – 4.3 mg/kg. Nevertheless, these potential outlier values are further tested for statistical significance as potential outliers. The potential outlier values for arsenic, molybdenum, and vanadium do appear to be higher than, and out of line with the rest of their respective datasets. The potential outlier values for arsenic, molybdenum, selenium, and vanadium are further tested for statistical significance as potential outliers in Section 3.1.3.

3.1.2.2 Gamma Survey Results Probability Plots

Figure 5 depicts the probability plots for gamma radiation results at background reference areas and the Survey Areas.

Figure 5. Survey Area and Background Reference Area Gamma Probability Plots



The BG-1 and BG-2 gamma probability plots in Figure 5 are approximately linear, indicating normal distributions. The five highest values in BG-1, identified as potential outliers in the box plot in Figure 2B, appear to be higher than, and out of line with, the distribution of the rest of the dataset, indicating that they are potential outliers. The eight highest values and one lowest value in the BG-2 dataset also appear out of line with the distribution of the rest of the dataset, indicating that they are potential outliers. These values are further evaluated for statistical significance in Section 3.1.4.

The gamma probability plots in Figure 5 for Survey Areas A and B are non-linear or S-shaped. The Survey Areas A and B gamma probability plots in Figure 5 indicate a sub-group of higher gamma radiation values in each probability plot which may be distinct from the rest of the datasets, and non-normal distribution. Additionally, the shape and smoothness of the probability plots for the Survey Area A and B gamma results confirm that the gamma radiation data are more log-normally distributed than the BG-1 and BG-2 gamma results.

3.1.3 Potential Soil Sample Data Outliers

Nine high results are identified as potential outlier values in the box plots in Figure 1B and probability plots in Figure 3. These values are:

Background Reference Area 1

- Selenium: 0.930 mg/kg, 0.940 mg/kg

Background Reference Area 2

- Arsenic: 10.0 mg/kg, 14.0 mg/kg
- Molybdenum: 0.350 mg/kg
- Selenium: 1.00 mg/kg, 1.00 mg/kg
- Vanadium: 18.0 mg/kg, 19.0 mg/kg

Dixon’s Test (Dixon, 1953) is designed to be used for datasets containing only one or two potential outlier values. Therefore, Dixon's Test was performed to the 95% confidence level on each of the potential soil sample outlier values summarized in Table 1.

Table 1. Summary of Dixon's Test on Maximum Values

Area	Constituent	Location ID	Method	Hypothesis	p_Value	Conclusion
Background Reference Area 1 (BG-1)	Se	S078-BG1-004	Dixon test for potential outliers	high value 0.930 is a potential outlier	< 0.05	Hypothesis accepted
	Se	S078-BG1-006	Dixon test for potential outliers	high value 0.940 is a potential outlier	< 0.05	Hypothesis accepted
Background Reference Area 2 (BG-2)	As	S078-BG2-010	Dixon test for potential outliers	high value 10.0 is a potential outlier	< 0.05	Hypothesis accepted
	As	S078-BG2-007	Dixon test for potential outliers	high value 14.0 is a potential outlier	< 0.05	Hypothesis accepted
	Mo	S078-BG2-001	Dixon test for potential outliers	high value 0.350 is a potential outlier	< 0.05	Hypothesis accepted
	Se	S078-BG2-005	Dixon test for potential outliers	high value 1.00 is a potential outlier	< 0.05	Hypothesis accepted
	Se	S078-BG2-010	Dixon test for potential outliers	high value 1.00 is a potential outlier	< 0.05	Hypothesis accepted
	V	S078-BG2-001	Dixon test for potential outliers	high value 18.0 is a potential outlier	> 0.05	Hypothesis rejected
	V	S078-BG2-010	Dixon test for potential outliers	high value 19.0 is a potential outlier	> 0.05	Hypothesis rejected

As = Arsenic Mo = Molybdenum Se = Selenium V = Vanadium

The test confirms that seven of the nine potential outliers tested are statistically significant (p value <0.05). The statistically significant potential outlier values for selenium at BG-1, and arsenic, molybdenum, and selenium at BG-2, were further investigated by reviewing sample forms, notes and laboratory reports. Field staff and field notes indicated nothing abnormal about the locations where the samples were collected, and the laboratory datasets show no data quality flags were applied to these values that would call their accuracy into question. Therefore, while these values are: 1) outside the interquartile range of their respective datasets (Figure 1B), 2) may not conform linearly with the respective dataset distributions in the probability plots (Figures 3 and 4), and 3) are deemed potential statistical outliers by Dixon's Test, they were not removed from the BG-1 and BG-2 datasets because no scientific reason was found to justify disqualifying these values. These values are considered representative of the natural variation at BG-1 and BG-2. However, descriptive statistics were calculated with and without these values for comparison (Section 3.3.1).

3.1.4 Potential Gamma Data Outliers

Potential gamma survey outlier values are observed for the BG-1 and BG-2 gamma datasets shown in the boxplots in Figure 2B. When viewed in the probability plots in Figure 5, the BG-1 and BG-2 gamma probability plots are approximately linear, indicating normal distributions. The five highest values in the BG-1 dataset appear to be higher than, and out of line with the distribution of the rest of the dataset. A total of five values in the BG-2 dataset were identified as higher than, and out of line with the distribution of the rest of the dataset. Because the number of values in the BG-1 and BG-2 gamma datasets is >30, Dixon’s Test was not appropriate for testing potential outliers. Instead, because the values appear to be generally normally distributed, it was appropriate to identify potential outliers using Z, t and chi squared scoring methods at the 95% confidence level. These tests were performed in the 'Outliers' package in R (Lukasz Komsta, 2011), and the results are summarized in Table 2. The R programming language complements ProUCL in its ability to provide more meaningful and useful graphics and summarizes the results equivalent to ProUCL. Because ProUCL and R packages follow similar statistical procedures, the results are comparable. The interquartile range evaluation (values outside 1.5 times the interquartile range) results are also provided in Table 2.

Table 2. Potential Gamma Outlier Interquartile Range, Z Score, t Score and Chi Squared Score Results

Area	Value (cpm)	Interquartile Range Result	Z Score Result	t Score Result	Chi Sq Score Result
Background Area 1 (BG-1)	22,609	High	Potential Outlier	Potential Outlier	Potential Outlier
	22,298	High	Potential Outlier	Potential Outlier	Potential Outlier
	22,221	High	Potential Outlier	Potential Outlier	Potential Outlier
	22,064	High	Potential Outlier	Potential Outlier	Potential Outlier
	21,925	High	Potential Outlier	Potential Outlier	Potential Outlier
Background Area 2 (BG-2)	16,423	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,956	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,851	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,628	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,612	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,544	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,407	High	Potential Outlier	Potential Outlier	Potential Outlier
	15,392	High	Potential Outlier	Potential Outlier	Potential Outlier
	10,048	Low	Potential Outlier	Potential Outlier	Potential Outlier

cpm Counts per minute

One possible reason for the potential outliers in the gamma radiation dataset may be the presence of a localized source of radiation. The gamma results were reviewed spatially and BG-1 and BG-2 are thought to be representative of Survey Areas A and B, respectively, and no scientific reason was found to remove the higher values from the evaluation. However, descriptive statistics were calculated with and without these values for comparison in Section 3.3.2.

3.2 COMPARE DATA POPULATIONS

Group comparison analyses provide insight into the relative concentrations of constituents between background reference areas and the Survey Areas. Observations made during these analyses may indicate the need for further evaluation or discussion regarding the influence of potential outlier values, and the use of background data. For instance, if two or more background reference areas were determined to be statistically similar to each other, these data could be combined to calculate more robust statistics (not a factor in this evaluation, as one background reference area was selected to represent each Survey Area). Alternatively, testing of this kind may reveal background concentrations statistically higher than corresponding Survey Area concentrations, requiring additional interpretation or modifications in the use of background reference area datasets. Finally, results of these evaluations are a component of determining background area representativeness, though statistical comparisons are not the only factors to be considered in judging representativeness. Factors such as geologic materials, predominant wind direction, distance from the Site, visual evidence of impacts due to mining (or other anthropogenic sources) and soil depth are all important to the selection of background reference areas.

Group comparisons, therefore, are considered instructive as a component of the overall evaluation of soil sample and gamma radiation survey results collected from background reference areas and Survey Areas. Relative data distributions were investigated by evaluating the box plots and probability plots in Figures 1A through 5, and by hypothesis testing with the non-parametric Mann-Whitney test, as applicable.

3.2.1 Evaluation of Box Plots

3.2.1.1 Soil Sample Box Plots

The box plot comparison in Figures 1A and 1B suggests that mean metals and Ra-226 values may differ between the background reference areas and the Survey Areas. As shown in Figures 1A and 1B, concentrations of Ra-226, selenium, uranium, and vanadium are elevated at Survey Area A compared with the other Survey Area and the background reference areas. Arsenic concentrations appear to be similar in BG-2 and Survey Areas A and B, but are lower at BG-1. Concentrations of molybdenum are similar at the background reference areas and Survey Areas, with the concentrations in the Survey Areas slightly elevated. When interpreting the soil sample box plots in Figures 1A and 1B, it is important to note that samples at background reference areas were collected randomly, while samples in the Survey Areas were collected judgmentally from areas of suspected contamination. Analytical constituent-specific observations from the boxplots in Figures 1A and 1B indicate:

- Arsenic. Arsenic concentrations are elevated at Survey Area A compared with BG-1 and similar between Survey Area B and BG-2. Concentrations at BG-2 are elevated relative to BG-1, while arsenic concentrations at Survey Area B and Survey Area A are similar.

- Molybdenum. Molybdenum concentrations are slightly elevated at Survey Area A compared with BG-1 and at Survey Area B compared with BG-2. Concentrations are similar between Survey Areas A and B, and BG-1 and BG-2.

- Ra-226. Ra-226 concentrations are elevated at Survey Area A relative to BG-1, and elevated at Survey Area B relative to BG-2. Ra-226 concentrations are slightly elevated at Survey Area B compared with Survey Area A and slightly elevated at BG-1 compared with BG-2.

- Selenium. Selenium concentrations are elevated at Survey Area A compared with BG-1 and at Survey Area B compared with BG-2. Selenium concentrations are similar between Survey Areas A and B, and BG-1 and BG-2.

- Uranium. Uranium concentrations are elevated at Survey Area A compared with BG-1, and Survey Area B and BG-2. Concentrations are similar between the background reference areas, and elevated at Survey Area A relative to Survey Area B.

- Vanadium. Vanadium concentrations are significantly elevated at Survey Area A relative to BG-1 and elevated at Survey Area B compared with BG-2. The concentrations are elevated at BG-2 compared with BG-1 and elevated at Survey Area A compared with Survey Area B.

3.2.1.2 Gamma Radiation Box Plots and Probability Plots

The box plot comparison in Figures 2A and 2B suggests that interquartile ranges are significantly elevated at Survey Area A when compared with BG-1, and significantly elevated in Survey Area B compared with BG-2. Gamma values in Survey Areas A and B are higher than those in BG-1 and BG-2. These observations are verified in Section 3.2.2 using the non-parametric Mann-Whitney test. Gamma radiation data distributions at BG-1 and BG-2 are approximately normal, while gamma radiation distributions at Survey Areas A and B are non-normal (Figure 5). These observations are further evaluated in Section 3.2.2 using the non-parametric Mann-Whitney test.

3.2.2 Mann-Whitney Testing

The Mann-Whitney test (Bain and Engelhardt, 1992) is a nonparametric test used for determining whether a difference exists between two or more population distributions. This test is also known as the Wilcoxon Rank Sum (WRS) test. This test evaluates whether measurements from one population consistently tend to be larger (or smaller) than those from another population. This test was selected over other comparative tests such as the Student’s t test and analysis of variance (ANOVA) because it remains robust in the absence of required assumptions that these two tests require, such as normally distributed data and equality of variances.

Soil samples at the background reference areas were collected randomly, while soil samples in the Survey Areas were collected judgmentally (see Section 3.1). Mann-Whitney testing is not appropriate for comparative analysis if one or both groups contain data collected using a judgmental approach. Therefore, the Mann-Whitney test was not performed for soil sample data between background reference areas and Survey Areas. Gamma radiation data, however, do represent non-judgmental sampling, and so the Mann-Whitney test was appropriate for comparison between background reference areas and Survey Areas (Table 3). Therefore, the test was performed two-sided on the background reference area and Survey Area gamma radiation data. The two-sided test accounts for results from one group being lower or higher than any other group (i.e., the hypothesis tested whether the two groups differ, independent of which group is higher). A test result p-value of 0.05 or smaller indicates that a significant difference exists between any two groups that are compared. Results of Mann-Whitney testing are presented in Table 3.

Table 3. Summary of Gamma Survey Mann-Whitney Test Results

Comparison	p_Value	Description
Background Reference Area 1 (BG-1) vs Survey Area A	0.799	No Significant Difference
Background Reference Area 1 (BG-1) Potential Outliers Excluded vs Background Reference Area 1 (BG-1)	0.693	No Significant Difference
Background Reference Area 1 (BG-1) Potential Outliers Excluded vs Survey Area A	0.894	No Significant Difference
Background Reference Area 2 (BG-2) vs Survey Area B	<0.05	Significant Difference
Background Reference Area 2 (BG-2) Potential Outliers Excluded vs Background Reference Area 2 (BG-2)	0.644	No Significant Difference
Background Reference Area 2 (BG-2) Potential Outliers Excluded vs Survey Area B	<0.05	Significant Difference
Background Reference Area 1 (BG-1) vs Background Reference Area 2 (BG-2)	<0.05	Significant Difference
Survey Area A vs Survey Area B	<0.05	Significant Difference

The results of the Mann-Whitney testing on gamma radiation survey results in Table 3 indicate the following:

- Gamma results are statistically elevated in Survey Area B and BG-2; this observation is valid for Survey Area B and BG-2 both with and without inclusion of potential outliers in the BG-2 dataset.

- Gamma results between Survey Area A and BG-1 are not statistically elevated both with and without inclusion of potential outliers in the BG-1 dataset.

- Additionally, gamma results are statistically elevated at Survey Area B relative to Survey Area A. Gamma results at BG-1 are statistically elevated relative to BG-2.

- The observation that gamma results at Survey Area B are statistically elevated relative to its respective Background Reference Area (BG-2) is likely attributable to the fact that background reference areas may not fully represent the degree of natural mineralization present at Survey Areas (see RSE Report Section 3.2.2.2). This latter point does not prohibit use of the gamma ILs calculated from these background reference areas, but this observation should be considered, as Site conditions are further evaluated for remediation.

- The inclusion or removal of potential outlier values has no effect on the results of the Mann-Whitney test between the background reference areas and Survey Areas (i.e., there are statistically significant differences in gamma results between BG-1 and Survey Area A and between BG-2 and Survey Area B, with and without potential outlier values included).

3.3 DESCRIPTIVE STATISTICS

Descriptive statistics, including the upper confidence limit (UCL) of the mean and the 95-95 upper tolerance limit (UTL), were calculated from gamma survey data and soil sample results. Descriptive statistics are important for any data evaluation to present the basic statistics of a data set with regards to its limits (maximum and minimum), central tendencies (mean and median) as well as data dispersion (coefficient of variance). The ILs for the Site also are taken from the descriptive statistics, namely the 95-95 UTL. The parameters and constituents evaluated include gamma radiation, arsenic, molybdenum, selenium, uranium, vanadium, and Ra-226.

Statistics were calculated using Environmental Protection Agency (EPA) ProUCL version 5.1 software. Statistical methodology employed by the software is documented in the *ProUCL Version 5.1 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations* (EPA, 2015). In the case of non-detect results, ProUCL does not recommend detection limit substitution methods (e.g., 1/2 the detection limit), considering these methods to be imprecise and out of date (EPA, 2015). The software instead calculates descriptive statistics for the detected results only, and follows various methods accordingly to calculate UCL and UTL values based on the percentage of non-detect results present in the dataset and on the distribution of the data (i.e., normal, lognormal, gamma, or unknown distribution).

Descriptive statistics for soil samples and gamma radiation survey results have been calculated with and without the potential outlier values previously identified, as applicable. Select descriptive statistics for these constituents are presented in Tables 4 and 5.

