

QUALITY ASSURANCE PROJECT PLAN

FOR THE

MIDNITE MINE PHASE 2A/1B RI/FS
STEVENS COUNTY, WASHINGTON

Contract Number: 68-W-98-228

Document Control Number: 1800.64

Revision 1

November 30, 2000



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SECTION A

Project Management

A.1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN

for the

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PREPARED BY:

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Project Management

INTRODUCTION

This document presents the Quality Assurance Project Plan for the Midnite Mine Phase 2A/1B RI/FS (hereafter referred to as the Phase 2A/1B QAPP). This document addends and is intended to be used in conjunction with *Quality Assurance Project Plan for the Midnite Mine Phase 1A RI/FS, Stevens County, Washington*, dated August 18, 1999, which was addended and amended in Revisions 1.1, 1.2, and 1.3 (hereafter referred to as the Phase 1A QAPP). This document presents those QAPP sections, tables, figures, and appendixes that differ significantly from the Phase 1A QAPP based on Phase 2A/1B RI/FS activities. Where QAPP sections, tables, figures, and appendixes do not differ significantly between Phase 1A and Phase 2A/1B, the reader is referred to the Phase 1A QAPP.

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µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micrometer
µS/cm	microsiemens per centimeter
°C	degrees Celsius
AB	ammonium bicarbonate
ADQ	Audit of Data Quality
AESE	Associated Environmental Scientists and Engineers
ASTM	American Society of Testing and Materials
bgs	below ground surface
cc	cubic centimeter
CLP	Contract Laboratory Program
cm/s	centimeters per second
COC	chain of custody
COD	chemical oxygen demand
CSM	conceptual site model
CVAA	cold vapor atomic absorption
DER	duplicate error ratio
DOT	Department of Transportation
DQA	Data Quality Assessment
DQO	Data Quality Objectives
DTPA	diethylene triamine pentaacetic acid
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FD	field duplicate
ft	feet
FS	Feasibility Study
G	glass
GC	gas chromatograph
GFAA	graphite furnace atomic absorption
GPS	global positioning system
GW	groundwater sample
HNO ₃	nitric acid
HSM	Project Health and Safety Manager
H ₂ SO ₄	sulfuric acid
HSP	Health and Safety Plan

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ICP	inductively coupled plasma
ICP-MS	inductively coupled plasma-mass spectrometry
ICS	interference check sample
ID	identification
I.D.	inner diameter
IDW	investigation derived waste
IS	internal standard
LCS	laboratory control sample
LIMS	Laboratory Information Management System
LLD	lower limit of detection
MA	Mined Area
m	meters
MEQ/G	milliequivalents per gram
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
ml	milliliter
MS	matrix spike
MSD	matrix spike duplicate
MSR	Management Systems Review
mV	millivolt
MW	monitoring well
NA	not applicable
NAREL	U.S. EPA National Air and Radiation Environmental Laboratory
NIST	National Institute for Standards and Technology
NTU	nephelometric turbidity unit
OD	outer diameter
oz	ounce
PARCC	precision, accuracy, representativeness, completeness, and comparability
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOCs	potential chemicals of concern
PCP	pollution control pond
PE	performance evaluation
PIA	Potentially Impacted Area
PPE	personal protective equipment
PRDL	project required detection limit

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PRQL	project required quantitation limit
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAP	quality assurance plan
QAPP	quality assurance project plan
QC	quality control
RB	rinsate blank
RI/FS	remedial investigation/feasibility study
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SHSM	Site Health and Safety Manager
SOPs	standard operating procedures
SOW	scope of work
SPT	standard penetration testing
START	Superfund Technical Assessment and Response Team
SVOCs	semivolatile organic compounds
TAL	target analyte list
TDS	total dissolved solids
TEPH	total extractable petroleum hydrocarbons
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSA	technical systems audit
TSS	total suspended solids
TVPH	total volatile petroleum hydrocarbons
URS	URS Corporation
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
VOCs	volatile organic compounds

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A.3 DISTRIBUTION LIST

QAPP Distribution	
Name	Organization
Elly Hale/Rick Poeton	U.S. Environmental Protection Agency
Elly Hale (unbound copy)	U.S. Environmental Protection Agency
Bruce Woods	U.S. Environmental Protection Agency
Lorraine Edmond	EPA Office of Environmental Assessment
Steve Richardson	ATSDR
John Griggs	NAREL
Corn Abeyta	Spokane Tribe of Indians
Allen Sedick	Bureau of Indian Affairs
Donna Bruce	Bureau of Indian Affairs
Julie Campbell	U.S. Fish and Wildlife Service
Kelly Courtright	Bureau of Land Management
Eric Hoffman	Bureau of Land Management
Fred Kirschner	Spokane Tribe of Indians
David Wynecoop	Spokane Tribe of Indians
Bob Nelson	Dawn Mining Company
Sherm Worthington	Shepherd Miller Inc.
Dr. Barbara Harper	AESE
Randall Connolly	Natural Resources
John Thackston	URS Corporation

Data Distribution					
Name	Title	Validated Data		Preliminary Data	
		Hard Copy	Electronic	Verbal	Fax
Elly Hale	EPA Work Assignment Manager	X	X		
John Thackston	URS Project Manager	X	X		
Fred Kirschner	Spokane Tribe of Indians	X	X		

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A.4 PROJECT ORGANIZATION

The Midnite Mine Phase 2A/1B Remedial Investigation/Feasibility Study (RI/FS) will be performed under the auspices of the Environmental Protection Agency (EPA) Region 10 by its prime subcontractor, URS Corporation (URS).

A project directory is shown in Table A.4-1. The project organization chart is shown on Figure A.4-1. The project organization is the same as that presented in the Phase 1A QAPP with the following exceptions:

- URS Project Manager – John Thackston
- URS Technical Advisor – position eliminated
- Primary Analytical Laboratories – EPA National Air Radiation and Environmental Laboratory (NAREL) of Montgomery, Alabama; Southwest Research Institute, Inc. (SWRI) of San Antonio, Texas; and Acculabs Research, Inc. of Golden, Colorado.

This organizational structure is designed to provide project control and proper quality assurance/quality control (QA/QC) for the field investigation. The roles and responsibilities of the key personnel are described below.

A.4.1 EPA Work Assignment Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.2 EPA Quality Assurance Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.3 URS Project Manager

The URS Project Manager, John Thackston, has primary responsibility for the completion of project activities. He will be responsible to the EPA for day-to-day control of planning, scheduling, and cost control. Mr. Thackston will be directly responsible for the development of technical reports and other project documents and for implementing the Health and Safety Plan (HSP). The URS Project Manager will assist project personnel in planning, coordinating, and controlling technical aspects of the project. He will be responsible for monitoring the quality of the technical and managerial aspects of the project, implementing the QAPP, implementing corrective measures, and maintaining communication with the EPA so that the objectives of the project are met.

A.4.4 URS Technical Advisor

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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A.4.5 URS Project Quality Assurance Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.6 URS Project Chemist

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.7 URS Project Health and Safety Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.8 URS Field Manager

No significant changes have been made to this section with the exception of changing the position title from Site Manager to Field Manager. Please refer to the Phase 1A QAPP.

A.4.9 URS Site Health and Safety Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.10 URS Site Sample Manager

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.11 Project Staff

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.4.12 Field and Laboratory Subcontractors

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.5 PROBLEM DEFINITION/BACKGROUND

A.5.1 Introduction

This section is not significantly changed from the Phase 1A QAPP with the following exceptions:

Phase 2A data collection will address the following:

- Surface water, sediment, external radiation, airborne radon, groundwater, and pit stability for the open pits.

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- Friable surface material*, airborne radon, radon flux, on-site cover and buffer material, and long-term stability in stockpiles, waste rock piles, and disturbed ground in the Mined Area (MA).
- Friable surface material, surface water, sediment, airborne radon, and external radiation on or adjacent to haul roads.
- Friable surface material, airborne radon, and external radiation in Potentially Impacted Area (PIA) downwind areas.
- Friable surface material, airborne radon, radon flux, and external radiation in background areas.

Phase 1B data collection will address:

- Sediment in PIA riparian areas.
- Groundwater along Blue Creek.
- Hydraulic parameters in the alluvium along the PIA drainages south and east of the MA and at Blue Creek.
- Groundwater, surface water, and sediment in background areas.
- Verification sampling of PIA sediment.

A.5.2 Previous Investigations

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.5.3 Investigation Approach

Data and results of the previous investigations have been used in the development of the Phase 2A/1B RI/FS field investigation approach. The Phase 2A work scope was defined based primarily on evaluation of data existing prior to the Phase 1A data collection work. The Phase 1B work scope was based primarily on evaluation of data available from Phase 1A, which included all the non-radiological data and the majority of the radionuclide data, and other previous investigations described in the Phase 1A QAPP. Considering the prior mining operations, the site has been divided into three principal investigation areas; the PIA, the MA, and Background Areas.

The Phase 2A field investigation to be conducted in 2000 is focused on data collection within the MA and for selected media within the PIA and background areas. The Phase 2A investigation will address surface water, sediment, friable surface material, radon, external radiation, and groundwater in the MA; and friable surface material, radon, external radiation, and potential haul road-affected surface water and sediment in the PIA.

* Friable surface material is the soil underlying the non-decomposed plant litter and debris.

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The Phase 1A field investigation conducted in fall 1999 and spring 2000 focused on characterization of surface water, sediment, and groundwater in the PIA. The results of the Phase 1A field investigation are pending. Phase 1B, to be conducted concurrently with the Phase 2A field investigations in 2000, will focus on additional sediment and groundwater data collection in the PIA drainages south of the MA and at Blue Creek, and additional surface water, groundwater, and sediment data collection in background areas.

The sampling strategy and rationale for Phase 2A/1B is discussed in Section A.7 and in Tables A.7-3 through A.7-8.

A.6 PROJECT DESCRIPTION AND SCHEDULE

A.6.1 Description

URS has prepared this QAPP on behalf of EPA for the Midnite Mine site. The QAPP has been prepared in accordance with EPA Region 10 Expanded QAPP Guidance for Superfund Lead Projects (EPA, 1998d) and EPA Requirements for Quality Assurance Project Plans (EPA, 1998b). The QAPP, which contains the sampling and analysis plan and standard operating procedures, provides the direction and procedures for implementing the Phase 2A/1B RI/FS field investigation for Midnite Mine. Data are being collected to satisfy the data needs identified during the data quality objective (DQO) process. Field activities and procedures are discussed in detail in Appendix A, Sampling and Analysis Plan, and Appendix B, Standard Operating Procedures.

A.6.2 Schedule

An estimated schedule for the planning and implementation of Phase 2A/1B field investigation activities is shown on Figure A.6-1. The schedule for the Phase 2A/1B field investigation activities is dependent on review and approval of the final Phase 2A/1B QAPP.

A.7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A.7.1 Purpose/Background

This section addresses the DQOs process applied in development of the Midnite Mine Phase 2A/1B QAPP. The DQO process is a systematic planning tool based on the Scientific Method for establishing criteria for data quality and for developing data collection designs. Establishing formal DQOs during the QAPP stage of a project allows clear and unambiguous definition of project objectives, decisions, and decision criteria so that data of sufficient type, quality, and quantity are generated to meet project objectives. The formal implementation of a DQO process brings structure to the planning process, thereby resulting in defensible decision making.

The U.S. Environmental Protection Agency's Guidance for the Data Quality Objectives Process (EPA QA/G-4, Final, September 1994a) was referenced in implementing the DQO process for

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the Phase 2A/1B QAPP. That document, which is intended to provide general guidance on developing data quality criteria and performance specifications for decision making, addresses application of the USEPA's seven step DQO process for site investigations.

A.7.2 Specifying Quality Objectives

Data used for the Midnite Mine RI/FS must be of sufficient quantity and quality to meet the needs of human health and ecological risk assessment and/or feasibility study. A substantial amount of usable historical data exist for the Phase 2A/1B RI/FS, however, some data gaps remain. The focus of the Phase 2A/1B field investigation is to gather the necessary additional data to support the RI/FS. Additional data may be required in the future to support design of remedial actions, if necessary.