3.3.1 Soil Sample Analytical Results Summary

As described in Section 3.2.1.1, Ra-226, selenium, uranium, and vanadium results appear to be elevated at Survey Area A compared with the other Survey Area and the background reference areas. Arsenic concentrations appear to be similar in BG-2 and Survey Areas A and B, but are lower at BG-1. Concentrations of molybdenum are similar at the background reference areas and Survey Areas, with the concentrations in the Survey Areas slightly elevated. An important consideration when comparing concentrations of metals and Ra-226 between background reference areas and Survey Areas is that the background reference areas were selected to be representative of the geology present in the region around the Site, whereas the Site was selected as a mine claim because it is in an area of mineralized bedrock likely to have localized, naturally elevated uranium concentrations (see RSE Report Section 3.2.2.2). It should be noted that concentrations of several of the metals measured in the Survey Area are within the range of metals concentrations typically observed in Western U.S. soils (USGS, 1984):

- Arsenic (mean = 5.5 mg/kg; range <0.10 – 97 mg/kg)
- Molybdenum (mean = 0.85 mg/kg; range <3 – 7 mg/kg)
- Selenium (mean = 0.23 mg/kg; range <0.1 – 4.3 mg/kg)
- Uranium (mean = 2.5 mg/kg; range 0.68 – 7.9 mg/kg)
- Vanadium (mean = 70 mg/kg; range 7 – 500 mg/kg)

As shown in Table 4, maximum detected concentrations of arsenic, molybdenum, selenium, and vanadium in the Survey Areas are within typical ranges reported for Western US soils, and may not be related to the uranium mineralization. Exceptions to the above are Ra-226 and uranium; elevated concentrations of these constituents in the Survey Areas are present in soils associated with the mineralized and/or disturbed portions of the Site (see RSE Report Section 4.6).

Table 4. Summary of Soil Sampling Results

Area	Statistic	Arsenic (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
Background Reference Area 1 (BG-1) All Data	Total Number of Observations	12	12	12	12	12	12
	Percent Non-Detects	--	33%	83%	--	--	--
	Minimum[1]	1.30	--	--	0.510	5.80	1.39
	Minimum Detect[2]	--	0.200	0.930	--	--	--
	Mean[1]	1.89	--	--	1.27	7.77	2.07
	Mean Detects[2]	--	0.299	0.935	--	--	--
	Median[1]	1.95	--	--	1.07	7.45	1.92
	Median Detects[2]	--	0.320	0.935	--	--	--
	Maximum[1]	3.00	--	--	2.40	9.90	3.14
	Maximum Detect[2]	--	0.350	0.940	--	--	--
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	Coefficient of Variation[1]	0.282	--	--	0.558	0.209	0.269
	CV Detects[2]	--	0.189	0.008	--	--	--
	UCL Type	95% Student's-t UCL	95% KM (t) UCL	95% KM (t) UCL	95% Student's-t UCL	95% Student's-t UCL	95% Student's-t UCL
	UCL Result	2.17	0.284	0.445	1.64	8.61	2.35
	UTL Type	UTL Normal	UTL KM Normal	UTL KM Normal	UTL Normal	UTL Normal	UTL Normal
	UTL Result	3.35	0.568	1.10	3.21	12.2	3.59
Background Reference Area 1 (BG-1) Excluding Potential Outliers[3]	Total Number of Observations	--	--	10	--	--	--
	Percent Non-Detects	--	--	100%	--	--	--
	Minimum Detect[2]	--	--	--	--	--	--
	Mean Detects[2]	--	--	--	--	--	--
	Maximum Detect[2]	--	--	--	--	--	--
	Distribution	--	--	Not Calculated	--	--	--
	UCL Type	--	--	Not Calculated	--	--	--
	UCL Result	--	--	Not Calculated	--	--	--
	UTL Type	--	--	Not Calculated	--	--	--
	UTL Result	--	--	Not Calculated	--	--	--
Background Reference Area 2 (BG-2) All Data	Total Number of Observations	10	10	10	10	10	10
	Percent Non-Detects	--	--	80%	--	--	--
	Minimum[1]	3.20	0.220	--	0.570	9.80	1.23
	Minimum Detect[2]	--	--	1.00	--	--	--
	Mean[1]	5.70	0.263	--	0.863	13.0	1.53
	Mean Detects[2]	--	--	1.00	--	--	--
	Median[1]	4.10	0.260	--	0.845	12.0	1.55
	Maximum[1]	14.0	0.350	--	1.20	19.0	1.79
	Maximum Detect[2]	--	--	1.00	--	--	--
	Distribution	Gamma	Normal	Not Calculated	Normal	Normal	Normal
	Coefficient of Variation[1]	0.624	0.141	--	0.237	0.245	0.110
	UCL Type	95% Adjusted Gamma UCL	95% Student's-t UCL	Not Calculated	95% Student's-t UCL	95% Student's-t UCL	95% Student's-t UCL
	UCL Result	8.49	0.285	Not Calculated	0.981	14.8	1.63
	UTL Type	UTL Gamma WH	UTL Normal	Not Calculated	UTL Normal	UTL Normal	UTL Normal
	UTL Result	18.6	0.371	Not Calculated	1.46	22.3	2.02

Area	Statistic	Arsenic (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
Background Reference Area 2 (BG-2) Excluding Potential Outliers [3]	Total Number of Observations	8	9	8	--	--	--
	Percent Non-Detects	--	--	100%	--	--	--
	Minimum[1]	3.20	0.220	--	--	--	--
	Minimum Detect[2]	--	--	--	--	--	--
	Mean[1]	4.13	0.253	--	--	--	--
	Mean Detects[2]	--	--	--	--	--	--
	Median[1]	3.65	0.260	--	--	--	--
	Maximum[1]	6.10	0.280	--	--	--	--
	Maximum Detect[2]	--	--	--	--	--	--
	Distribution	Normal	Normal	Not Calculated	--	--	--
	Coefficient of Variation[1]	0.238	0.088	--	--	--	--
	UCL Type	95% Student's-t UCL	95% Student's-t UCL	Not Calculated	--	--	--
	UCL Result	4.78	0.267	Not Calculated	--	--	--
	UTL Type	UTL Normal	UTL Normal	Not Calculated	--	--	--
	UTL Result	7.26	0.321	Not Calculated	--	--	--
Survey Area A	Total Number of Observations	47	47	47	47	47	47
	Percent Non-Detects	--	2%	4%	--	--	--
	Minimum[1]	1.80	--	--	0.730	9.20	1.19
	Minimum Detect[2]	--	0.200	1.10	--	--	--
	Mean[1]	4.26	--	--	6.14	25.0	5.54
	Mean Detects[2]	--	0.506	1.62	--	--	--
	Median[1]	4.10	--	--	4.60	22.0	4.54
	Median Detects[2]	--	0.465	1.40	--	--	--
	Maximum[1]	9.70	--	--	24.0	110	24.8
	Maximum Detect[2]	--	1.50	3.90	--	--	--
	Distribution	Gamma	Normal	Normal	Gamma	Normal	Lognormal
	Coefficient of Variation[1]	0.285	--	--	0.878	0.616	0.790
	CV Detects[2]	--	0.437	0.315	--	--	--
	UCL Type	95% Adjusted Gamma UCL	95% KM (t) UCL	95% KM (t) UCL	95% Adjusted Gamma UCL	95% Student's-t UCL	95% H-UCL
	UCL Result	4.56	0.554	1.72	7.47	28.7	6.50
	UTL Type	UTL Gamma WH	UTL KM Normal	UTL KM Normal	UTL Gamma WH	UTL Normal	UTL Lognormal
	UTL Result	6.88	0.957	2.65	18.5	56.8	16.1
Survey Area B	Total Number of Observations	29	29	29	29	29	29
	Percent Non-Detects	--	3%	21%	--	--	--
	Minimum[1]	1.80	--	--	0.740	9.80	0.940
	Minimum Detect[2]	--	0.270	0.960	--	--	--
	Mean[1]	4.82	--	--	8.87	21.8	4.06
	Mean Detects[2]	--	1.13	1.90	--	--	--
	Median[1]	4.50	--	--	3.50	17.0	2.36
	Median Detects[2]	--	0.580	1.60	--	--	--
	Maximum[1]	13.0	--	--	92.0	74.0	24.8
	Maximum Detect[2]	--	5.00	7.80	--	--	--
	Distribution	Normal	Unknown	Normal	Unknown	Normal	Unknown
	Coefficient of Variation[1]	0.487	--	--	2.05	0.652	1.17
	CV Detects[2]	--	1.04	0.725	--	--	--
	UCL Type	95% Student's-t UCL	95% KM (Chebyshev) UCL	95% KM (t) UCL	95% Chebyshev (Mean, Sd) UCL	95% Student's-t UCL	95% Chebyshev (Mean, Sd) UCL
	UCL Result	5.56	2.04	2.11	23.6	26.3	7.89
	UTL Type	UTL Normal	Non-Parametric -Max	UTL KM Normal	UTL Non-Parametric	UTL Normal	UTL Non-Parametric
	UTL Result	10.1	5.00	4.51	92.0	53.6	24.8

1	This statistic is reported by ProUCL when the dataset contains 100 percent detections.
2	This statistic is reported by ProUCL when non-detect values exist in the dataset. The value reported is calculated using detections only.
3	Statistics shown are for the constituents where potential outliers were identified, calculated with the potential outliers removed.
CV	Coefficient of variation
KM	Kaplan Meier
mg/kg	Milligrams per kilogram
--	Not applicable
pCi/g	Picocuries per gram
WH	Wilson Hilferty
Note	The UTL result that is shown on the table is based on the output from ProUCL. ProUCL evaluates the data and provides all possible UCLs from its UCL module for three possible data distributions, then identifies a recommended UCL value. ProUCL does not identify a recommended UTL value. The UTLs are therefore based on the distribution of the recommended UCL. Please refer to ProUCL Version 5.1 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Non-detect Observations (EPA, 2015) for further information

3.3.2 Gamma Radiation Results Summary

Table 5 presents the descriptive statistics output from the ProUCL software for the gamma radiation survey results.

Table 5. Summary of Walk-over Gamma Results

Area	Statistic	Gamma (cpm)
Background Reference Area 1 (BG-1) All Data	Total Number of Observations	237
	Minimum	15,584
	Mean	18,165
	Median	17,880
	Maximum	22,609
	Distribution	Normal
	Coefficient of Variation	0.076
	UCL Type	95% Student's-t UCL
	UCL Result	18,313
	UTL Type	UTL Normal
	UTL Result	20,677
Background Reference Area 1 (BG-1) Excluding Potential Outliers	Total Number of Observations	232
	Minimum	15,584
	Mean	18,077
	Median	17,855
	Maximum	21,273
	Distribution	Normal
	Coefficient of Variation	0.070
	UCL Type	95% Student's-t UCL
	UCL Result	18,214
	UTL Type	UTL Normal
	UTL Result	20,369
Background Reference Area 2 (BG-2) All Data	Total Number of Observations	338
	Minimum	10,048
	Mean	12,709
	Median	12,518
	Maximum	16,423
	Distribution	Normal
	Coefficient of Variation	0.088
	UCL Type	95% Student's-t UCL
	UCL Result	12,809
	UTL Type	UTL Normal
	UTL Result	14,707
Background Reference Area 2 (BG-2) Excluding Potential Outliers	Total Number of Observations	329
	Minimum	10,192
	Mean	12,644
	Median	12,501
	Maximum	15,283
	Distribution	Normal
	Coefficient of Variation	0.080
	UCL Type	95% Student's-t UCL
	UCL Result	12,736
	UTL Type	UTL Normal
	UTL Result	14,463

Area	Statistic	Gamma (cpm)
Survey Area A	Total Number of Observations	61,651
	Minimum	5,437
	Mean	18,833
	Median	18,015
	Maximum	115,935
	Distribution	--
	Coefficient of Variation	0.234
	UCL Type	--
	UCL Result	18,862
	UTL Type	--
	UTL Result	26,111
Survey Area B	Total Number of Observations	47,009
	Minimum	7,869
	Mean	20,316
	Median	17,547
	Maximum	301,035
	Distribution	--
	Coefficient of Variation	0.515
	UCL Type	--
	UCL Result	20,396
	UTL Type	--
	UTL Result	37,645

CPM Counts per minute

As noted for metals and Ra-226 in Section 3.3.1, gamma results measured within Survey Area A and B appeared to be elevated relative to gamma results measured in background reference areas because background reference areas were selected to represent the geology present in the region around the Site, whereas the Site was selected as a mine claim because it is in an area of mineralized bedrock likely to have localized naturally elevated uranium concentrations. Therefore, it is not surprising that gamma results within the Survey Areas are somewhat higher than gamma results at the background reference areas. Elevated gamma results in portions of the Survey Areas are likely attributable to historic waste piles, as well as a higher degree of natural mineralization within the Survey Areas relative to the background reference areas.

4.0 INVESTIGATION LEVELS

The calculated 95-95 UTL values described in Section 3.3 are used as the ILs for gamma measurement results and soil sampling results because they reflect the natural variability in the background data, and provide an upper limit from background data to be used for single-point comparisons to Survey Area data. The ILs for analytical results of soil samples and gamma radiation results in Survey Areas A and B are based on Background Reference Areas BG-1 and BG-2, respectively.

In the case of selenium at BG-1, the two detected values appear artificially elevated in Figures 1B and 3, because the remaining sample results were non-detect values. In addition, the two detected values (i.e., 0.930 mg/kg and 0.940 mg/kg) are well within the range of selenium concentrations typically observed in Western U.S. soils (USGS, 1984): range <0.1 – 4.3 mg/kg. Therefore, the Survey Area A IL for selenium is based on the 95-95 UTL value calculated using all BG-1 selenium data.

4.1 SURVEY AREA A INVESTIGATION LEVELS

- Arsenic (mg/kg): 3.35
- Molybdenum (mg/kg): 0.568
- Selenium (mg/kg): 1.10
- Uranium (mg/kg): 3.21
- Vanadium (mg/kg): 12.2
- Ra-226 (pCi/g): 3.59
- Gamma radiation measurements (cpm): 20,677

4.2 SURVEY AREA B INVESTIGATION LEVELS

- Arsenic (mg/kg): 18.6
- Molybdenum (mg/kg): 0.371
- Selenium (mg/kg): None (No IL could be calculated because the two detections are not distinct values)
- Uranium (mg/kg): 1.46
- Vanadium (mg/kg): 22.3
- Ra-226 (pCi/g): 2.02
- Gamma radiation measurements (cpm): 14,707

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Appendix E Cultural and Biological Resource Clearance Documents

BIOLOGICAL EVALUATION

For the Proposed:

Claim 28
Abandon Uranium Mine - Environmental Response Trust Project

Sponsored by:

MWH Global / Stantec

Prepared by:

Adkins Consulting, Inc.
180 East 12th Street, Unit 5
Durango, Colorado 81301

Revised August 2016
June 2016

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1. INTRODUCTION AND PROJECT BACKGROUND

The federal Endangered Species Act (ESA) of 1973, 16 U.S.C. §1531 et seq., requires all federal departments and agencies to conserve threatened, endangered, and critical and sensitive species and the habitats on which they depend, and to consult with the U.S. Fish and Wildlife Service (USFWS) on all actions authorized, funded, or carried out by each agency to ensure that the action will not likely jeopardize the continued existence of any threatened and endangered species or adversely modify critical habitat [USFWS 1998]. This report describes the potential for federal ESA-listed species and Navajo Nation Endangered Species List (NESL) endangered, threatened, candidate, or otherwise designated sensitive flora and fauna to occur in the proposed action area. The action area with regard to the ESA is defined as any area that may be directly or indirectly impacted by the proposed action [50 CFR §402.02]. This report is intended to provide the responsible official with information to make determinations of effect on species with special conservation status.

As the result of settlement by the United States, the Navajo Nation AUM Environmental Response Trust—First Phase was established to evaluate certain abandoned uranium mines located across the Navajo Nation. The project requires investigation of these sites prior to potential remediation activities in the future. MWH Global, a division of Stantec (MWH), will conduct exploratory activities at the Claim 28 abandoned uranium mine (AUM) such as pedestrian gamma surveys, mapping, well sampling, and surface soil sampling within the mine claim boundaries and surrounding buffer zone. Subsequent earthwork and long term monitoring may be involved after final approval by the Navajo Nation Environmental Protection Agency (NNEPA) in conjunction with the U. S. Environmental Protection Agency (USEPA).