A.7.2.1 Human and Ecological Receptors and Exposure Pathways

Phase 2A human and ecological receptors and exposure pathways are listed on Tables A.7-1 and A.7-2. Phase 1A/1B receptors and exposure pathways are presented in the Phase 1A QAPP.

At present, EPA and URS are actively working with the Spokane Tribe of Indians to further refine the appropriate ecological receptors, exposure pathways, and conceptual site models. This is an ongoing process that is not yet finalized. Nonetheless, the basic pathways and receptors are the same as presented in the Phase 1A QAPP. The final detailed exposure pathways and conceptual site models will be presented in the work plan for the human health risk assessment.

A.7.2.2 Sampling Strategy and Rationale

Tables A.7-3 through A.7-8 provide the sampling strategy and rationale developed based on the Phase 2A/1B DQO process.

A.7.2.2.1 Decisions

The identified types of decisions on Tables A.7-3 through A.7-8 are based on expected risk assessment and feasibility study considerations for the MA, PIA downwind areas, PIA haul roads, PIA drainages south of the MA, and Blue Creek.

A.7.2.2.2 Data Gaps

During the DQO process, a list of information types necessary to resolve the identified decisions was developed. That list was then compared to available historic data to determine whether sufficient data already exist to resolve the decisions. A substantial quantity of historic data from previous investigations is potentially usable for risk assessment and feasibility study needs for Phase 2A/1B pending verification of data quality. This includes open pit and reservoir surface water and sediment chemical and radionuclide data; MA friable surface material chemical and radionuclide data; external radiation, airborne radon, and radon flux measurements in the MA; and PIA downwind area radiation and chemical and radionuclide results. However, in many cases, the historic data: 1) do not address all potential chemicals of concern (PCOCs) necessary

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for the risk assessment, 2) were not collected in all areas of concern, or 3) were collected in a manner that limits their comparability with background information. Therefore, additional data collection is necessary to supplement the existing data.

The major data gaps identified during the Phase 2A/1B DQO process are:

1. Incomplete PCOC concentration/activity data for certain previously sampled media. Typically this consisted of incomplete metals and radionuclide decay series data for surface water and sediment in the open pits; friable surface material in the MA, on the PIA haul roads, and in PIA downwind areas; and sediment in PIA riparian areas.
2. Incomplete external radiation data. Historic gamma radiation data exist for some areas but are absent or inadequate for other key areas (i.e., open pits, PIA haul roads, PIA downwind areas).
3. Incomplete or no airborne radon data for various areas (i.e., open pits, stockpiles, waste rock piles, and disturbed ground areas in the MA, PIA haul roads, PIA downwind areas).
4. Incomplete groundwater hydraulic and chemical data for the MA and Blue Creek. Additional data collection is required for the bedrock groundwater system in the vicinity of the Hillside Dump, the open pits, the MA, and for the alluvial groundwater system at the southern drainages and Blue Creek below its confluence with the Eastern Drainage.
5. Incomplete radon flux information for the MA to support the feasibility study.
6. Incomplete ecological parameter data for the MA and PIA to support the ecological risk assessment and feasibility study.
7. Incomplete geologic, geotechnical, volume, surface area, and material properties information to support the feasibility study.
8. Incomplete or no background conditions information for various media or parameters, including surface material, airborne radon, radon flux, external radiation, surface water, sediment, and groundwater.

Based on these data gaps, field data collection activities and samples have been identified for Phase 2A/1B. These field activities and samples are listed on Tables A.7-3 through A.7-8 and correlate with field activities and samples identified in Appendix A, the Sampling and Analysis Plan. Locations of data collection activities are shown on Figures A.7-1 through A.7-5.

A.7.2.2.3 Sampling Activities and Rationale

Tables A.7-3 through A.7-8 present Phase 2A/1B sampling activities and rationale for:

- open pits in the MA
- stockpiles, waste rock piles, and disturbed ground in the MA
- PIA haul roads
- PIA downwind areas

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- Phase 2A background characterization
- Phase 1B follow-on investigations in the PIA and background areas

Open Pits in the MA

Additional data collection is necessary in Pits 3 and 4 in the MA to support risk assessment and the feasibility study. The human health risk assessment will consider risks to a human receptor living in the MA or PIA, or working in or visiting the MA and PIA. Risk to humans may occur as a result of exposure to PCOCs in surface water and sediment in the pit bottoms or pit lakes (if present); ingestion of plants or animals exposed to PCOCs in the pits; external radiation emanating from the pit walls, sediment, and surface water; PCOCs in windblown dust, or radon in air. The ecological risk assessment will consider risks associated with exposure of ecological resources to pit sediment and surface water and external radiation. To assess these risks, the following additional data collection is necessary (Table A.7-3):

- Open pit water and sediment PCOC concentrations. Existing chemical and radionuclide data are available for surface water and sediment in the open pits, however, those data are not sufficient for risk assessment. For surface water, existing data do not include radon or full radioactive decay series data needed for the risk assessment. For sediment, previous samples were collected along the pit lake edge when water levels were relatively high. Because PCOC concentrations are expected to be highest near the bottom of the pit, where the most sediment has accumulated, the historical metals and radionuclide data may not represent worst case conditions. Therefore, collection and analysis of open pit lake surface water and sediment samples is necessary.

The open pit water and sediment samples will be collected from the nearest accessible point to the bottom of the pit (if water is absent), or from near the point where the haul road enters the pit lake (if water is present) (Figure A.7-1). Because the haul road offers the easiest access to the pit, this area is considered the most likely exposure point for humans and livestock or large terrestrial wildlife. The surface water and sediment samples will be analyzed for a wide variety of chemicals and radionuclides, including radioactive decay series isotopes (Table A.7-3). It is possible that Ra226 in sediment can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section 4.7.2.2.6.

There is no natural background analog for open pits. Therefore, open pit surface water and sediment data will be evaluated using the statistical methods presented for stream surface water and sediment in the Phase 1A QAPP to determine if those media have been affected by the mine.

- External radiation emanating from the open pit walls, sediment, and surface water has the potential to affect human and ecological receptors within the pit. Limited data are available concerning external radiation levels within the pit; therefore, gamma radiation surveys will be performed. The surveys will be conducted along the pit haul roads. Integrated gamma

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measurements along the length of the haul roads will provide an estimate of the radiation exposure to a receptor walking along the roads. Point gamma measurements along the roads will provide an estimate of the total pit radiation levels for various pit lake level scenarios.

- Exposure to radon in air in the pits is a component of risk to human receptors. Limited data are available concerning radon concentrations in air; therefore additional data collection is needed. Radon measurement devices will be placed in each pit for a period of up to 1 month (weather conditions permitting) to estimate radon levels in air in the pits (Figure A.7-1).

PCOC concentrations in airborne dust will be estimated through modeling from PCOC concentrations in pit sediment. Therefore, airborne particulate sampling is not necessary.

In addition to the risks to humans or organisms posed by entering the open pits, the pits also have the potential to act as contamination sources to groundwater in the MA, which in turn can affect groundwater in the PIA. Currently, there is insufficient information to understand the hydraulic relationship between the open pits and the surrounding bedrock groundwater system, or to determine whether or not deep bedrock groundwater has been affected by the mine. Such an understanding is necessary in order to predict how the open pits might affect MA or PIA groundwater, or conversely, how the groundwater may affect the open pits in the future. Additional data collection in Phase 2A is focused on estimating the direction of horizontal and vertical hydraulic gradients in the vicinity of the pits (to determine whether the pits act as hydraulic sources or sinks), and assessing whether bedrock groundwater has been affected by the pits. This information will be necessary to support evaluation of MA and pit remediation alternatives in the Feasibility Study (FS).

Monitoring wells will be installed immediately south of each pit, which are the most likely locations for pit outflow to the bedrock groundwater system (Figure A.7-1). For Pit 3, a well pair (MWP3-01 and MWP3-02) consisting of a bedrock water table well and a deep bedrock well will be installed to assess horizontal and vertical hydraulic gradients, and bedrock groundwater quality near the pit. For Pit 4, only a deep bedrock well (MWP4-02) will be installed because a bedrock well pair (BOM-8S/8D) is already present near the southern end of the pit.

The bedrock groundwater samples will be analyzed for a suite of inorganic chemical and radionuclide parameters selected to indicate whether or not bedrock groundwater has been affected by the mine (Table A.7-3). The groundwater data will be evaluated using the statistical methods presented for groundwater in the Phase 1A QAPP.

Additional data collection to support the FS will involve surveying of the pit sediment levels (if no pit lake is present or water levels are very low) to allow estimation of the volume of sediment within each pit, and geologic mapping of the pit walls to assess open pit remedial alternatives (e.g., pit backfilling), and long-term pit wall stability.

Stockpiles, Waste Rock Piles, and Disturbed Ground

Additional data collection is necessary in the MA to support the risk assessment and feasibility study. The human health risk assessment will consider risks to a human receptor living in the

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MA or PIA, or working in or visiting the MA or PIA. Risk to humans may occur as a result of exposure to PCOCs in friable surface material or affected plants or animals in the MA; external radiation emanating from the stockpiles, waste rock piles, or disturbed areas; PCOCs in windblown dust; or radon in air. Risks to ecological receptors may occur from exposure to external radiation and contact or ingestion of surface material. To assess these risks, the following additional data collection is necessary (Table A.7-4):

- Friable surface material PCOC concentrations and activities. Historical data exist for surface material in the MA but do not include all PCOCs. In particular, existing data do not include PCOC activities for all radioactive constituents or isotopes of concern. Because the surface materials may not be in radioactive equilibrium, activities of decay products cannot be reliably estimated from activities of parent constituents. Therefore, measurements of individual constituents and isotopes are necessary for estimating risk.

This will be accomplished by collection of surface material samples from stockpiles, waste rock piles, and disturbed ground areas (Figure A.7-1). The locations of the surface material samples were randomly selected from within a sampling grid superimposed over the MA. This grid consisted of 100' x 100' cells, which were individually numbered. A random-number generator was used to select the cells in which samples will be collected.

The surface material samples will be analyzed for a wide variety of chemicals and radionuclides, including radioactive decay series isotopes (Table A.7-4). It is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The results of the surface material sampling will be evaluated relative to background conditions to assess whether the MA surface materials have been affected. Section A.7.3 discusses the statistical basis for sampling of surface materials in the MA and comparison to background.

- Exposure to radon in air is a component of risk to human receptors. Limited data are available concerning radon concentrations in air; therefore additional data collection is needed. Radon measurement devices will be collocated with surface material sampling locations throughout the MA for an initial period of 6 to 8 months to estimate radon levels in air in the MA (Figure A.7-1). Additional radon sampling will be conducted to obtain representative data that integrate the effects of temporal variability over a longer period. When weather and access permit, in April to May 2001, the alpha-track detectors will be collected for lab analysis. At that time, a new set of detectors will be deployed at the same locations to extend the monitoring period to one year.

Substantial amounts of historic gamma radiation data exist for stockpiles, waste rock piles, and disturbed ground areas of the MA. Therefore, additional data collection to assess risk from external radiation is not necessary.

PCOC concentrations in airborne dust will be estimated through modeling from PCOC concentrations in surface material. Therefore, airborne particulate sampling is not necessary.

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In addition to data collection for risk assessment, a number of data collection needs were identified for assessment of remedial alternatives for the MA in the FS:

- The Hillside Dump is a large waste rock pile located along the northwest edge of the MA. Because of its location and separation from other stockpiles and waste rock piles, it is likely to be evaluated as a separate and distinct feature in the FS, particularly with respect to the need for and design of capping. Whether the Hillside Dump has affected groundwater is a key factor in determining whether this feature will require remedial action. Existing groundwater data are not conclusive with respect to whether the Hillside Dump has affected groundwater. Therefore, additional groundwater data will be collected by installing and sampling a bedrock water table well (MWHD-01) immediately down gradient of the Hillside Dump at a location that has not been affected by other stockpiles and waste rock piles.
- Deep bedrock groundwater in the MA has the potential to affect groundwater in the PIA. Existing data are inconclusive with respect to the degree and extent of affected groundwater in the deep bedrock beneath the MA. Therefore, deep bedrock groundwater data collection is necessary to support the FS. One deep bedrock well (MWDB-01) will be installed south of the central mining area to evaluate deep bedrock water quality. This location has the highest likelihood of being affected by the MA because it is downgradient of most of the major stockpiles, waste rock piles, and backfilled and open pits.