In support of this project, MWH contracted Adkins Consulting, Inc. (ACI) to conduct surveys for ESA-listed species and Navajo Nation Endangered Species List (NESL) endangered, threatened, candidate, or otherwise designated sensitive species.

The objectives of the biological surveys were as follows:

- To compile a list of ESA-listed or NESL species potentially occurring in the proposed action area.
- To provide a physical and biological description of the proposed action area.
- To determine the presence of ESA-listed or NESL species in the proposed action area.
- To assess potential impacts the proposed action may have on any ESA-listed or NESL species present in the area.
- To assess potential impacts to species protected under the Migratory Bird Treaty Act (MBTA).

2. PROJECT DESCRIPTION

2.1. Location

Claim 28 is located in Apache County Arizona, approximately 22 miles west of Chinle, Arizona at an elevation of approximately 6,900 feet. Global Positioning System coordinates are 36°14' 42” N by 109° 53' 30” W NAD 83. The site is located on Navajo Tribal Trust Lands within the Bureau of Indian Affairs (BIA) Chinle Agency. The legal description of the project surface location is as follows: Section 20, Township 33 North, Range 23 East, Gila and Salt River Principal Meridian. Project area maps are provided in Appendix A.

2.2. Estimated Disturbance

MWH proposes a phased approach to scientific investigations at the Claim 28 AUM. The study area encompasses the claim boundary and a 100-foot perimeter buffer zone for a total of approximately 27.0 acres. Please refer to Appendix A for maps delineating the mine claim boundary and buffer zone.

The project will also include a walkover survey for gamma radiation across a small area known as the "background area". Please refer to Appendix A for a map of the background sample areas. A few soil samples approximately 3 inches in diameter and up to 6 inches deep will be collected by hand in these areas.

- Phase I: Spring of 2016 activity would entail pedestrian biological surveys and land surveying. Fall of 2016 work would entail pedestrian activity including gamma surveys, mapping, well sampling, and surface soil sampling. In 2016, there will be a maximum of 5 people onsite for no more than 5 to 7 days. Surface disturbance would be minimal and noise would be light.
- Phase II: Beginning in 2017, equipment including an excavator or small mobile drilling unit may be used to collect one or more soil samples. Up to 8 people may be onsite all day for a period of one week. Equipment travel would be confined to a temporary travel corridor approximately 20 feet in width. Within the travel corridor, vegetation and surface soil would sustain some disturbance but would not be bladed or bulldozed. During Phase II, noise may be moderate for a short duration, and surface disturbance will be light to moderate but confined to a minimal footprint within the study area. No permanent structures will be left on site.

3. AFFECTED ENVIRONMENT

3.1. Proposed Project Area (PPA)

The proposed project area (PPA) at Claim 28 includes the mine boundary with a 100-foot buffer zone surrounding the perimeter of the boundary. The affected environment or action area includes any area that may be directly or indirectly impacted by the proposed activities. Project area maps are provided in Appendix A.

3.1.1. Environmental Setting

Project activities would occur in northeastern Arizona located within the USEPA designated Arizona/New Mexico Plateau Level III Ecoregion. The Arizona/New Mexico Plateau occurs primarily in Arizona, Colorado, and New Mexico, with a small portion in Nevada. This ecoregion is approximately 45,870,500 acres, and the elevation ranges from 2,165 to 11,949 feet. The ecoregion's landscapes include low mountains, hills, mesas, foothills, irregular plains, alkaline basins, some sand dunes, and wetlands. This ecoregion is a large transitional region between the semiarid grasslands to the east, the drier shrublands and woodlands to the north, and the lower, hotter, less vegetated areas to the west and south.

Claim 28 is situated on a southwest facing slope near the confluence of Tah Chee and Aspen Wash. To the north, is the large expanse of Black Mesa, and 6 miles to the south, is the small community of Blue Gap, Arizona. The southern portion of the site is within sagebrush and scattered pinon-juniper vegetation communities transitioning to sandstone cliffs and mesa top to the north.

Flora

Vegetation communities found within the region include shrublands with big sagebrush, rabbitbrush, winterfat, shadscale saltbush, and greasewood; and grasslands of blue grama, Western wheatgrass, green needlegrass, and needle-and-thread grass. Higher elevations may support piñon pine and juniper woodlands. The Claim 28 site is within sagebrush and scattered piñon-juniper vegetation communities.

Fauna

Wildlife or evidence of wildlife observed within the PPA included common raven (*Corvus corax*), cottontail rabbit (S*ylvilagus* sp.), coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), golden eagle (*Aquila chrysaetos*), and ferruginous hawk (*Buteo regalis*).

Surveyors observed an active common raven nest and American kestrel nest in the sandstone cliffs west of the PPA, a ferruginous hawk pair was seen soaring in the distance approximately 0.5 mile north of the mine site, and surveyors noted a golden eagle alongside the road when leaving the site approximately one mile south of the PPA boundary. Surveyors also observed an unknown falcon north of the mine site that was most likely a prairie falcon (*Falco mexicanus*) but could not be confirmed. Further analysis of sensitive species can be found in Section 4 of this document.

Hydrology/Wetlands

Under Executive Orders 11988 and 11990, Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and floodplains, and preserve and enhance their natural and beneficial values. These habitats should be conserved through avoidance, or mitigated to ensure that there would be no net loss of wetlands function and value.

Run-off from precipitation in the project area generally drains south through Polacca Wash for 90 miles and joins the Little Colorado River near Leupp, AZ. There are no wetlands, seeps, springs, or riparian areas within the proposed project area. The proposed project activities would contribute to a negligible increase in sedimentation down gradient of the project area. This increase is not anticipated to be a factor due to the distance from perennial waters. There is no suitable habitat for ESA-listed fish, nor critical habitats thereof, in Polacca Wash.

Cumulative impacts to surface waters would be negligible. Surface-disturbing activities other than the proposed action that may cause accelerated erosion include, but are not limited to, construction of roads, other facilities, and installation of trenches for utilities; road maintenance such as grading or ditch-cleaning; public recreational activities; vegetation manipulation and management activities; natural and prescribed fires; and livestock grazing. Because the proposed action would have a negligible impact to downstream surface water quality, the cumulative impact also would be negligible when added to other past, present, and reasonably foreseeable activities.

4. THREATENED, ENDANGERED, AND SENSITIVE SPECIES EVALUATION

The Endangered Species Act (ESA) of 1973 requires all federal departments and agencies to conserve threatened, endangered, and critical and sensitive species and the habitats on which they depend, and to consult with the U.S. Fish and Wildlife Service (USFWS) on all actions authorized, funded, or carried out by the agency to ensure that the action will not likely jeopardize the continued existence of any threatened and endangered species or adversely modify critical habitat.

4.1. Methods

4.1.1. Off-site Methods

Prior to conducting fieldwork, ACI compiled data on species listed under the ESA. Informal consultation was initiated by requesting an Official Species List from the USFWS Information, Planning, and Conservation System (IPaC) website (http://ecos.fws.gov/ipac/). ACI received the Official Species List (02EAAZ00-2016-SLI-0358) on April 7, 2016. See Table 1 for USFWS-listed threatened, endangered, or candidate species with potential to occur in the PPA.

The Navajo Nation Department of Fish and Wildlife (NNDFW), Navajo Natural Heritage Program (File # 15mwh101_a) sent MWH a NESL information letter dated 29 December, 2015. The letter suggests biologists determine habitat suitability within the project area for the provided list of species of concern with potential to occur on the 7.5-minute quadrangles containing the project boundaries. The Navajo species of concern listed in the NESL information letter are included in Table 2.a below.

In addition to the above listed species, ACI reviewed species protected under the MBTA with potential to occur in the proposed project and action area (Table 3).

4.1.2. On-site Survey Methods

An on-site pedestrian survey was conducted in April 2016 by ACI personnel under a permit issued by NNDFW. The purpose of the survey was to assess habitat potential for ESA-listed or NESL animal species. Field biologists with considerable experience identifying local wildlife species lead survey crews. The survey consisted of walking transects ten feet apart throughout the PPA including a survey buffer of approximately 50 feet beyond the PPA edge of disturbance. The surrounding areas were visually inspected with binoculars for nests, raptors, or past signs of raptor use. Weather conditions were clear and visibility was good.

Follow up surveys were conducted at the site specifically targeting Golden eagle (*Aquila chrysaetos*), Ferruginous hawk (*Buteo regalis*), and American peregrine falcon (*Falco peregrinus*) following Navajo Natural Heritage Program (NNHP) guidelines. All wildlife species observed in the action area were recorded, and digital photos were taken (Appendix B). Follow up survey details including date, site conditions and methods can be found on summary sheets attached as Appendix C.

4.2. ESA-Listed Species Analysis and Results

4.2.1. Species from the USFWS IPaC Official Species List

Table 1 includes ESA-listed species that have the potential to occur in the project area based on the USFWS IPaC Official Species List. ACI biologists evaluated habitat suitability within and surrounding the PPA for the species in Table 1.

Table 1: USFWS IPaC Official Species List for the Claim 28 Project

Species	Status	Occurrence Within Region	Habitat	Potential to Occur within Action Area
BIRDS				
California Condor (*Gymnogyps californianus*)	Endangered	In northern Arizona, condors are located primarily near the Vermilion cliffs, Grand Canyon and Coconnino County.[3]	Large areas of remote country for foraging, roosting, and nesting. Roost on large trees or snags, or on isolated rocky outcrops and cliffs. Nests are located in shallow caves and rock crevices on cliffs where there is minimal disturbance. Foraging habitat includes open grasslands and oak savanna foothills that support populations of large mammals such as deer and cattle.[1]	No potential. Action area does not provide suitable habitat for species to occur.

Table 1: USFWS IPaC Official Species List for the Claim 28 Project

Species	Status	Occurrence Within Region	Habitat	Potential to Occur within Action Area
Mexican spotted owl (*Strix occidentalis lucida*)	Threatened with Designated Critical Habitat	Year-round range.[1]	Mixed conifer forests. Typically where unlogged, uneven-aged, closed-canopy forests occur in steep canyons.[1]	No potential. Action area does not provide suitable habitat for species to occur.
Western Yellow-Billed Cuckoo (*Coccyzus americanus*)	Threatened	Possible rare summer/breeding occurrences.[2]	In the southwestern U.S., associated with riparian woodlands dominated by cottonwood or willow trees. In New Mexico, native or exotic species may be used.[2]	No potential. Action area does not provide suitable habitat for species to occur.
FISHES				
Roundtail chub (*Gila robusta*)	Proposed Threatened	San Juan and Mancos Rivers. Rarely encountered in recent surveys; some found from Shiprock to near Lake Powell with most between Shiprock and Aneth. [2,3]	Rocky runs, rapids, and pools of creeks and small to large rivers; also large reservoirs in the upper Colorado River system.[2]	No potential. Action area does not provide suitable habitat for species to occur.
Zuni Bluehead Sucker (*Catostomus discobolus yarrowi*)	Endangered	Native to headwater streams of the Little Colorado River in east-central AZ and west-central NM; current range in NM is limited to the upper Río Nutria drainage.[2]	Low-velocity pools and pool-runs with seasonally dense perilithic and periphytic algae, particularly shady, cobble/boulder/bedrock substrates in streams with frequent runs and pools.[2]	No potential. Action area is within the watershed; however, the PPA is 90 miles from the Little Colorado River; negligible effects from the proposed project to the drainage system are expected.
MAMMALS				
Black-footed ferret (*Mustela nigripes*)	Endangered	Reintroduced into Coconino County.[1]	Open habitat, including grasslands, steppe, and shrub steppe. Closely associated with prairie dog colonies. At least 40 hectares of prairie dog colony required to support one ferret.[2]	No potential. Action area does not provide suitable habitat for species to occur. Action area does not provide prairie dog colonies of sufficient size.

Table 1: USFWS IPaC Official Species List for the Claim 28 Project

Species	Status	Occurrence Within Region	Habitat	Potential to Occur within Action Area
Gray wolf (*Canus lupus*)	Proposed Experimental	In NE AZ, South of Hwy 60 in Apache, Coconino, and Navajo County; In NW NM, south of I-40 in Cibola, McKinley and Catron County.[2]	Not limited to any particular habitat type. Viable populations occur only where human population density and persecution level are low and prey densities are high. Birthing dens may be on bluffs or slopes among rocks or in enlarged badger holes. In Arizona and New Mexico, diet includes primarily elk and sometimes livestock, deer, rodents, or lagomorphs.[2]	No potential. Action area may provide suitable habitat; however, human activity in the area would be a limiting factor. Action area is outside of range for this species.
REPTILES				
Northern Mexican gartersnake (*Thamnophis eques megalops*)	Threatened	Most of AZ; In SE NM including Catron, Grant and Hildago County [2]	Considered a riparian obligate except during dispersal behavior. Occurs chiefly in the following general habitat types: (1) Source-area wetlands [e.g., cienegas (mid-elevation wetlands with highly organic, reducing (basic, or alkaline) soils), stock tanks (small earthen impoundment), etc.]; (2) large river riparian woodlands and forests; and (3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass). Occurs at elevations 130 to 8,497 (ft).[2]	No potential. Action area does not provide suitable habitat for species to occur.

[1]USFWS; [2]NatureServe Explorer; [3]Navajo Endangered Species List, Species Accounts 2008; [4]Redente 2016

4.2.2. ESA-Listed Species Eliminated From Further Consideration

Table 1 includes eight (8) ESA-listed species that have the potential to occur in the project area based on the USFWS IPaC Official Species List. All of the species in Table 1 have been eliminated from further discussion in this report. There would be no direct, indirect or cumulative impacts to the species in Table 1.

4.3. NESL Species Analysis and Results

4.3.1. Navajo Endangered Species List (NESL) and Species of Concern

Table 2.a lists species of concern with potential to occur on the 7.5-minute quadrangle(s) containing the project boundaries. According to the NESL information letter received from the NFWD found in Appendix D, the banner tailed kangaroo rat (*Dipodomys spectabilis*) is known to occur within three miles of project

site. ACI biologists evaluated the potential for the species of concern listed in the table below to occur within the project area.

Additionally, the NESL information letter requested that the potential for black-footed ferret (*Mustela nigripes*) be evaluated if prairie dog towns of sufficient size (per NFWD guidelines) occur in the project area, and that potential for Parish's alkali grass (*Puccinellia parishii*) be evaluated if wetland conditions exist that contain white alkaline crusts. Species listed by the USFWS in Table 1 are not reiterated here.

Table 2.a: Navajo Endangered Species List (NESL) and Species of Concern

Species	Status	Habitat Associations	Potential to Occur in Project or Action Area
ANIMALS			
Mountain plover *(Charadrius montanus)*	NESL G4	Typically nests in flat (<2% slope) to slightly rolling expanses of grassland, semi-desert, or badland, in an area with short, sparse vegetation, large bare areas (often >1/3 of total area), and that is typically disturbed (e.g. grazed); may also nest in plowed or fallow cultivation fields. Nest is a scrape in dirt often next to a grass clump or old cow manure pile. Migration habitat is similar to breeding habitat.[2,3]	No potential. Action area does not provide suitable habitat for species to occur.
Golden eagle (*Aquila chrysaetos*)	NESL G3	In the west, mostly open habitats in mountainous, canyon terrain. Nests primarily on cliffs. [3]	Action area provides potential foraging habitat for species to occur. Sandstone cliffs surrounding the site provide potential nesting habitat.
Ferruginous hawk (*Buteo regalis*)	NESL G3	Breed in open country, usually prairies, plains and badlands; semi- desert grass-shrub, sagebrush-grass & piñon-juniper plant associations. [3]	Action area provides potential foraging habitat for species to occur. Sandstone cliffs surrounding the site provide potential nesting habitat.
American peregrine falcon (*Falco peregrinus*)	NESL G4 NM-T	Nests on steep cliffs >30 m tall (typically >45 m) in a scrape on sheltered ledges or potholes. Foraging habitat quality is an important factor; often, but not always, extensive wetland and/or forest habitat is within the falcon's hunting range of <=12 km. Nest in ledges or potholes on cliffs in wooded/forested habitats; Forage over riparian woodlands, coniferous & deciduous forests, shrublands, prairies. [3]	Action area provides marginal potential foraging habitat. Cliffs surrounding the site provide marginal nesting habitat.
Banner tailed kangaroo rat (*Dipodomys spectabilis*)	NESL G4	Potential range includes desertlands east of the Chuska Mountains, and east and north of Black Mesa in Apache Co., AZ and San Juan Co., UT. Dens are elaborate, distinctive burrow systems usually with 3-12 burrow openings on a discrete, raised mound (<or=1.2 m tall by 1.5-4.5 m diameter) in Great Basin desert grassland or desertscrub, with heavier soils. Presence of grasses is necessary. [3,4,6]	Action area provides suitable habitat for species to occur. Southern portion of the site within the flat provides potential habitat; however, no burrows found within or near PPA during survey.

Species	Status	Habitat Associations	Potential to Occur in Project or Action Area
PLANTS			
Parish's alkali grass (*Puccinellia parishii*)	NESL G4 NM-E	Alkaline springs, seeps, and seasonally wet areas that occur at the heads of drainages or on gentle slopes. Elevation: 2600-7200 feet.[2,3]	No potential. Action area does not provide suitable alkaline soils for species to occur.

Species are listed by the NESL as; Group 2: Endangered (survival or recruitment in jeopardy); Group 3: Endangered (survival or recruitment in jeopardy in foreseeable future); and Group 4: Species of Consideration. NESL Species with New Mexico State Endangered or Threatened status are labeled as NM-T or NM-E.

Sources: Sources: [1]New Mexico Natural Heritage Program 2010, [2]NatureServe Explorer; [3]Navajo Endangered Species List, Species Accounts 2008, [4] IUCN Red List, [5]Redente 2016, [6] Hammerson et al 2004.

4.3.2. NESL Species Eliminated From Further Consideration

Table 2.a includes six (6) NESL and Navajo Species of Concern that have the potential to occur in the project area based on the general geographical association. The following species have been eliminated from further discussion in this report because the action area does not provide suitable habitat for them to occur: Mountain plover *(Charadrius montanus),* Banner tailed kangaroo rat *(Dipodomys spectabilis),* and Parish's alkali grass *(Puccinellia parishii)*. None of these species were observed during surveys of the proposed project area or immediate surroundings. Critical habitats of these species do not exist within or adjacent to the proposed project area. There would be no direct, indirect or cumulative impacts to these species.

Habitat potential was assessed for the American peregrine falcon (*Falco peregrinus*) within the action area. ACI biologists determined the sandstone cliffs within and surrounding the site to be marginal potential nesting habitat for this species and conducted follow up surveys to closely examine the cliff faces for any signs of use. Sixteen hours of observation following Navajo Natural Heritage Program (NNHP) protocol were conducted during April 2016. ACI biologists saw no sign of use by this species and concluded the habitat was not likely to be used by American peregrine falcon based on this detailed study. Survey results were discussed with Chad Smith, NNDFW zoologist, and with his concurrence, no further surveys were conducted. The project site was eliminated as potential nesting habitat for the following reasons: Cliff walls are approximately 100 feet in height but are somewhat sloped and ledged instead of sheer, the surrounding area does not provide the preferred extensive riparian or forested foraging habitat for this species, and the presence of prairie falcon typically distinguishes habitat from that of American peregrine falcon on Navajo lands (Chad Smith--NNDFW zoologist, personal communication, May 9th, 2016).

4.3.3. NESL Species Warranting Further Analysis

Table 2.b lists NESL and Navajo Species of Concern with potential to occur within the proposed project area based on habitat suitability or actual record of observation.

Table 2.b: NESL and Navajo Species of Concern Warranting Further Analysis

Species	Status	Habitat Associations	Potential to Occur in Project or Action Area
ANIMALS			
Golden eagle (*Aquila chrysaetos*)	NESL G3	In the west, mostly open habitats in mountainous, canyon terrain. Nests primarily on cliffs. [3]	Action area provides potential foraging habitat for species to occur. Sandstone cliffs surrounding the site provide potential nesting habitat.

Species	Status	Habitat Associations	Potential to Occur in Project or Action Area
Ferruginous hawk (*Buteo regalis*)	NESL G3	Breed in open country, usually prairies, plains and badlands; semi-desert grass-shrub, sagebrush-grass & piñon-juniper plant associations. [3]	Action area provides potential foraging habitat for species to occur. Sandstone cliffs surrounding the site provide potential nesting habitat.

Species are listed by the NESL as; Group 2: Endangered (survival or recruitment in jeopardy); Group 3: Endangered (survival or recruitment in jeopardy in foreseeable future); and Group 4: Species of Consideration. NESL Species with New Mexico State Endangered or Threatened status are labeled as NM-T or NM-E.

Sources: [1]New Mexico Natural Heritage Program 2010, [2]NatureServe Explorer; [3]Navajo Endangered Species List, Species Accounts 2008, [4] IUCN Red List, [5]Redente 2016, [6] Hammerson et al 2004.

4.4. Migratory Bird Species

The Migratory Bird Treaty Act (MBTA) implements various treaties and conventions between the U.S. and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful.

The bald eagle (*Haliaeetus leucocephalus*) was delisted under the ESA on August 9, 2007. Both the bald eagle and golden eagle (*Aquila chrysaetos*) are still protected under the MBTA and Bald and Golden Eagle Protection Act (BGEPA). The BGEPA affords both eagles protection in addition to that provided by the MBTA, in particular, by making it unlawful to "disturb" eagles.

In preparation for conducting the migratory bird survey, information from the New Mexico Partners In Flight website (http://www.hawksaloft.org/pif.shtml), the New Mexico PIF highest priority list of species of concern by vegetation type, the USFWS's Division of Migratory Bird Management website (http://www.fws.gov/migratorybirds/), and the 2002 Birds of Conservation Concern Report for the Southern Rockies/Colorado Plateau Bird Conservation Region (BCR) No. 16, were used to develop a list of high priority migratory bird species with potential to occur in the area of the proposed action. Species addressed previously will not be reiterated here.

Table 3: Priority Birds of Conservation Concern with Potential to Occur in the Project Area

Species Name	Habitat Associations	Potential to Occur in the Project Area
Black-throated sparrow (*Amphispiza bilineata*)	Xeric habitats dominated by open shrubs with areas of bare ground.	No suitable habitat is present within the action area for species to occur.
Brewer's sparrow (*Spizella breweri*)	Closely associated with sagebrush, preferring dense stands broken up with grassy areas.	No suitable habitat is present within the action area for species to occur.
Gray vireo (*Vireo vicinior*)	Open stands of piñon pine and Utah juniper (5,800 – 7,200 ft) with a shrub component and mostly bare ground; antelope bitterbrush, mountain mahogany, Utah serviceberry and big sagebrush often present. Broad, flat or gently sloped canyons, in areas with rock outcroppings, or near ridge-tops.	Suitable habitat is present within the action area for species to occur.
Loggerhead shrike (*Lanius ludovicianus*)	Open country interspersed with improved pastures, grasslands, and hayfields. Nests in sagebrush areas, desert scrub, and woodland edges.	No suitable habitat is present within the action area for species to occur.
Mountain bluebird (*Sialia currucoides*)	Open piñon-juniper woodlands, mountain meadows, and sagebrush shrublands; requires larger trees and snags for cavity nesting.	Suitable habitat is present within the action area for species to occur.
Mourning dove (*Zenaida*	Open country, scattered trees, and woodland	No suitable habitat is present within

macroura)	edges. Feeds on ground in grasslands and agricultural fields. Roost in woodlands in the winter. Nests in trees or on ground.	the action area for species to occur.
Sage sparrow (*Amphispiza belli*)	Large and contiguous areas of tall and dense sagebrush. Negatively associated with seral mosaics and patchy shrublands and abundance of greasewood.	No suitable habitat is present within the action area for species to occur.
Sage thrasher (*Oreoscoptes montanus*)	Shrub-steppe dominated by big sagebrush.	No suitable habitat is present within the action area for species to occur.
Scaled quail (*Callipepla squamata*)	Brushy arroyos, cactus flats, sagebrush or mesquite plains, desert grasslands, Plains grasslands, and agricultural areas. Good breeding habitat has a diverse grass composition, with varied forbs and scattered shrubs.	No suitable habitat present within the action area for species to occur. Lack of diverse grass composition with varied forbs likely a limiting factor.
Swainson's hawk (*Buteo swainsoni*)	A mixture of grassland, cropland, and shrub vegetation; nests on utility poles and in isolated trees in rangeland. Nest densities higher in agricultural areas.	No suitable habitat is present within the action area for species to occur.
Vesper sparrow (*Pooecetes gramineus*)	Dry montane meadows, grasslands, prairie, and sagebrush steppe with grass component; nests on ground at base of grass clumps.	No suitable habitat present within the action area for species to occur. Lack of significant grassland/prairie component a limiting factor.
Bald eagle (*Haliaeetus leucocephalus*)	Near lakes, rivers and cottonwood galleries. Nests near surface water in large trees. May forage terrestrially in winter	No suitable habitat present within the action area for species to occur.
Bendire's thrasher (*Toxostoma bendirei*)	Typically inhabits sparse desert shrubland & open woodland with scattered shrubs; breeds in scattered locations in central & western portions of NM; most common in southwest NM.	No suitable habitat is present within the action area for species to occur.
Piñon jay (*Gymnorhinus cyanocephalus*)	Foothills throughout CO and NM wherever large blocks of piñon-juniper woodland habitat occurs.	Suitable habitat present within the action area for species to occur.
Prairie falcon (*Falco mexicanus*)	Arid, open country, grasslands or desert scrub, rangeland; nests on cliff ledges, trees, power structures.	Action area provides potential foraging and nesting habitat for species to occur.
Western burrowing owl (*Athene cunicularia hypugaea*)	Open grasslands and sometimes other open areas (such as vacant lots). Nests in abandoned burrows, such as those dug by prairie dogs.	No suitable habitat present within the action area for species to occur.

5. EFFECTS ANALYSIS

Effects or impacts can be either long term (permanent or residual) or short term (incidental or temporary). Short-term impacts affect the environment for only a limited period and then the environment reverts rapidly back to pre-action conditions. Long-term impacts are substantial and permanent alterations to the pre-existing environmental condition. Direct effects are those effects that are caused by the action and occur in the same time and place as the action. Indirect effects are those effects that are caused by or will result from the proposed action and are later in time but still reasonably certain to occur (USFWS 1998).

5.1. Direct and Indirect Effects

The PPA includes the claim boundary and a 100-foot perimeter buffer zone for a total of approximately 27.0 acres. The project will also include a walkover survey for gamma radiation across a small area known as the “background area” (see Appendix A for map). A few soil samples approximately 3 inches in diameter and up to 6 inches deep will be collected by hand in these areas. The proposed action would result in a short term increase in human activity within the PPA at varying degrees depending on the project phase:

- Phase I: Spring of 2016 activity would entail pedestrian biological surveys and land surveying. During 2016, work would entail pedestrian activity including gamma surveys, mapping, well sampling, and surface soil sampling. For this phase, there will be a maximum of 5 people onsite for no more than 5 to 7 days. Surface disturbance would be minimal and noise would be light.

- Phase II: Beginning in 2017, equipment including an excavator or small mobile drilling unit may be used to collect one or more soil samples. Up to 8 people may be onsite all day for a period of one week. Equipment travel would be confined to a temporary travel corridor approximately 20 feet in width. Within the travel corridor, vegetation and surface soil would sustain some disturbance but would not be bladed or bulldozed. During Phase II, noise may be moderate for a short duration, and surface disturbance will be light to moderate but confined to a minimal footprint within the study area. No permanent structures will be left on site.

Best Management Practices (BMPs) incorporated into project design will reduce potential impacts including: confining equipment travel to PPA boundary, minimizing travel corridors as much as practicable, limiting truck and equipment travel within the PPA when surfaces are wet and soil may become deeply rutted, and using previously disturbed areas for travel when possible.

5.1.1. Golden eagle, Ferruginous hawk

Habitat potential was assessed for the golden eagle and ferruginous hawk within the action area. ACI biologists determined the sandstone cliffs surrounding the site to be potential nesting habitat for this species and conducted follow up surveys to closely examine the cliff faces for any signs of use. Observations following Navajo Natural Heritage Program (NNHP) protocol were conducted during April 2016. ACI biologists observed a ferruginous hawk pair soaring in the distance approximately 0.5 mile north of the mine site, and surveyors noted a golden eagle alongside the road when leaving the site approximately 1 mile south of the PPA boundary. No active nests for these species were observed.

Phase I:
Noise and surface disturbance will be low and short term during pedestrian survey activity. Adult raptors would not be directly impacted by Phase I because of their mobility and ability to avoid areas of human activity. The area is not currently occupied as a nest territory; Phase I activities that may occur within the breeding season are unlikely to discourage adults from selecting the area as a new nest territory. Direct and indirect effects from Phase I are expected to be short term and negligible.

Phase II:
During Phase II, noise may be moderate for a short duration, and surface disturbance will be light to moderate within a minimal footprint at the study area. No permanent structures will be left on site. Adult raptors would not be directly harmed by Phase II activities because of their mobility and ability to avoid areas of human activity. Phase II activities that may occur within the breeding season may disrupt potential nesting in the area. Nest initiation or nesting activity within the PPA is not expected to be directly impacted if activities occur outside of the raptor breeding season for the region: for golden eagle, 15 January to 15 July; and for ferruginous hawk, 1 March to 1 May for nests with no eggs and until mid to late July for productive nests (Navajo Nation Division of Natural Resources, Department of Fish and Wildlife 2008b).

5.1.2. *Migratory Birds*

The PPA encompasses approximately 27.0 acres of potential migratory bird habitat in the form of Great Basin Desert scrub and rocky ledges. Numerous trees are within the PPA boundary.

During the April 2016 survey of the PPA surveyors observed an active common raven nest and American kestrel nest in the sandstone cliffs west of the PPA. Pictures can be found in Appendix B, and the sighting locations are noted on aerial imagery in Appendix A.

Phase I:
Noise and surface disturbance will be low during pedestrian survey activity. Adult migratory birds would not be directly impacted by Phase I because of their mobility and ability to avoid areas of human activity. Minor human presence during project activities within the breeding season may indirectly disturb or displace adults from nests and foraging habitats for a short period of time. Direct and indirect effects are expected to be short term and negligible.

Phase II:
Adult migratory birds would not be directly harmed by the activities because of their mobility and ability to avoid areas of human activity. During Phase II, noise may be moderate but for a short duration, and surface disturbance will be light to moderate but confined to a minimal footprint within the study area. No permanent structures will be left on site. No active nests within the PPA are expected to be directly impacted during Phase II if activities occur outside of the typical migratory bird breeding season. The increased human presence during project activities within the breeding season may indirectly disturb or displace adults from nests and foraging habitats for a short period of time. Direct impacts are more likely if surface disturbing activities occur during the breeding season (April 1 through August 15).

5.2. Cumulative Effects

Cumulative impacts of an action include the total effects on a resource or ecosystem. Cumulative effects in the context of the Endangered Species Act pertain to non-Federal actions, and are reasonably certain to occur in the action area (USFWS 1998).

5.2.1. *Golden eagle, Ferruginous hawk*

Additional existing surface disturbances within the action area include unimproved access roads to the residences nearby, all-terrain vehicle use and active wildlife and livestock grazing. Local plant and animal pest control are also activities that may occur in the vicinity. These foreseeable actions would cumulatively impact raptors through habitat loss or contamination. Human activity may also increase available prey base if the activity leads to an increase in rodent population numbers. The intensity of indirect effects would be dependent upon the species, its life history, time of year and/or day and the type and level of human and vehicular activity is occurring.

5.2.2. *Migratory Birds*

With the implementation of BMPs discussed in Section 5.1, the cumulative impact of the proposed action on migratory birds would be low based on the minimal surface disturbance involved and the availability of adjacent similar habitats.

6. CONCLUSIONS

U.S. Fish and Wildlife Service Listed Species (USFWS)

ACI conducted informal consultation with the USFWS and received an Official Species List for the proposed project area. Qualified ACI biologists evaluated habitat suitability within and surrounding the PPA for these species and concluded the potential does not exist for USFWS-listed species to occur within the proposed project area. No further consultation with the USFWS is required.

Migratory Birds

The proposed action phases would result in varying degrees of noise and surface disturbance within approximately 27.0 acres of potential migratory bird habitat in the form of Great Basin Desert scrub, rocky ledges and numerous piñon-juniper trees. During Phase I, noise and surface disturbance will be low during pedestrian survey activity. Direct and indirect effects are expected to be short term and negligible. For Phase II, the total surface disturbance is unknown at this point; however equipment movement would be confined to only a few temporary travel corridors. Within the travel corridors, vegetation and surface soil would sustain some disturbance but would not be bladed or bulldozed. Possible direct impacts would be short term and are more likely if surface disturbing activities occur during the breeding season (April 1 through August 15). Effects to potential habitat for migratory birds is anticipated to be minor and short term due to the limited degree of vegetation and soil disruption and the abundance of adjacent habitat for these species.