The bedrock groundwater samples will be analyzed for a suite of inorganic chemical and radionuclide parameters selected to indicate whether or not bedrock groundwater has been affected by the mine (Table A.7-4). The groundwater data will be evaluated using the statistical methods presented for groundwater in the Phase 1A QAPP.

- Radon flux rate is a key parameter in the design of cover thickness for stockpiles, waste rock piles, and disturbed ground. Limited radon flux data are available for MA materials. To evaluate the feasibility of applying partial covers or various thicknesses of cover material over the MA, radon flux will be measured for the various types of stockpiles, waste rock piles, and disturbed ground areas (Figure A.7-2).

Radon flux samplers will be deployed at the planned locations during September, 2000. After the lab data are obtained for this set of samples, a subset of the locations will be selected for future radon flux sampling (about 3 rounds of sampling) to evaluate temporal variability of flux for the remainder of the one year period ending October 2001.

- Surface material samples will also be collected for analysis of radon emanation fraction at the MA and background locations to allow an alternate approach for evaluating radon flux. Analysis of the radon emanation fraction has been commonly used for uranium mill tailings radon-barrier design.
- The FS may consider the use of on-site in situ non-mineralized calc-silicate materials as cover or buffer material. Lithologic mapping of the surface geology will be performed to assess the types and quantity of material available on site for this purpose.
- The FS must consider the long-term stability of the South Spoils and Hillside Dump stockpiles. Insufficient geotechnical information exists for this purpose; therefore additional

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data collection is required (Figure A.7-5). Bulk subsurface material samples for geotechnical testing will be obtained by drilling test holes and excavating test pits. Piezometers will be installed in each test hole to allow water level measurement for estimating saturation and pore pressure in the waste rock materials.

PIA Haul Roads

Haul roads covered with gravel derived from stockpile material extend through the PIA from the MA to the Ford-Wellpinit Road. The human health risk assessment will consider risks to a human receptor using or being near the haul roads. Potential risks associated with the haul roads include exposure to PCOCs in friable surface material, surface water, or sediment on or adjacent to the roads; external radiation emanating from the road surface material; PCOCs in windblown dust, or radon in air. To assess these risks, the following additional data collection is necessary (Table A.7-5):

- Friable surface material PCOC concentrations and activities. Limited data exist regarding PCOC concentrations/activities in road surface material, and in surface material adjacent to the roads. Therefore, additional data collection is necessary.

Samples of friable surface material will be collected along the east and west haul roads, from the MA to the Ford-Wellpinit Road (Figures A.7-1 and A.7-3). Samples will consist of road material, and soil from areas immediately adjacent to the roads.

The locations of the surface material samples were randomly selected from within separate sampling grids superimposed over the haul roads and strips of land adjacent to the haul roads.

The surface material samples will be analyzed for a wide variety of chemicals and radionuclides, including individual radioactive decay series isotopes, if necessary (Table A.7-5). However, analyses of certain individual decay series isotopes (i.e., those of Th, U, Pa) are not necessary if gamma spectroscopic analysis, analysis of isotopic uranium, Pb210, and Po210 provide information that demonstrates that surface materials have not been affected above background levels. Therefore, a two-stage analysis process will be applied for haul road surface material samples to determine the appropriate radionuclide analyses. Section A.7.2.2.4 discusses this two-stage process.

Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The results of the surface material sampling will be evaluated relative to background conditions to assess whether the surface materials have been affected. Section A.7.3 discusses the statistical basis for sampling of haul road surface material and comparison to background.

- Surface water and sediment may have been affected by runoff from the haul roads. Existing data are sufficient to characterize the west haul road, but no data exist for potentially affected sediment and surface water along the east haul road. Therefore, one sediment and one

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surface water (if present) sample will be obtained from a location along the east haul road (Figure A.7-3).

The surface water and sediment samples will be analyzed for a wide variety of chemicals and radionuclides, including decay series isotopes (Table A.7-5). However, as discussed for haul road surface materials, analysis of individual decay series isotopes for sediment may not be necessary. Section A.7.2.2.4 discusses this issue. Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The haul road surface water and sediment data will be evaluated using the statistical methods presented for stream surface water and sediment in the Phase 1A QAPP to determine if those media have been affected by the mine.

- Airborne radon. Measurements of radon activity in air will be conducted in the vicinity of the east and west haul roads (Figures A.7-1 and A.7-3).
- Longitudinal and transverse gamma radiation surveys will be performed along both the east and west haul roads. Gamma radiation transect surveys will be conducted along the entire lengths of each haul road and perpendicular to the roads at each sampling location. Gamma radiation measurements will also be obtained at each surface material sampling location. The purpose of the longitudinal transect surveys is to evaluate risks to a human walking along the roads. The purpose of the transverse transect surveys is to evaluate the extent laterally from the roads of radioactive road dust and to evaluate risks from exposure near the roads. The surveys will consist of both integrated and point measurements. The measurements at the sampling locations will also be used to evaluate risks from exposure near the roads.

PCOC concentrations in airborne dust will be estimated through modeling from PCOC concentrations in surface material. Therefore, airborne particulate sampling is not necessary.

PIA Downwind Areas

PIA areas downwind of the MA may have been affected by deposition of windblown dust from the MA. Although all areas of the PIA have the potential to have been affected by windblown dust from the MA, meteorological data indicate that the primary downwind directions are southwest and northeast of the MA (Figure A.7-1). Therefore, these are considered the most likely areas to have been affected.

The human health risk assessment will consider risks to a human receptor living in or visiting the downwind areas. Potential risks associated with the downwind areas include exposure to PCOCs in friable surface material; PCOCs in plants or animals in the downwind areas; external radiation emanating from the surface material; PCOCs in windblown dust, or radon in air. To assess these risks, the following additional data collection is necessary (Table A.7-6):

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- Friable surface material PCOC concentrations and activities. Limited data exist regarding PCOC concentrations/activities in surface material in the downwind areas. Therefore, additional data collection is necessary.