Wetlands

Under Executive Orders 11988 and 11990, Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and floodplains, and preserve and enhance their natural and beneficial values. These habitats should be conserved through avoidance, or mitigated to ensure that there would be no net loss of wetlands function and value. No impacts to wetlands are anticipated. The proposed project activities would contribute to a negligible increase in sedimentation down gradient of the project area. This increase is not anticipated to be a factor due to the distance from perennial waters. There is no suitable habitat for ESA-listed fish, nor critical habitats thereof, within 90 miles of the PPA.

Navajo Endangered Species List (NESL) and Species of Concern

Two (2) NESL and Navajo species of concern have potential to occur within of near the PPA based on habitat suitability or actual record of observation. Based on site surveys, ACI determined the surrounding areas contain potential foraging and nesting habitat for the following: golden eagle and ferruginous hawk.

Potential effects to these species are discussed in detail in Section 5 above. The short term increased human activity and ground disturbance associated with Phase II of the project may have some impact on these species; however, with the implementation of recommendations discussed in Section 7 below, it is unlikely that the proposed action would result in detriment to the two (2) NESL and Navajo species of concern.

7. RECOMMENDATIONS FOR AVOIDANCE

1. ACI recommends that the proponent implement standard Best Management Practices (BMPs) designed to protect sensitive wildlife species during project activity including: confining equipment travel to PPA boundary, minimizing travel corridors as much as practicable, limiting truck and equipment travel within the PPA when surfaces are wet and soil may become deeply rutted, and using previously disturbed areas for travel when possible.

2. For ferruginous hawk, ACI recommends a survey of the cliffs within 0.25 mile of the PPA boundary prior to activities involving large groups of people and vehicles (>6), machinery, or loud equipment, if those activities will occur during the typical ferruginous hawk breeding season of 1 March to 1 May for nests with no eggs and until mid to late July for productive nests (Navajo Nation Division of Natural Resources, Department of Fish and Wildlife 2008b). ACI makes this recommendation based on observing a ferruginous hawk pair soaring just north of the PPA during the April 2016 survey.

8. SUPPORTING INFORMATION

8.1. Consultation and Coordination

John Nystedt, Fish and Wildlife Biologist/AESO Tribal Coordinator
USFWS AZ Ecological Services Office - Flagstaff Suboffice
Southwest Forest Science Complex, 2500 S Pine Knoll Dr, Rm 232
Flagstaff, AZ 86001

Pam Kyselka, Project Reviewer and
Chad Smith, Zoologist
Navajo Nation Department of Fish and Wildlife
Natural Heritage Program
PO Box 1480
Window Rock, AZ 86515

8.2. Report Preparers and Certification

Adkins Consulting, Inc.
180 E. 12th Street, Unit 5
Durango, Colorado 81301
Lori Gregory, Biologist; Sarah McCloskey, Field Biologist; Arnold Clifford, Lead Field Biologist

It is believed by Adkins Consulting that the proposed action would not violate any of the provisions of the Endangered Species Act of 1973, as amended. Conclusions are based on actual field examination and are correct to the best of my knowledge.

1 August 2016

______________________________ ________
Lori Gregory Date
Wildlife Biologist
Adkins Consulting
505.787.4088

8.3. References

Code of Federal Regulations (CFR). Interagency Cooperation--50 CFR §402 (June 3, 1986). U.S. Government Publishing Office Electronic Code of Federal Regulations. 732 North Capitol Street, NW, Washington, DC. Retrieved from: https://www.gpo.gov/fdsys/search/home.action.

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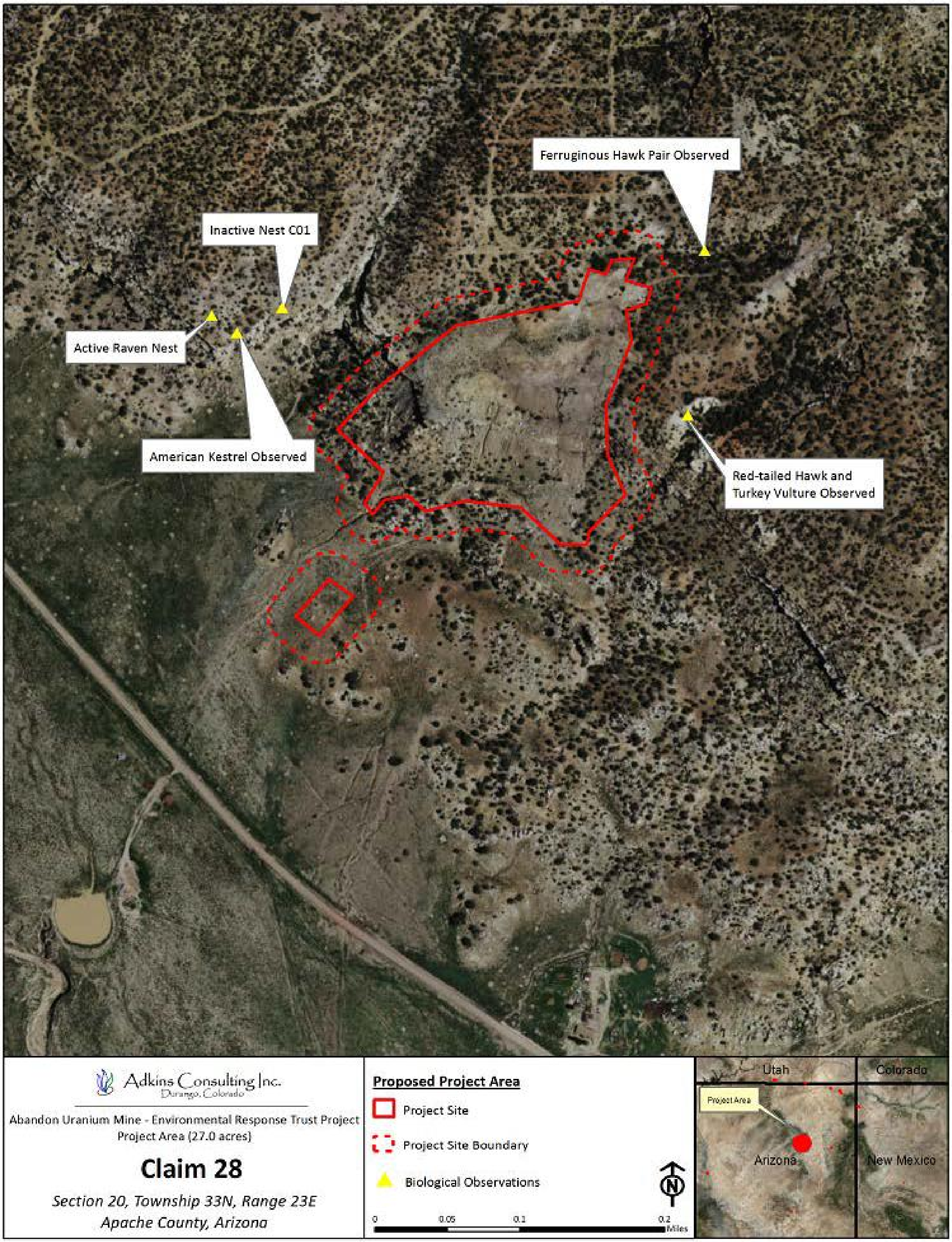
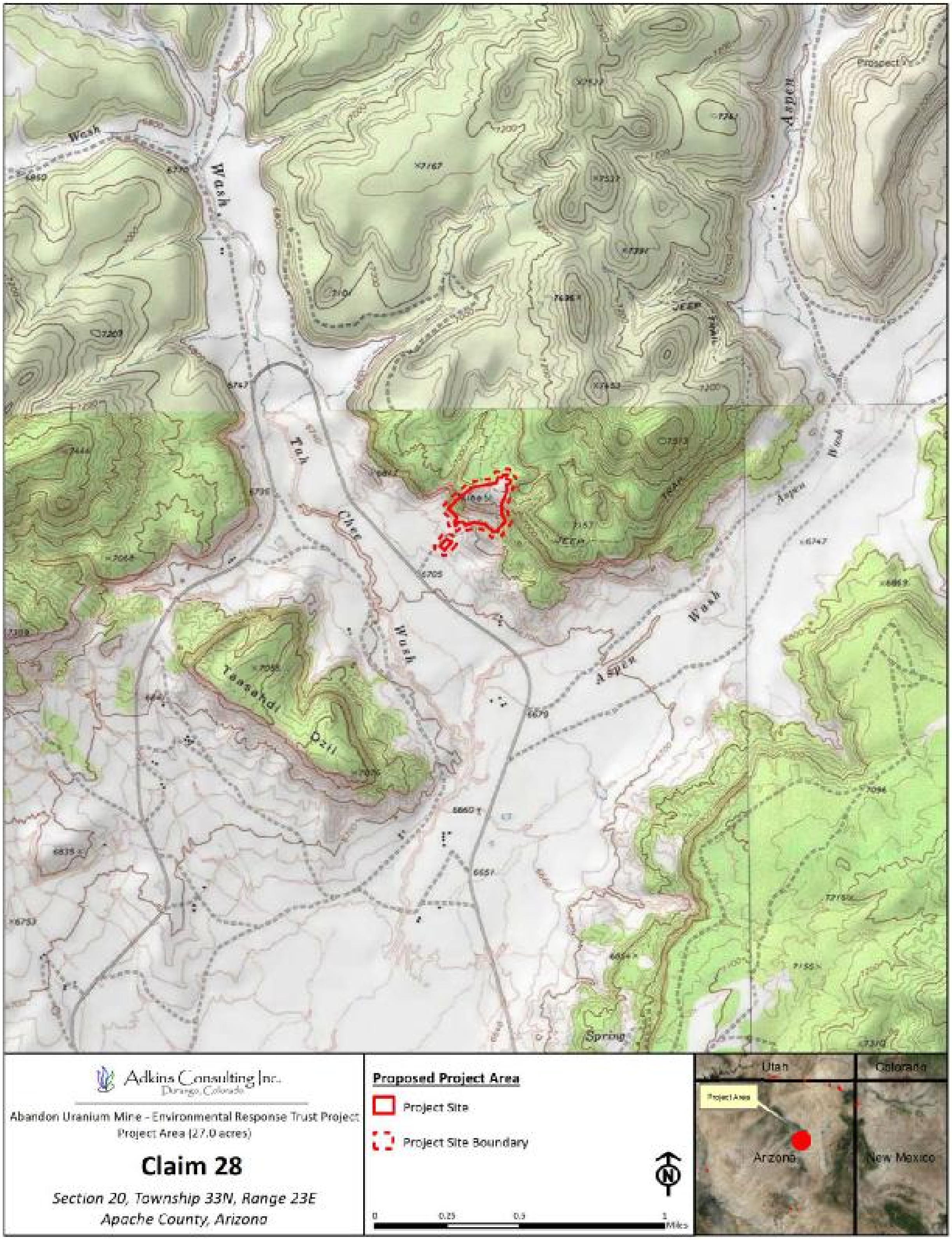
APPENDIX A. MAPS





Adkins Consulting Inc.
Durango, Colorado

Abandon Uranium Mine - Environmental Response Trust Project
Project Area (27.0 acres)

Claim 28

Section 20, Township 33N, Range 23E
Apache County, Arizona

Proposed Project Area

- 🟥 Project Site
- ⬚ Project Site Boundary

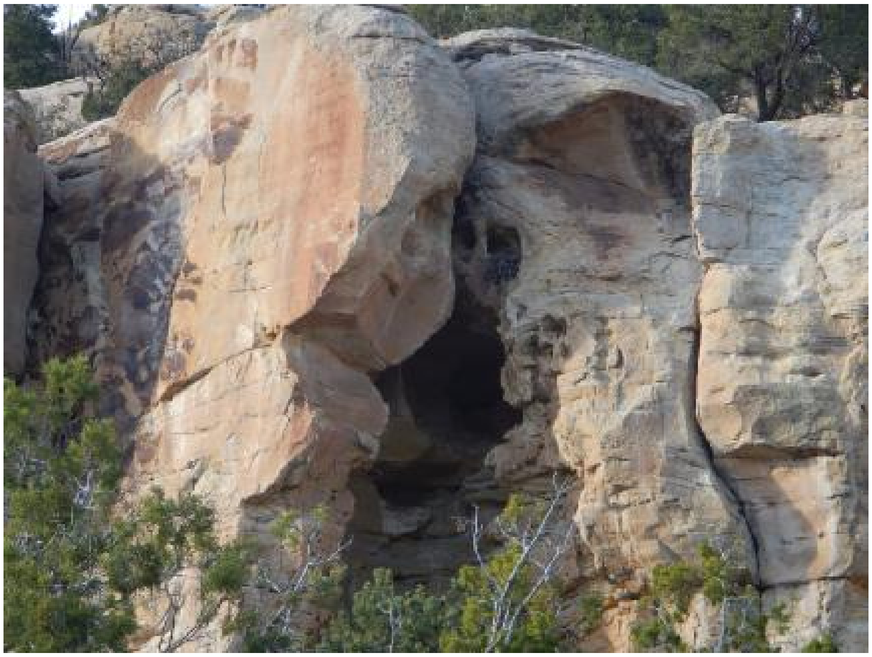
APPENDIX B. PHOTOGRAPHS

View from south PPA looking northwest

View from south PPA looking north

View from north PPA looking north

Old nest (C-01 on map) southeast of the PPA



Raven nest

APPENDIX C. NOTES FROM SPECIES SPECIFIC SURVEYS

Adkins Consulting Inc.
Environmental Permitting Services
180 East 12 Street Suite #5
Durango, CO 81301
Phone: 505-793-1140

DAILY REPORT
Field Surveys

PROJECT NAME: NN AUM SITE: Claim 28

DATE: 04/07/2016

WEATHER: Sunny High 50's, light breeze

PERSONELL ONSITE: Arnold Clifford (Principal Biologist), Sarah McCloskey (Field Assistant)

==

CONTRACTORS ONSITE NOTES:

The site is located within the beginning of a canyon entrance with sandstone cliffs within a half mile to the south and west of the site. The southern portion of the site is within sagebrush and scattered pinon juniper vegetation communities transitioning to sandstone cliffs and mesa top to the north of the site. The sandstone cliffs within and surrounding the site provide potential habitat for Peregrine Falcon as well as Golden Eagle and small badland outcrops along the base of the cliffs provide possible Ferruginous Hawk habitat. Site will require further surveys.

Adkins Consulting Inc.
Environmental Permitting Services
180 East 12 Street Suite #5
Durango, CO 81301
Phone: 505-793-1140

DAILY REPORT
Field Surveys

PROJECT NAME: NN AUM SITE: Claim 28

DATE: 4/24/16

WEATHER: Sunny, calm, temps mid 60's

PERSONNEL ONSITE: Arnold Cifford (Principal Biologist), Sarah McCloskey (Field Assistant)

==

CONTRACTORS ONSITE NOTES:

Background: During the previous habitat assessment survey, habitat was documented for Golden Eagles, Peregrine Falcons and Ferruginous Hawks.

Purpose: In areas where suitable habitat occurs, a formal survey of the species is to be performed following Navajo Nation survey protocols[1] outlined below:

Golden Eagle – A single pedestrian survey with high-power optics for nest sites or breeding adults from 1 MAR-15 JUN.

Ferruginous Hawk – A single pedestrian survey with high-power optics for nest sites or breeding adults from 1 MAR-15 JUN.

Peregrine Falcons - Two 8 hours surveys (4 hours before sunset and 4 hours after sunrise the following day) during each period: 1 FEB-30 APR (surveys during egg-laying/incubation discouraged) & 1 MAY-31 JUL (2 survey preferably prior to JUL). Productivity surveys require >=1 additional visits.

Methods: Surveys were performed for Peregrine Falcon and Golden Eagle. Surveyors arrived at the project site at 4:30 p.m. and conducted a thorough survey of the project area. Surveys included establishing appropriate vantage points, remaining at those points for 20 to 30 minutes listening for calls and using high powered binoculars to examine cliff faces for signs of nesting (ex. whitewash, nests, single or pairs of adults remaining in the area, etc.) and continuing father down the canyon until dark. Surveyors left the site at 8:35 p.m.

Additional Information: This concludes the required surveys for the Golden Eagle and Ferruginous Hawk at the Claim 28 site. Surveyors will revisit site tomorrow (4/25/16) to complete the morning portion of the Peregrine Falcon survey. One more complete Peregrine Falcon survey (evening and following morning) will be needed at the site before April 30th.

Findings: Observers located a raven nest west of the mine site along a cliff ledge. A single Ferruginous Hawk was seen flying from the north above the mine site pursuing a raven. They remained in the area for less than a minute then flew back north out of site. A pair of Ferruginous Hawks were then seen approximately 30 minutes later soaring in the distance approximately 0.5 miles north of the mine site.

Adkins Consulting Inc.
Environmental Permitting Services

180 East 12 Street Suite #5
Durango, CO 81301
Phone: 505-793-1140

DAILY REPORT
Field Surveys

PROJECT NAME: NN AUM SITE: Claim 28

DATE: 4/25/16

WEATHER: Party cloudy, calm for most of the survey, winds picked up to 5-10 mph for approximately 30 minutes before the end of survey temps low 50's

PERSONNEL ONSITE: Arnold Clifford (Principal Biologist), Sarah McCloskey (Field Assistant)

==

CONTRACTORS ONSITE NOTES:

Background: During the previous habitat assessment survey, habitat was documented for Golden Eagles, Peregrine Falcons, and Ferruginous Hawk. Surveys were completed for Golden Eagle and Ferruginous Hawk last night (4/24/16).

Purpose: In areas where suitable habitat occurs, a formal survey of the species is to be performed following Navajo Nation survey protocols[1] outlined below:

Peregrine Falcons - Two 8 hours surveys (4 hours before sunset and 4 hours after sunrise the following day) during each period: 1 FEB-30 APR (surveys during egg-laying/incubation discouraged) & 1 MAY-31 JUL (2 survey preferably prior to JUL). Productivity surveys require >=1 additional visits.

Methods: Surveyors arrived at the project site at 6:15 a.m. and conducted a thorough survey of the project area. Surveys included establishing appropriate vantage points, remaining at those points for 20 to 30 minutes listening for calls and using high powered binoculars to examine cliff faces for signs of nesting (ex. whitewash, nests, single or pairs of adults remaining in the area, etc.) and continuing father down the canyon until 10:15 a.m.

Additional Information: This completes the first of two required surveys before April 30th. Surveyors will return tonight for the pm portion of the second survey.

Findings: The raven nest located yesterday was still active. A Red-Tailed hawk was seen soaring north of the mine site and remained in the area for a few minutes then left and was not seen or heard again. An American Kestrel was observed leaving a crevice within the sandstone cliffs west of the mine site. Crevice is heavily whitewashed and Kestrel remained in the area for a few minutes exhibiting an alarm call then flew out of site to the east. During the same time another unidentified Falcon flew from the north overhead from the mesa above the mine site then quickly flew back the same direction. The Falcon was likely a Prairie Falcon but identity could not be confirmed. Surveyors noted a Golden Eagle alongside the road when leaving the site approximately 1 miles south of the survey area, was likely foraging.

Adkins Consulting Inc.
Environmental Permitting Services

180 East 12 Street Suite #5
Durango, CO 81301
Phone: 505-793-1140

DAILY REPORT
Field Surveys

PROJECT NAME: NN AUM SITE: Claim 28

DATE: 4/25/16

WEATHER: Cloudy, light to strong winds subsiding throughout the evening, it began snowing about half way through the survey, temps mid 30's

PERSONNEL ONSITE: Arnold Clifford (Principal Biologist), Sarah McCloskey (Field Assistant)

==

CONTRACTORS ONSITE NOTES:

Background: During the previous habitat assessment survey, habitat was documented for Golden Eagles, Peregrine Falcons and Ferruginous Hawks. Surveys were completed for Golden Eagle and Ferruginous Hawk on (4/23/16). The first of two Peregrine Falcon surveys was also completed this morning.

Purpose: In areas where suitable habitat occurs, a formal survey of the species is to be performed following Navajo Nation survey protocols[1] outlined below:

Peregrine Falcons - Two 8 hours surveys (4 hours before sunset and 4 hours after sunrise the following day) during each period: 1 FEB-30 APR (surveys during egg-laying/incubation discouraged) & 1 MAY-31 JUL (2 survey preferably prior to JUL). Productivity surveys require >=1 additional visits.

Methods: Surveyors arrived at the project site at 4:10 p.m. and conducted a thorough survey of the project area. Surveys included establishing appropriate vantage points, remaining at those points for 20 to 30 minutes listening for calls and using high powered binoculars to examine cliff faces for signs of nesting (ex. whitewash, nests, single or pairs of adults remaining in the area, etc.) and continuing father down the canyon until dark. Surveyors left the site at 8:10 p.m.

Additional Information: Tomorrow's morning survey will complete the second of two required surveys before April 30th.

Findings: The raven nest located yesterday was still active. A Turkey Vulture flew into the canyon from the north, flew around the area for about a minute then returned north. No other raptors were seen or heard during the survey.

APPENDIX D. NESL LETTER

NNHP
Navajo Natural Heritage Program

PO Box 1480
Window Rock, AZ
86515

P 928.871.6472
F 928.871.7603

http://nnhp.nndfw.org

15mwh101_a

29-December-2015

Eileen Dornfest - Project Manager
MWH Americas
3665 John F Kennedy Parkway
Bldg 1, Suite 206
Ft. Collins, CO 80525

SUBJECT: Navajo Nation AUM Environmental Response Trust (ERT) Project - Mine Claim 28 Added

Eileen Dornfest,

NNHP has performed an analysis of your project in comparison to known biological resources of the Navajo Nation and has included the findings in this letter. The letter is composed of seven parts. The sections as they appear in the letter are:

1. **Known Species** – a list of all species within relative proximity to the project
2. **Potential Species** – a list of potential species based on project proximity to respective suitable habitat
3. **Quadrangles** – an exhaustive list of quads containing the project
4. **Project Summary** – a categorized list of biological resources within relative proximity to the project grouped by individual project site(s) or quads
5. **Conditional Criteria Notes** – additional details concerning various species, habitat, etc.
6. **Personnel Contacts** – a list of employee contacts
7. **Resources** – identifies sources for further information

Known Species lists “species of concern” known to occur within proximity to the project area. Planning for avoidance of these species is expected. If no species are displayed then based upon the records of the Navajo Nation Department of Fish and Wildlife (NNDFW) there are no “species of concern” within proximity to the project. Refer to the Navajo Endangered Species List (NESL) Species Accounts for recommended avoidance measures, biology, and distribution of NESL species on the Navajo Nation (http://nnhp.nndfw.org/sp_account.htm).

Potential Species lists species that are potentially within proximity to the project area and need to be evaluated for presence/absence. If no species are found within the Known or Potential Species lists, the project is not expected to affect any federally listed species, nor significantly impact any tribally listed species or other species of concern. Potential for species has been determined primarily on habitat characteristics and species range information. A thorough habitat analysis, and if necessary, species specific surveys, are required to determine the potential for each species.

Species of concern include protected, candidate, and other rare or otherwise sensitive species, including certain native species and species of economic or cultural significance. For legally protected species, the following tribal and federal statuses are indicated: NESL, federal Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), and Eagle Protection Act (EPA). No legal protection is afforded species with only

ESA candidate, NESL group 4 status, and species listed on the Sensitive Species List. Please be aware of these species during surveys and inform the NNDFW of observations. Reported observations of these species and documenting them in project planning and management is important for conservation and may contribute to ensuring they will not be up listed in the future.

In any and all correspondence with NNDFW or NNHP concerning this project please cite the Data Request Code associated with this document. It can be found in this report on the top right corner of the every page. Additionally please cite this code in any biological evaluation documents returned to our office.

1. Known Species *(NESL=Navajo Endangered Species List, FE=Federally Endangered, FT=Federally Threatened, FC=Federal Candidate)*

Species

DISP = Dipodomys spectabilis / Banner-tailed Kangaroo Rat NESL G4

2. Potential Species

Species

AQCH = Aquila chrysaetos / Golden Eagle NESL G3
CHMO = Charadrius montanus / Mountain Plover NESL G4
FAPE = Falco peregrinus / Peregrine Falcon NESL G4
STOCLU = Strix occidentalis lucida / Mexican Spotted Owl NESL G3 FT

3. Quadrangles (7.5 Minute)

Quadrangles

Blue Gap (36109-B8) / AZ

4. Project Summary *(EO1 Mile/EO 3 Miles=elements occuring within 1 & 3 miles., MSO=mexican spotted owl PACs, POTS=potential species, RCP=Biological Areas)*

SITE	EO1MI	EO3MI	QUAD	MSO	POTS	AREAS
Claim 28	None	DISP	Blue Gap (36109-B8) / AZ	None	STOCLU, FAPE, CHMO, AQCH	Area 1, Area 3

5. Conditional Criteria Notes *(Recent revisions made please read thoroughly. For certain species, and/or circumstances, please read and comply)*

A. **Biological Resource Land Use Clearance Policies and Procedures (RCP)** - The purpose of the RCP is to assist the Navajo Nation government and chapters ensure compliance with federal and Navajo laws which protect, wildlife resources, including plants, and their habitat resulting in an expedited land use clearance process. After years of research and study, the NNDFW has identified and mapped wildlife habitat and sensitive areas that cover the entire Navajo Nation.
The following is a brief summary of six (6) wildlife areas:
1.***Highly Sensitive Area*** – recommended no development with few exceptions.
2.***Moderately Sensitive Area*** – moderate restrictions on development to avoid sensitive species/habitats.
3.***Less Sensitive Area*** – fewest restrictions on development.
4.***Community Development Area*** – areas in and around towns with few or no restrictions on development.
5.***Biological Preserve*** – no development unless compatible with the purpose of this area.
6.***Recreation Area*** – no development unless compatible with the purpose of this area.
None - outside the boundaries of the Navajo Nation
This is not intended to be a full description of the RCP please refer to the our website for additional information at http://www.nndfw.org/clup.htm.

B. **Raptors** – If raptors are known to occur within 1 mile of project location: Contact Chad Smith at 871-7070 regarding your evaluation of potential impacts and mitigation.
o **Golden and Bald Eagles**- If Golden or Bald Eagle are known to occur within 1 mile of the project, decision makers need to ensure that they are not in violation of the Golden and Bald Eagle Nest Protection Regulations found at http://nnhp.nndfw.org/docs_reps/gben.pdf.
o **Ferruginous Hawks** – Refer to "Navajo Nation Department of Fish and Wildlife's Ferruginous Hawk Management Guidelines for Nest Protection" http://nnhp.nndfw.org/docs_reps.htm for relevant information on avoiding impacts to Ferruginous Hawks within 1 mile of project location.
o **Mexican Spotted Owl** - Please refer to the Navajo Nation Mexican Spotted Owl Management Plan http://nnhp.nndfw.org/docs_reps.htm for relevant information on proper project planning near/within spotted owl protected activity centers and habitat.

C. **Surveys** – Biological surveys need to be conducted during the appropriate season to ensure they are complete and accurate please refer to NN Species Accounts http://nnhp.nndfw.org/sp_account.htm. Surveyors on the Navajo Nation must be permitted by the Director, NNDFW. Contact Jeff Cole at (928) 871-7068 for permitting procedures. Questions pertaining to surveys should be directed to the NNDFW Zoologist (Chad Smith) for animals at 871-7070, and Botanist (Andrea Hazelton) for plants at (928)523-3221. Questions regarding biological evaluation should be directed to Jeff Cole at 871-7068.

D. **Oil/Gas Lease Sales** – Any settling or evaporation pits that could hold contaminants should be lined and covered. Covering pits, with a net or other material, will deter waterfowl and other migratory bird use. Lining pits will protect ground water quality.

E. **Power line Projects** – These projects need to ensure that they do not violate the regulations set forth in the Navajo Nation Raptor Electrocution Prevention Regulations found at http://nnhp.nndfw.org/docs_reps/repr.pdf.

F. **Guy Wires** – Does the project design include guy wires for structural support? If so, and if bird species may occur in relatively high concentrations in the project area, then guy wires should be equipped with highly visual markers to reduce the potential mortality due to bird-guy wire collisions. Examples of visual markers include aviation balls and bird flight diverters. Birds can be expected to occur in relatively high concentrations along migration routes (e.g., rivers, ridges or other distinctive linear topographic features) or where important habitat for breeding, feeding, roosting, etc. occurs. The U.S. Fish and Wildlife Service recommends marking guy wires with at least one marker per 100 meters of wire.

G. **San Juan River** – On 21 March 1994 (Federal Register, Vol. 59, No. 54), the U.S. Fish and Wildlife Service designated portions of the San Juan River (SJR) as critical habitat for Ptychocheilus lucius (Colorado pikeminnow) and Xyrauchen texanus (Razorback sucker). Colorado pikeminnow critical habitat includes the SJR and its 100-year floodplain from the State Route 371 Bridge in T29N, R13W, sec. 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan arm of Lake Powell in T41S, R11E, sec. 26 (Salt Lake Meridian) up to the full pool elevation. Razorback sucker critical habitat includes the SJR and its 100-year floodplain from the Hogback Diversion in T29N, R16W, sec. 9 (New Mexico Meridian) to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell in T41S, R11E, sec. 26 (Salt Lake Meridian). All actions carried out, funded or authorized by a federal agency which may alter the constituent elements of critical habitat must undergo section 7 consultation under the Endangered Species Act of 1973, as amended. Constituent elements are those physical and biological attributes essential to a species conservation and include, but are not limited to, water, physical habitat, and biological environment as required for each particular life stage of a species.

H. **Little Colorado River** - On 21 March 1994 (Federal Register, Vol. 59, No. 54) the U.S. Fish and Wildlife Service designated Critical Habitat along portions of the Colorado and Little Colorado Rivers (LCR) for Gila cypha (humpback chub). Within or adjacent to the Navajo Nation this critical habitat includes the LCR and its 100-year floodplain from river mile 8 in T32N R6E, sec. 12 (Salt and Gila River Meridian) to its confluence with the Colorado River in T32N R5E sec. 1 (S&GRM) and the Colorado River and 100-year floodplain from Nautuloid Canyon (River Mile 34) T36N R5E sec. 35 (S&GRM) to its confluence with the LCR. All actions carried out, funded or authorized by a federal agency which may alter the constituent elements of Critical Habitat must undergo section 7 consultation under the Endangered Species Act of 1973, as amended. Constituent elements are those physical and biological attributes essential to a species conservation and include, but are not limited to, water, physical habitat, and biological environment as required for each particular life stage of a species.

I. **Wetlands** – In Arizona and New Mexico, potential impacts to wetlands should also be evaluated. The U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI) maps should be examined to determine whether areas classified as wetlands are located close enough to the project site(s) to be impacted. In cases where the maps are inconclusive (e.g., due to their small scale), field surveys must be completed. For field surveys, wetlands identification and delineation methodology contained in the "Corps of Engineers Wetlands Delineation Manual" (Technical Report Y-87-1) should be used. When wetlands are present, potential impacts must be addressed in an environmental assessment and the Army Corps of Engineers, Phoenix office, must be contacted. NWI maps are available for examination at the Navajo Natural Heritage Program (NNHP) office, or may be purchased through the U.S. Geological Survey (order forms are available through the NNHP). The NNHP has complete coverage of the Navajo Nation, excluding Utah, at 1:100,000 scale; and coverage at 1:24,000 scale in the southwestern portion of the Navajo Nation. In Utah, the U.S. Fish & Wildlife Service's National Wetlands Inventory maps are not yet available for the Utah portion of the Navajo Nation, therefore, field surveys should be completed to determine whether wetlands are located close enough to the project site(s) to be impacted. For field surveys, wetlands identification and delineation methodology contained in the "Corps of Engineers Wetlands Delineation Manual" (Technical Report Y-87-1) should be used. When wetlands are present, potential impacts must be addressed in an environmental assessment and the Army Corps of Engineers, Phoenix office, must be contacted. For more information contact the Navajo Environmental Protection Agency's Water Quality Program.