Samples of friable surface material will be collected from both the southeast and northeast primary downwind areas (Figure A.7-1). The locations of the surface material samples were randomly selected from the grid cells within separate sampling grids superimposed over the two primary downwind areas.

Surface material samples will be collected at depths of 0 to 5 cm below the surface litter for analysis of a wide variety of chemicals and radionuclides, including individual radioactive decay series isotopes, if necessary (Table A.7-6). However, as discussed for haul road samples, analyses of certain individual decay series isotopes are not necessary if gamma spectroscopic analysis and analysis of isotopic uranium, Pb210, and Po210, provide information that demonstrates that surface materials have not been affected above background levels. Therefore, the two-stage analysis process discussed in Section A.7.2.2.4 will be applied. Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The results of the shallow surface material samples (0 to 5 cm depths) will be evaluated relative to background conditions to assess whether the surface materials have been affected. Section A.7.3 discusses the statistical basis for sampling of downwind area surface material and comparison to background.

In addition to the surface materials samples to be collected at depths of 0-5 cm below the surface litter, URS will also collect deeper samples at all the same PIA and background locations at depths of 5-20 cm below the litter. These deeper samples are hereafter referred to as “subsurface samples”. At locations where there is less than 20 cm of friable surface material present above the bedrock, the subsurface samples will be collected to the maximum soil depth available. The subsurface samples will be collected as composite samples in the same manner as previously described for the shallow surface material samples. The subsurface samples will be analyzed for total organic carbon (TOC), moisture content and pH at all locations. At approximately 25 percent of the locations, the deeper samples will also be analyzed for other agronomic parameters (Tables A.7-5, A.7-6 and A.7-7).

Further more-detailed analyses of selected subsurface samples will be performed following the process described below. The goal of this process is to select samples for detailed lab analyses that most likely include the range of values in each PIA and background sub-area. As described in other sections of this QAPP, there are three PIA surface material sub-areas addressed in this study. Two PIA sub-areas are downwind of the MA to the southwest and northeast. Another PIA sub-area lies adjacent to the haul roads. There are also two background surface material sub-areas, the mineralized area and the non-mineralized area.

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The first step for identifying subsurface samples for detailed lab analysis will be to tabulate the lab data for trace metals and radioactive indicator parameters¹ from the surface material samples in each PIA sub-area. Each PIA sub-area contains 16 surface samples and 16 subsurface samples (13 subsurface samples in the haul road sub-area). Each background sub-area contains 20 surface samples and 20 subsurface samples.

The second step of this process involves rank-ordering the surface samples based on the lab analyses of the metals and radioactive indicator parameters. For each PIA and background sub-area surface sample location the concentration of each trace metal and the activity of each radioactive indicator parameter will be ranked. For each sample location, the ranks of each trace metal and the ranks of each radioactive indicator parameter will be summed. These sums will then be ranked for each sample location to normalize the metals and the radioactive parameters, which will provide the basis for an overall ranking of the surface samples within each sub-area.

The third step of the process will be to select 6 sample locations within each PIA sub-area that are equally distributed within the overall rankings of the surface samples within that sub-area. By this procedure, the subsurface samples at these locations will include the minimum, maximum and intermediate composite values for metals and radionuclides measured in the surface samples in each PIA sub-area. Detailed lab analyses² will be performed on the 6 selected subsurface samples from each PIA sub-area, which will result in detailed analyses for a total of 18 PIA subsurface samples.

The fourth step will be to select and analyze 8 subsurface samples from each of the two background sub-areas using the same rank-ordering process as for the previous step. This will result in obtaining detailed lab analyses² of 16 background subsurface material samples at locations which include the minimum, maximum and intermediate values for composite metals and radionuclides measured in the surface samples in each background sub-area. The remainder of the PIA and background subsurface samples will be archived to allow for future lab analyses, if warranted.

After the lab data are obtained for the subsurface samples, potentially affected subsurface sample locations will be identified by calculating background limit values for each indicator parameter and comparing the limits to the data for individual PIA samples of the subsurface materials. The background limit values will be calculated by pooling the data for the 16 subsurface samples, using the same approach as described in section A.7.3. Results of the comparisons between background and PIA data will be plotted on a map to provide information on the areal distribution of parameters exceeding background limits within the PIA sub-areas. The number, type and distribution of parameters in the PIA that exceed

¹ The radioactive parameters that would indicate windblown contamination include Pb-210, Po-210, and Ra-226. The trace metal indicator parameters for this will include arsenic, beryllium, cobalt, cadmium, chromium, lead, molybdenum, nickel, vanadium and zinc.

² The detailed parameter list for lab analyses of subsurface samples will include the metals, isotopic uranium, isotopic thorium, isotopic radium, Pa-231, Po-210 and Pb-210.

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background limits will be used to evaluate whether the subsurface materials are affected and which parameters will be addressed in the HHRA and ERA.³

- Airborne radon. Measurements of radon activity in air will be conducted in one location in each of the two primary downwind areas (Figure A.7-1).
- Gamma radiation surveys will be performed in each primary downwind area. Gamma radiation measurements will be obtained at each surface material sampling location. The surveys will consist of point measurements.

PCOC concentrations in airborne dust will be estimated through modeling from PCOC concentrations in surface material. Therefore, airborne particulate sampling is not necessary.

Phase 2A Background Characterization

The Phase 2A investigation activities discussed above typically involve comparison of MA or PIA PCOC concentrations/activities to background levels. Phase 1 addressed background characterization of groundwater, surface water and sediment. Phase 2A will address background characterization of surface material, external radiation, airborne radon, and radon flux. Because limited data exist regarding background conditions for these media, additional data collection is necessary (Table A.7-7).

Because the MA and PIA overlies both mineralized and non-mineralized areas, it is necessary to compare PIA and MA levels to background levels that incorporate both mineralized and non-mineralized area effects. Therefore, two background areas were identified; a mineralized area north of the MA, and a non-mineralized area northeast of the MA (Figure A.7-3). Both areas were identified based on evaluation of available geologic information, including regional geologic mapping studies by the U.S. Geological Survey (USGS), and mineral deposit investigations conducted by Bendix Corporation for the NURE program.

The background areas were selected to be free of effects from the MA. The mineralized background area (BKMIN) is located on the north side of Spokane Mountain, approximately 1 mile or more distant from the MA. Collecting background samples in this area avoids the potential presence of windblown dust from the mine site.

The non-mineralized background area (BKNON) is located approximately 1½ miles or more northeast of the MA. The potential for the presence of windblown dust from the mine site in this background sampling area is avoided because of its distance from the site.

The following Phase 2A background characterization activities are necessary:

- Friable surface material PCOC concentrations and activities. Limited data exist regarding PCOC concentrations/activities in surface material in the background areas. Therefore, additional data collection is necessary.

³ A sample location will be considered affected if it contains more than **m** exceedances of UTLs for the parameters used in the background comparison.

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Samples of friable surface material will be collected at 20 locations in each of the mineralized and non-mineralized areas (Figure A.7-3). The locations of the surface material samples were randomly selected from within separate sampling grids superimposed over the two background areas.

The surface material samples collected at depths of 0 to 5 cm will be analyzed for a wide variety of chemicals and radionuclides, including individual radioactive decay series isotopes (Table A.7-7). However, as described earlier in this section (A.7.2.2.3), the deeper materials samples (5 to 20 cm depth) will be analyzed for TOC, moisture content, and pH, and a subset will be analyzed for agronomic parameters. Further detailed lab analyses of some deeper samples will be determined following the ranking procedures described previously under the subsection on PIA downward areas.

Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The results of MA and PIA surface material sampling will be evaluated relative to background conditions to assess whether the surface materials have been affected. Section A.7.3 discusses the statistical derivation of background and comparison of MA and PIA data to background.

- Airborne radon. Measurements of radon activity in air will be conducted in 9 locations within each of the two background areas (Figure A.7-3). Airborne radon sampling locations are collocated with nine of the surface material sampling locations.

Because airborne radon concentrations can be heavily influenced by subsurface radon migration along structural features, airborne radon measurement locations in the mineralized background area were selected to include locations in the vicinity of a structural contact between the Togo Formation and the porphyritic quartz monzonite unit of the Loon Lake Granite. Locations were also selected to be within areas identified as being anomalous during historical mineral deposit investigations.

Airborne radon sampling will be conducted over the period of one year on the same schedule described previously for the PIA locations.

- Radon Flux. Radon flux measurements will be obtained at locations within the two background areas (Figure A.7-3). Radon flux measurement locations are collocated with airborne radon measurement locations. Radon flux will be measured several times during the period of September 2000 through October 2001, on the same schedule described previously for the PIA locations.

Because radon flux measurements can be heavily influenced by subsurface radon migration along structural features, radon flux measurement locations in the mineralized background area were selected to include locations in the vicinity of a structural contact between the Togo Formation and the porphyritic quartz monzonite. Locations were also selected to be within areas identified during historical mineral deposit investigations as being anomalous.

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- Gamma radiation surveys will be performed in each background area. Gamma radiation measurements will be obtained at each surface material sampling location. The surveys will consist of point measurements.

Phase 1B

Phase 1A investigations, conducted in the fall of 1999 and spring of 2000, addressed PIA and background groundwater, surface water, and sediment. Based on the Phase 1A results, several follow-on Phase 1B data collection activities have been identified (Table A.7-8):

- Determination of PCOC concentrations/activities in sediment in PIA riparian areas. Riparian areas consist of fluvial deposition areas adjacent to the main stream channels in the PIA. These areas are typically characterized by deposition of fine-grained sediments during stream flooding, and by specific vegetation associated with the streams. Riparian areas are important to the human health and ecological risk assessments for two reasons: 1) the fine grained, organic rich nature of the sediments may result in higher concentrations/activities of PCOCs, and 2) riparian areas typically contain an abundance of plants and organisms that can be affected and/or consumed by humans or other organisms.

Because the sediment sampling conducted during Phase 1A and during previous investigations by others was primarily within active stream channels, additional sample collection in riparian areas is necessary.

This will be accomplished by collection of 13 sediment samples from riparian areas in the Western, Central, and Eastern drainages south of the MA, and along Blue Creek below its confluence with the Eastern Drainage (Figure A.7-4). Ten of the locations of the sediment samples were randomly selected from within separate sampling grids superimposed over each of the drainages and Blue Creek. Three additional sampling locations were selected to be at locations of groundwater seepage in the Western, Central, and Eastern Drainages. It is expected that groundwater discharge in the Western, Central, and Eastern Drainages may be affected, resulting in higher PCOC concentrations in riparian sediment at those locations.

The sediment samples will be analyzed for a wide variety of chemicals and radionuclides, including individual radioactive decay series isotopes, if necessary (Table A.7-8). However, as discussed for PIA surface material samples, analyses of certain individual decay series isotopes are not necessary if gamma spectroscopic analysis and analysis of isotopic uranium, Pb210, and Po210, provide information that demonstrates that PIA sediment has not been affected above background levels. Therefore, the two-stage analysis process discussed in Section A.7.2.2.4 will be applied. Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The PIA sediment data will be evaluated using the statistical methods presented for stream sediment in the Phase 1A QAPP to determine if the sediment has been affected by the mine.

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- Determination of PCOC concentrations in alluvial groundwater along Blue Creek. The results of Phase 1A groundwater sampling at the terminus of the Eastern Drainage suggest alluvial groundwater adjacent to Blue Creek may be affected by the mine. No alluvial groundwater data exist for Blue Creek, therefore, additional data collection is necessary to resolve whether alluvial groundwater beneath and adjacent to Blue Creek has been affected.

One alluvial monitoring well (MWBC-01) will be installed and sampled immediately downstream of the confluence of Blue Creek and the Eastern Drainage (Figure A.7-4). The groundwater samples will be analyzed for a suite of inorganic chemical and radionuclide parameters selected to indicate whether or not groundwater has been affected by the mine (Table A.7-8). The groundwater data will be evaluated using the statistical methods presented for groundwater in the Phase 1A QAPP.
- Estimation of hydraulic conductivity of alluvial materials in the PIA. The FS will likely consider remedial alternatives for alluvial groundwater contamination identified in the PIA south of the MA. Hydraulic conductivity data exist for the alluvial groundwater system at only two locations (GW-35A and GW-36A). Therefore, additional data collection is needed.