J. **Life Length of Data Request** – The information in this report was identified by the NNHP and NNDFW's biologists and computerized database, and is based on data available at the time of this response. If project planning takes more than two (02) years from the date of this response, verification of the information provided herein is necessary. It should not be regarded as the final statement on the occurrence of any species, nor should it substitute for on-site surveys. Also, because the NNDFW information is continually updated, any given information response is only wholly appropriate for its respective request.

K. **Ground Water Pumping** - Projects involving the ground water pumping for mining operations, agricultural projects or commercial wells (including municipal wells) will have to provide an analysis on the effects to surface water and address potential impacts on all aquatic and/or wetlands species listed below. NESL Species potentially impacted by ground water pumping: Carex specuicola (Navajo Sedge), Cirsium rydbergii (Rydberg's Thistle), Primula specuicola (Cave Primrose), Platanthera zothecina (Alcove Bog Orchid), Puccinellia parishii (Parish Alkali Grass), Zigadenus vaginatus (Alcove Death Camas), Perityle specuicola (Alcove Rock Daisy), Symphyotrichum welshii (Welsh's American-aster), Coccyzus americanus (Yellow-billed Cuckoo), Empidonax traillii extimus (Southwestern Willow Flycatcher), Rana pipiens (Northern Leopard Frog), Gila cypha (Humpback Chub), Gila robusta (Roundtail Chub), Ptychocheilus lucius (Colorado Pikeminnow), Xyrauchen texanus (Razorback Sucker), Cinclus mexicanus (American Dipper), Speyeria nokomis (Western Seep Fritillary), Aechmophorus clarkia (Clark's Grebe), Ceryle alcyon (Belted Kingfisher), Dendroica petechia (Yellow Warbler), Porzana carolina (Sora), Catostomus discobolus (Bluehead Sucker), Cottus bairdi (Mottled Sculpin), Oxyloma kanabense (Kanab Ambersnail)

6. Personnel Contacts

Wildlife Manager
Sam Diswood
928.871.7062
sdiswood@nndfw.org

Zoologist
Chad Smith
928.871.7070
csmith@nndfw.org

Botanist
Vacant

Biological Reviewer
Pamela Kyselka
928.871.7065
pkyselka@nndfw.org

GIS Supervisor
Dexter D Prall
928.645.2898
prall@nndfw.org

Wildlife Tech
Sonja Detsoi
928.871.6472
sdetsoi@nndfw.org

7. Resources

National Environmental Policy Act

Navajo Endangered Species List:
http://nnhp.nndfw.org/endangered.htm

Species Accounts:
http://nnhp.nndfw.org/sp_account.htm

Biological Investigation Permit Application
http://nnhp.nndfw.org/study_permit.htm

Navajo Nation Sensitive Species List
http://nnhp.nndfw.org/study_permit.htm

Various Species Management and/or Document and Reports
http://nnhp.nndfw.org/docs_reps.htm

Consultant List
(Coming Soon)

Dexter D Prall, GIS Supervisor - Natural Heritage Program
Navajo Nation Department of Fish and Wildlife

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
PO Box 4950, Window Rock, Arizona 86515
TEL: (928) 871-7198 **FAX:** (928) 871-7886

CULTURAL RESOURCES COMPLIANCE FORM

ROUTE COPIES TO:	**NNHPD NO.: HPD-16-589**
☑ DCRM	**OTHER PROJECT NO.: DCRM 2016-07**

PROJECT TITLE: A Cultural Resource Inventory of Two Abandoned Uranium Mines for MWH Global, Inc. (Claim 28 and Occurrence B) in Apache County, Arizona.

LEAD AGENCY: BIA/NR

SPONSOR: Sadie Hoskie, Trustee, The Navajo Nation Abandoned Uranium Mines, Environmental Response Trust, P.O. Box 3330, Window Rock, AZ 86515

PROJECT DESCRIPTION: The proposed undertaking involves the completion of Removal Site Evaluations (RSEs) to define the horizontal extent of contamination in surface soils and sediments at the two former uranium mine areas. Ground disturbing activities will be intensive and extensive with the use of heavy equipment and hand tools. The area of effect is 20.1-acres.

LAND STATUS:	Navajo Tribal Trust
CHAPTER:	Blue Gap, Chinle

LOCATION:	*T.*	33	*N.,*	*R.*	23	*E-*	*Sec.*	UP;	Blue Gap	Quadrangle,	Apache	County	Arizona	G&SRPM
LOCATION:	*T.*	32	*N.,*	*R.*	27	*E-*	*Sec.*	UP;	Del Muerto	Quadrangle,	Apache	County	Arizona	G&SRPM

PROJECT ARCHAEOLOGIST:	Jeremy Begay, Jeffrey Begay
NAVAJO ANTIQUITIES PERMIT NO.:	B16040
DATE INSPECTED:	4/21/2016, 5/4/2016
DATE OF REPORT:	7/15/2016
TOTAL ACREAGE INSPECTED:	36.8 – ac
METHOD OF INVESTIGATION:	Class III pedestrian inventory with transects spaced 10 m apart.
LIST OF CULTURAL RESOURCES FOUND:	**(2) Sites Previously Recorded (AZ-I-49-31; AZ-I-53-13)** **(3) Isolated Occurrences (IOs)** **(1) Traditional Cultural Property (TCP)**
LIST OF ELIGIBLE PROPERTIES:	**(1) Site, Previously Recorded (AZ-I-49-31)** **(1) Traditional Cultural Property (TCP)**
LIST OF NON-ELIGIBLE PROPERTIES:	**(1) Site (AZ-I-53-13)** **(3) Isolated Occurrences (IOs)**
LIST OF ARCHAEOLOGICAL RESOURCES:	**(1) Site, Previously Recorded (AZ-I-49-31)**

EFFECT/CONDITIONS OF COMPLIANCE: No historic properties affected with the following conditions:

Site: AZ-I-49-31:

1. **Prior to any construction, the site boundary will be flagged and/or temporarily fenced under the direction of a qualified archaeologist & shown to the construction foreman.**
2. **All ground disturbance within the 50 ft. of the site boundary will be monitored by a qualified archaeologist.**
3. **No construction, equipment or vehicular traffic will be allowed within the site boundary.**
4. **A brief letter/report documenting the result of the monitoring will be submitted to NNHPD within 30 days of monitoring activities.**
5. **All future maintenance activities shall avoid the site by a minimum of 50 ft. from the site boundary.**

Site AZ-I-53-13:
There is no evidence of this site. No further work is warranted.

TCP:
TCP will be avoided by the proposed undertaking.

In the event of a discovery [*"discovery"* means any previously unidentified or incorrectly identified cultural resources including but not limited to archaeological deposits, human remains, or locations reportedly associated with Native American religious/traditional beliefs or practices], all operations in the immediate vicinity of the discovery must cease, and the Navajo Nation Historic Preservation Department must be notified at (928) 871-7198.

FORM PREPARED BY: **Tamara Billie**
FINALIZED: September 9, 2016

Notification to Proceed Recommended ☑ Yes ☐ No
Conditions: ☑ Yes ☐ No
Tamara 9/9/16
The Navajo Nation Historic Preservation Office Date

Navajo Region Approval ☒ Yes ☐ No
9-28-16
BIA – Navajo Regional Office Date
Acting

NNDFW Review No. 15mwh101a-c28

BIOLOGICAL RESOURCES COMPLIANCE FORM
NAVAJO NATION DEPARTMENT OF FISH AND WILDLIFE
P.O. BOX 1480, WINDOW ROCK, ARIZONA 86515-1480

It is the Department's opinion the project described below, with applicable conditions, is in compliance with Tribal and Federal laws protecting biological resources including the Navajo Endangered Species and Environmental Policy Codes, U.S. Endangered Species, Migratory Bird Treaty, Eagle Protection and National Environmental Policy Acts. This form does not preclude or replace consultation with the U.S. Fish and Wildlife Service if a Federally-listed species is affected.

PROJECT NAME & NO.: Claim 28 - Abandoned Uranium Mine Project

DESCRIPTION: Proposed Phase I & II scientific investigations at an abandoned mine site. Phase I would entail biological and land surveying with a maximum of 5 people onsite for no more than 5-7 days. Disturbance would be light. Phase II would require the use of an excavator or a small mobile drilling unit to collect one or more soil samples with up to 8 people onsite for a period of one week. A temporary travel corridor 20 ft. in width would be necessary to move equipment to the site. Disturbance would be light to moderate. No permanent structures would be left onsite. The proposed project area (mine boundary and buffer) would be approximately 27.0 acres.

LOCATION: 36°14'42"N 109°53'30"W, Tachee/Blue Gap Chapter, Apache County, Arizona

REPRESENTATIVE: Lori Gregory, Adkins Consulting, Inc. for MWH Global/Stantec

ACTION AGENCY: U.S. Environmental Protection Agency and Navajo Nation

B.R. REPORT TITLE / DATE / PREPARER: BE-Claim 28 Abandoned Uranium Mine Project/AUG 2016/Lori Gregory

SIGNIFICANT BIOLOGICAL RESOURCES FOUND: Area 3. Suitable nesting habitat is present in the project area for Migratory Birds not listed under the NESL or ESA. Migratory Birds and their habitats are protected under the Migratory Bird Treaty Act (16 USC §703-712) and Executive Order 13186. Under the EO, all federal agencies are required to consider management impacts to protect migratory non-game birds.

POTENTIAL IMPACTS

NESL SPECIES POTENTIALLY IMPACTED: NA

FEDERALLY-LISTED SPECIES AFFECTED: NA

OTHER SIGNIFICANT IMPACTS TO BIOLOGICAL RESOURCES: NA

AVOIDANCE / MITIGATION MEASURES: Mitigation measures will be implemented to ensure that there are no impacts to migratory birds that could potentially nest in the project area.

CONDITIONS OF COMPLIANCE*: NA

FORM PREPARED BY / DATE: Pamela A. Kyselka/17 NOV 2016

COPIES TO: (add categories as necessary)

☐ ______________________ ☐ ______________________

2 NTC § 164 Recommendation: Signature Date

☒Approval

☐Conditional Approval (with memo) 11/18/16

☐Disapproval (with memo) Gloria M. Tom, Director, Navajo Nation Department of Fish and Wildlife

☐Categorical Exclusion (with request letter)

☐None (with memo)

*I understand and accept the conditions of compliance, and acknowledge that lack of signature may be grounds for the Department not recommending the above described project for approval to the Tribal Decision-maker.

Representative's signature Date

From: Nystedt, John
To: Justin Peterson
Cc: Lori Gregory; Pam Kyselka; tbillie@navajo-nsn.gov; Harrilene Yazzie; Melissa Mata
Subject: Navajo Nation AUM Environmental Response Trust - -First Phase
Date: Monday, November 07, 2016 4:08:30 PM
Attachments: image001.png

Justin,

Thank you for your November 6, 2016, email. This email documents our response regarding the subject project, in compliance with section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1531 et seq.). Based on the information you provided, we believe no endangered or threatened species or critical habitat will be affected by this project; nor is this project likely to jeopardize the continued existence of any proposed species or adversely modify any proposed critical habitat. No further review is required for this project at this time. Should project plans change or if new information on the distribution of listed or proposed species becomes available, this determination may need to be reconsidered. In all future communication on this project, please refer to consultation numbers given below.

In keeping with our trust responsibilities to American Indian Tribes, by copy of this email, we will notify the Navajo Nation, which may be affected by the proposed action and encourage you to invite the Bureau of Indian Affairs to participate in the review of your proposed action.

Should you require further assistance or if you have any questions, please contact me as indicated below, or my supervisor, Brenda Smith, at 556-2157. Thank you for your continued efforts to conserve endangered species.

Claim 28	02EAAZ00-2016-SLI-0358
Section 26 (Desiddero Group)	02ENNM00-2016-SLI-0447
Mitten #3	06E23000-2016-SLI-0210
NA-0904	02EAAZ00-2016-SLI-0363
Occurrence B	02EAAZ00-2016-SLI-0361
Standing Rock	02ENNM00-2016-SLI-0448
Alongo Mines	02ENNM00-2016-SLI-0465
Tsosie 1*	02EAAZ00-2016-SLI-0364
Boyd Tisi No. 2 Western	02EAAZ00-2016-SLI-0355
Harvey Blackwater #3	02EAAZ00-2016-SLI-0356 / 06E23000-2016-SLI-0207
Oak 124/125	02ENNM00-2016-SLI-0466
NA-0928	02EAAZ00-2016-SLI-0360
Hoskie Tso #1	02EAAZ00-2016-SLI-0362
Charles Keith	06E23000-2016-SLI-0208
Barton 3	02EAAZ00-2016-SLI-0354
Eunice Becenti	02ENNM00-2016-SLI-0444

* It is our understanding that the Tsosie No. 1 site has been put on hold indefinitely due to access issues. However, provided the results of the survey were negative (i.e., no potential for

any ESA-listed species) then we would come to the same conclusion, above, as for the other 15 projects.

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Fish and Wildlife Biologist/AESO Tribal Coordinator
USFWS AZ Ecological Services Office - Flagstaff Suboffice
Southwest Forest Science Complex, 2500 S Pine Knoll Dr, Rm 232
Flagstaff, AZ 86001-6381 (928) 556-2160 Fax-2121 Cell:(602) 478-3797
http://www.fws.gov/southwest/es/arizona/

Appendix F Data Usability Report, Laboratory Analytical Data, and Data Validation Reports

F.1Data Usability Report

F.2 Laboratory Analytical Data and Data Validation Reports

(provided in a separate electronic file due to its file size and length)

F.1 Data Usability Report

DATA USABILITY REPORT

1.0 INTRODUCTION

This data usability report presents a summary of the validation results for the sample data collected from the Claim 28 Site (the Site) as part of the Removal Site Evaluation (RSE) performed for the Navajo Nation AUM Environmental Response Trust—First Phase. The purpose of the validation was to ascertain the data usability measured against the data quality objectives (DQOs) and confirm that results obtained are scientifically defensible.

Samples were collected between October 19, 2016 and October 21, 2017 and were analyzed by ALS Environmental of Ft. Collins, Colorado, for all methods except mercury in water. ACZ Laboratories, Inc. of Steamboat Springs, Colorado, analyzed water samples for mercury. Samples were analyzed for one or more of the following:

- Radium-226 in soil by United States Environmental Protection Agency (USEPA) Method 901.1
- Metals in soil by USEPA Method SW6020
- Isotopic thorium in soil by USDOEAS-06/EMSL/LV
- Radium-226 in water by USEPA Method 903.1
- Radium-228 in water by USEPA Method 904
- Gross alpha/beta in water by USEPA Method 900
- Total and dissolved metals in water by USEPA 200.8
- Total dissolved solids in water by USEPA 160.1
- Alkalinity in water by USEPA 310.1
- Chloride and sulfate in water by USEPA 300.0
- Total and dissolved mercury in water by USEPA Method 1631

Samples were collected and analyzed according to the procedures and specific criteria presented in the *Quality Assurance Project Plan, Navajo Nation AUM Environmental Response Trust (QAPP)* (MWH, 2016).

Project data were validated as follows:

- Laboratory Data Consultants, Inc. (LDC) of Carlsbad, California, performed validation of all radiological soil and water data, plus ten percent of the non-radiological data (Level IV only)

- All non-radiological soil and water data were validated by the Stantec Consulting Services Inc. (Stantec; formerly MWH) Project Chemist (Level III only)
- All samples received Level III data validation
- Ten percent of the sample results for all methods received a more detailed Level IV validation

The analytical data were validated based on the results of the following data evaluation parameters or quality control (QC) samples:

- Compliance with the QAPP
- Sample preservation
- Sample extraction and analytical holding times
- Initial calibration (ICAL), initial calibration verification (ICV), and continuing calibration verification (CCV) results
- Method and initial/continuing calibration blank (ICB/CCB) sample results
- Matrix spike/matrix spike duplicate (MS/MSD) sample results
- Laboratory duplicate results
- Serial dilution (metals analysis only)
- Interference check samples (ICS) (metals analysis only)
- Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) results
- Field duplicate sample results
- Minimum detectable concentration (radiological analyses only)
- Reporting limits
- Sample result verification
- Completeness evaluation
- Comparability evaluation

Sample results that were qualified due to quality control parameters outside of acceptance criteria are listed on Table F.1-1.

2.0 DATA VALIDATION RESULTS

Stantec reviewed the data validation reports and assessed the qualified data against the DQOs for the project. The following summarizes the data validation findings for each of the data evaluation parameters.

2.1 QUALITY ASSURANCE PROJECT PLAN COMPLIANCE EVALUATION

Based on the data validation, all samples were analyzed following the quality control criteria specified in the QAPP, with the following exception: ALS routinely dilutes all metals samples by a factor of 10 times in order to protect their ICP-MS instrument from the adverse effects of running samples with high total dissolved solids. This also includes running a long series of samples (as is common in a production laboratory) with intermediate dissolved solids. The vulnerable parts of the instrument are the nebulizer, which produces an aerosol, and the cones, which disperse the aerosol. These areas form scaly deposits from the samples in the sample solution, despite the nitric acid and other acids present in the digestate. These parts of the instrument periodically need to be taken apart and cleaned, but in a production setting the laboratory wants to avoid any downtime as much as possible. As an ameliorating factor, the laboratory also takes account of this dilution factor up front in the project planning stages. The laboratory will not quote a reporting limit for this instrument that cannot be achieved after the 10 times dilution required for the instrument. Not all of the requested reporting limits can be met using the laboratory's routine protocol. The dilution is narrated by the laboratory merely as a matter of transparency, as well as for the validator's information. The dilution should have no impact on the project's sensitivity goals.

Sample Preservation Evaluation. All samples were preserved as specified in the QAPP.

Holding Time Evaluation. All analytical holding times were met.

Initial Calibration, Initial Calibration Verification, and Continuing Calibration Verification Evaluation. All ICAL, ICV, and CCV results were within acceptance criteria.

Method Blank Evaluation. No analytes were detected in any method blank, with exception of gross alpha in a preparation blank associated with sample ID S078-WS-002. The sample result was greater than 5 times the blank result. The sample result was qualified with a "B" flag to indicate blank contamination and the sample result may potentially be biased high (see Table F-1).

Initial and Continuing Calibration Blank Evaluation. No sample data were qualified due to ICB/CCB data.

Matrix Spike/Matrix Spike Duplicate Samples Evaluation. All MS/MSD recoveries were within acceptance criteria with the exception of several metals. Table F-1 lists the analytes where an

MS and/or MSD percent recovery was outside the acceptance criteria. Sample results were qualified with a "J+" flag for results that are estimated and potentially biased high; sample results were qualified with a "J-" flag for results that are estimated and potentially biased low. A few MS/MSD RPDs were outside acceptance criteria. The results were qualified with a "J" flag if not otherwise qualified.

Laboratory Duplicate Sample Evaluation. For some analyses, the laboratory prepared and analyzed a duplicate sample. RPD results were evaluated between the parent and laboratory duplicate samples. Several RPDs were outside the acceptance criteria for the analysis of metals. Sample results were qualified with a "J" flag if not otherwise qualified.

Serial Dilution Evaluation. All serial dilution percent differences were within acceptance criteria, except for one sample analyzed for arsenic. The sample result was qualified as estimated with a "J" flag.

Interference Check Sample Evaluation. All interference check samples were within acceptance criteria.

Laboratory Control Sample/Laboratory Control Sample Duplicate Evaluation. All LCS and LCSD recoveries were within acceptance criteria. All LCS/LCSD RPDs were within acceptance criteria.

Field Duplicate Evaluation. The RPDs were less than the guidance RPD of 30 percent established in the QAPP for all field duplicate pairs, with the exception of results for twenty metals, four radium-226, and one gross alpha and gross beta. The primary cause for RPDs exceeding 30 percent for some duplicate pairs is assumed to be the heterogeneity/variability of soil samples. The sample IDs, sample results, and RPDs for those results that did not meet the guidance RPD are listed in Table F.1-2. Sample results were not qualified due to RPDs exceeding the guidance criteria, as described in the QAPP.

Minimum Detectable Concentration Evaluation. All minimum detectable concentrations met reporting limits with the exception of five samples for the analysis of radium-226 and three samples for the analysis of gross alpha and gross beta. However, with one exception, the reported activity for each of these samples was greater than the achieved minimum detectable concentration and no qualification was needed. The result for gross alpha in sample S078-WL-001 was less than the sample-specific minimum detectable concentration.

Reporting Limit Evaluation. All sample data were reported to the reporting limit established in the QAPP, with the exception of the metals, as discussed at the beginning of this section related to dilution.

Sample Result Verification. All sample result verifications were acceptable with the exception of twenty samples analyzed for radium-226. The sample density exceeded the limit of +/- 15% of the density of the calibration standard. Cases that exceed the limit of +/- 15% of the density of the calibration standard were qualified with a "J+" flag for those results that may be biased high and a "J-" flag for those results that may be biased low (see Table F.1-1).

Completeness Evaluation. All samples and QC samples were collected as scheduled, resulting in 100 percent sampling completeness for this project. Based on the results of the data validation described in the previous sections, all data are considered valid as qualified. No data were rejected; consequently, analytical completeness was 100 percent, which met the 95 percent analytical completeness goal established in the QAPP.

Comparability Evaluation. Comparability is a qualitative parameter that expresses the confidence that one data set may be compared to another. For this project, sample collection and analysis followed standard methods and the data were reported using standard units of measure as specified in the QAPP. In addition, QC data for this project indicate the data are comparable. As a result, the data from this project should be comparable to other data collected at this Site using similar sample collection and analytical methodology.

3.0 DATA VALIDATION SUMMARY

Precision. Based on the MS/MSD sample, LCS/LCSD sample, laboratory duplicate sample, and field duplicate results, the data are precise as qualified.

Accuracy. Based on the ICAL, ICV, CCV, MS/MSD, and LCS, the data are accurate as qualified.

Representativeness. Based on the results of the sample preservation and holding time evaluation; the method and ICB/CCB blank sample results; the field duplicate sample evaluation; and the RL evaluation the data are considered representative of the Site as qualified.

Completeness. All media and QC sample results were valid and collected as scheduled; therefore, completeness for this RSE is 100 percent.

Comparability. Standard methods of sample collection and standard units of measure were used during this project. The analysis performed by the laboratory was in accordance with current USEPA methodology and the QAPP.

Based on the results of the data validation, all data are considered valid as qualified.

Table F.1-1
Summary of Qualified Data
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Field Sample Identification	Sample Date	Analysis Code	Analyte	Sample Result	Units	QC Type	QC Result	QC Limit	Added Flag	Comment
S078-BG2-009	10/19/16	SW6020	Molybdenum	0.25	mg/kg	MS	68%	75% - 125%	J-	Result is estimated, potentially biased low. MS recovery below acceptance criteria.
S078-BG2-009	10/19/16	SW6020	Vanadium	13	mg/kg	MSD	130%	75% - 125%	J+	Result is estimated, potentially biased high. MSD recovery above acceptance criteria.
S078-BG1-006	10/19/16	E901.1	Radium-226	2.83	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-007-01	4/20/17	SW6020	Uranium	4.7	mg/kg	MS MSD MS/MSD RPD	63% 228% 27%	75% - 125% 75% - 125% 20%	J	Result is estimated, bias unknown. MS and MSD recoveries outside acceptance criteria. MS/MSD RPD outside acceptance
S078-SCX-007-01	4/20/17	SW6020	Arsenic	4.2	mg/kg	MSD LR	128% 24%	75% - 125% 20%	J+	Result is estimated, potentially biased high. MSD recovery above acceptance criteria. LR RPD outside acceptance criteria.
S078-SCX-007-01	4/20/17	SW6020	Vanadium	30	mg/kg	MS MSD MS/MSD RPD	24% 221% 47%	75% - 125% 75% - 125% 20%	J	Result is estimated, bias unknown. MS and MSD recoveries outside acceptance criteria. MS/MSD RPD outside acceptance
S078-SCX-006-02	4/20/17	E901.1	Radium-226	3.49	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-010-02	4/20/17	E901.1	Radium-226	2.56	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-010-03	4/20/17	E901.1	Radium-226	4.01	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.

Notes
mg/kg milligrams per kilogram
pCi/g picocuries per gram
pCi/L picocuries per liter
LCS laboratory control sample
LR laboratory replicate (duplicate)

MB method blank
MS matrix spike
MSD matrix spike duplicate
RPD relative percent difference

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Summary of Qualified Data
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Field Sample Identification	Sample Date	Analysis Code	Analyte	Sample Result	Units	QC Type	QC Result	QC Limit	Added Flag	Comment
S078-SCX-011-02	4/20/17	E901.1	Radium-226	3.48	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-009-01	4/20/17	E901.1	Radium-226	6.34	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-006-03	4/20/17	E901.1	Radium-226	1.2	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-CX-008	4/19/17	SW6020	Arsenic	4.6	mg/kg	LR	21%	20%	J	Result is estimated, bias unknown. LR RPD outside acceptance criteria.
S078-CX-008	4/19/17	SW6020	Vanadium	16	mg/kg	MSD	71%	75% - 125%	J-	Result is estimated, potentially biased low. MSD recovery below acceptance criteria.
S078-CX-001	4/18/17	E901.1	Radium-226	7.8	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-CX-006	4/18/17	E901.1	Radium-226	5.18	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-038-02	10/17/17	SW6020	Arsenic	5.9	mg/kg	LR	26%	20%	J	Result is estimated, bias unknown. LR RPD outside acceptance criteria.
S078-SCX-038-02	10/17/17	SW6020	Vanadium	30	mg/kg	MSD	73%	75% - 125%	J-	Result is estimated, potentially biased low. MSD recovery below acceptance criteria.

Notes

mg/kg milligrams per kilogram	MB method blank
pCi/g picocuries per gram	MS matrix spike
pCi/L picocuries per liter	MSD matrix spike duplicate
LCS laboratory control sample	RPD relative percent difference
LR laboratory replicate (duplicate)	

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Summary of Qualified Data
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Field Sample Identification	Sample Date	Analysis Code	Analyte	Sample Result	Units	QC Type	QC Result	QC Limit	Added Flag	Comment
S078-BG2-011-01	10/13/17	E901.1	Radium-226	5.89	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-061-02	10/21/17	E901.1	Radium-226	1.87	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-039-01	10/17/17	E901.1	Radium-226	3.24	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-026-01	10/13/17	E901.1	Radium-226	5.31	pCi/g	Result Verification		±15%	J+	Result is estimated, potentially biased high. Sample density differs by more than 15% of LCS density.
S078-SCX-026-01	10/13/17	SW6020	Molybdenum	0.7	mg/kg	MSD	74%	75% - 125%	J-	Result is estimated, potentially biased low. MSD recovery below acceptance criteria.
S078-SCX-031-01	10/16/17	SW6020	Vanadium	110	mg/kg	LR	111%	20%	J	Result is estimated, bias unknown. LR RPD outside acceptance criteria.
S078-SCX-032-02	10/16/17	E901.1	Radium-226	47.7	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-050-01	10/19/17	E901.1	Radium-226	4.18	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.

Notes

mg/kg milligrams per kilogram	MB method blank
pCi/g picocuries per gram	MS matrix spike
pCi/L picocuries per liter	MSD matrix spike duplicate
LCS laboratory control sample	RPD relative percent difference
LR laboratory replicate (duplicate)	

Table F.1-1
Summary of Qualified Data
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Field Sample Identification	Sample Date	Analysis Code	Analyte	Sample Result	Units	QC Type	QC Result	QC Limit	Added Flag	Comment
S078-SCX-045-01	10/18/17	SW6020	Arsenic	4.1	mg/kg	LR Serial Dilution	22% 11%	20% 10%	J	Result is estimated, bias unknown. LR RPD outside acceptance criteria. Serial dilution %D greater than control limit.
S078-SCX-045-01	10/18/17	SW6020	Uranium	4.6	mg/kg	LR	26%	20%	J	Result is estimated, bias unknown. LR RPD outside acceptance criteria.
S078-SCX-045-01	10/18/17	SW6020	Vanadium	23	mg/kg	MS MSD MS/MSD RPD	1018% 129% 111%	75% - 125% 75% - 125% 20%	J+	Result is estimated, potentially biased high. MS and MSD recoveries above acceptance criteria. MS/MSD RPD outside
S078-SCX-041-02	10/18/17	E901.1	Radium-226	5.95	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-044-01	10/18/17	E901.1	Radium-226	3.76	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-021-01	10/12/17	SW6020	Vanadium	14	mg/kg	MS MSD	132% 169%	75% - 125% 75% - 125%	J+	Result is estimated, potentially biased high. MS and MSD recoveries above acceptance criteria.
S078-SCX-021-01	10/12/17	SW6020	Molybdenum	0.31	mg/kg	MS MSD	66% 70%	75% - 125% 75% - 125%	J-	Result is estimated, potentially biased low. MS and MSD recoveries below acceptance criteria.
S078-SCX-012-02	10/11/17	E901.1	Radium-226	136	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-012-03	10/11/17	E901.1	Radium-226	59.1	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-SCX-012-05	10/11/17	E901.1	Radium-226	18.5	pCi/g	Result Verification		±15%	J-	Result is estimated, potentially biased low. Sample density differs by more than 15% of LCS density.
S078-WS-002	11/5/16	E900.0	Gross Alpha	549	pCi/L	MB	0.82 pCi/L	0.70	B	Presumed contamination from preparation (method) blank.

Notes
mg/kg milligrams per kilogram
pCi/g picocuries per gram
pCi/L picocuries per liter
LCS laboratory control sample
LR laboratory replicate (duplicate)
MB method blank
MS matrix spike
MSD matrix spike duplicate
RPD relative percent difference

Table F.1-2
Results that did not Meet the Relative Percent Difference Guidance
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Primary Sample / Duplicate Indentification	Sample Date	Parameter	Primary Result	Duplicate Result	Units	RPD (%)
S078-BG2-001/S078-BG2-201	10/19/2016	Vanadium	18	13	mg/kg	32%
S078-BG1-001/S078-BG1-201	10/19/2016	Uranium	0.7	1.1	mg/kg	44%
S078-WL-001/S078-WL-201	10/19/2016	Gross Alpha	5.5	7.8	pCi/l	35%
S078-WL-001/S078-WL-201	10/19/2016	Gross Beta	8.1	12.9	pCi/l	46%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Arsenic	2.7	5	mg/kg	60%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Molybdenum	0.33	0.6	mg/kg	63%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Selenium	1.7	3	mg/kg	55%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Uranium	6.4	31	mg/kg	132%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Vanadium	20	59	mg/kg	99%
S078-SCX-001-01/S078-SCX-201-01	4/19/2017	Radium-226	5.61	14.2	pCi/g	87%
S078-SCX-028-01/S078-SCX-228-01	10/14/2017	Arsenic	4.3	5.9	mg/kg	31%
S078-SCX-033-02/S078-SCX-233-02	10/16/2017	Arsenic	3.5	4.8	mg/kg	31%
S078-SCX-033-02/S078-SCX-233-02	10/16/2017	Selenium	1.2	1.8	mg/kg	40%
S078-SCX-033-02/S078-SCX-233-02	10/16/2017	Uranium	2.2	3.5	mg/kg	46%
S078-SCX-033-02/S078-SCX-233-02	10/16/2017	Vanadium	11	15	mg/kg	31%
S078-SCX-049-01/S078-SCX-249-01	10/19/2017	Arsenic	5.3	3.5	mg/kg	41%
S078-SCX-049-01/S078-SCX-249-01	10/19/2017	Radium-226	5.25	7.81	pCi/g	39%
S078-SCX-054-01/S078-SCX-254-01	10/20/2017	Uranium	2	7.8	mg/kg	118%
S078-SCX-054-01/S078-SCX-254-01	10/20/2017	Radium-226	1.66	5.22	pCi/g	103%
S078-SCX-055-01/S078-SCX-255-01	10/20/2017	Uranium	24	16	mg/kg	40%
S078-SCX-055-01/S078-SCX-255-01	10/20/2017	Radium-226	15.9	10.0	pCi/g	46%
S078-SCX-058-03/S078-SCX-248-03	10/20/2017	Arsenic	4.6	3.3	mg/kg	33%
S078-SCX-058-03/S078-SCX-248-03	10/20/2017	Molybdenum	1	0.72	mg/kg	33%
S078-SCX-058-03/S078-SCX-248-03	10/20/2017	Selenium	2.5	1.5	mg/kg	50%
S078-SCX-058-03/S078-SCX-248-03	10/20/2017	Uranium	5	2.8	mg/kg	56%

Notes
mg/kg milligrams per kilogram
pCi/g picocuries per gram
pCi/l picocuries per liter
RPD relative percent difference