This will be accomplished by conducting slug tests in each existing alluvial monitoring well in the Western, Central, and Eastern Drainages, and in the new Blue Creek alluvial well (Figures A.7-4 and A.7-5).
- Background groundwater PCOC concentrations/activities. Statistical analysis of the Phase 1A background groundwater data indicate that statistically different populations exist for the fall and spring sampling rounds and for alluvial and bedrock groundwater. Therefore, collection of additional background groundwater samples is necessary to increase the statistical power in the groundwater background data for PIA data comparison purposes.

This will be accomplished by collecting background groundwater samples at each existing background well (Figure A.7-3). The groundwater samples will be analyzed for a wide variety of chemical and radionuclide parameters (Table A.7-8). The analytical parameters are the same as those specified in Phase 1A with the exception that the samples will not be analyzed for Th, Ra, Pb, or Po isotopes. Section A.7.2.2.5 discusses the basis for this reduction in parameters. The groundwater data will be evaluated using the statistical methods presented for background groundwater in the Phase 1A QAPP.
- Background surface water PCOC concentrations/activities. Statistical analysis of the Phase 1A background surface water data indicate that statistically different populations exist for the fall and spring sampling rounds. Therefore, collection of additional background surface water samples is necessary to increase the statistical power in the surface water background data for PIA data comparison purposes.

This will be accomplished by collecting background surface water samples at each previously sampled surface water sampling station (Figure A.7-3). The surface water samples will be analyzed for a wide variety of chemical and radionuclide parameters (Table A.7-8). The analytical parameters are the same as those specified in Phase 1A with the exception that the samples will not be analyzed for thorium, radium, lead, or polonium

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isotopes. Section A.7.2.2.5 discusses the basis for this reduction in parameters. The surface water data will be evaluated using the statistical methods presented for background surface water in the Phase 1A QAPP.

- Background sediment PCOCs. As discussed previously, characterization of riparian sediments is required for the human health and ecological risk assessments. Based on a review of Phase 1A data it was determined that additional background riparian sediment samples are necessary.

Four background riparian sediment samples will be collected at selected Phase 1A background surface water sampling stations. (Figure A.7-3). The background sediment samples will be analyzed for a wide variety of chemical and radionuclide parameters, including radionuclide decay series isotopes (Table A.7-8). It is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6. The sediment data will be evaluated using the statistical methods presented for background sediment in the Phase 1A QAPP.

- Verification of PCOC concentrations/activities in PIA sediments. PCOCs were detected in PIA sediments during Phase 1A. The Phase 1A QAPP requires verification of those PCOC concentrations/activities to support comparison to background concentrations/activities. This will be accomplished by verification sampling of selected sediment locations where PCOCs were detected (Figure A.7-4). Certain other locations where PCOCs were detected will not be resampled because either: 1) the detected concentrations/activities were clearly above background levels, or 2) the locations were bounded upstream and downstream by other locations where concentrations/activities were clearly above background levels.

The PIA sediment samples will be analyzed for a wide variety of chemicals and radionuclides, including individual radioactive decay series isotopes, if necessary (Table A.7-8). However, as discussed for PIA surface material samples, analyses of certain individual decay series isotopes are not necessary if gamma spectroscopic analysis and analysis of isotopic uranium, Pb210, and Po210, provide information that demonstrates that PIA sediment has not been affected above background levels. Therefore, the two-stage analysis process discussed in Section A.7.2.2.4 will be applied. Also, it is possible that Ra226 activities can be estimated based on gamma spectroscopy without the need for application of the time-consuming de-emanation method. A process for determining Ra226 by gamma spectroscopy is discussed in Section A.7.2.2.6.

The PIA sediment data will be evaluated using the statistical methods presented for stream sediment in the Phase 1A QAPP to determine if the sediment has been affected by the mine.

A.7.2.2.4 Two-Step Process for Evaluating the Need for Analysis for Th, Ra, and Pa Isotopes in PIA Surface Material and Sediment

Activities for certain isotopes of the following radionuclides in PIA surface material and sediment are necessary to support the risk assessments if PIA surface materials and sediments have been affected by the mine above background levels: U, Th, Ra, Pa, Pb, and Po. To reduce

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radionuclide analytical costs and project schedule, a two-step process for radiological laboratory analyses has been developed to determine whether PIA surface materials or sediments have been affected above background levels prior to analyzing for the full suite of radionuclide isotopes. This approach takes advantage of the relatively quick turn-around time for the gamma spectroscopy analyses (by NAREL Method GAM-01).

All of the PIA samples of surface material and sediment will be collected in the field as though the full suite of radiological isotopes will be needed for the risk assessment. However whether the full suite of these isotopes is actually needed depends on whether the surface materials and sediments in the PIA have been affected above background. Thus for these samples, the first step will be to analyze a limited suite of radiological indicator isotopes that include isotopic uranium, Po210, Pb 210 and other radioactive isotopes of interest included in the gamma spectroscopic analysis (Ra 226, Bi 214, Pb 214, Pa231 using the NAREL GAM-01 method). Elevated levels of these indicator isotopes, relative to their background levels, would indicate mine-related contamination. If a statistical comparison of a PIA indicator data population to the background data population shows there are mine-related effects in the PIA surface material or sediment, then those samples would be analyzed for the remainder of the radiological parameters necessary for the risk assessments. However, if the background comparison does not indicate mine-related effects, then no additional radiological analyses will be performed for these PIA surface material and sediment samples.

A.7.2.2.5 Basis for Reduction in Decay Series Analyses for Groundwater and Surface Water

Two rounds of Phase 1A sampling and analyses have been performed to provide the radionuclide decay series data for groundwater and surface water needed for the risk assessments. Nonetheless, a primary objective of Phase 2A is better defining the nature and extent of mine-affected groundwater in the MA and PIA. To meet this objective while minimizing cost for the analyses, the radiological analyses of groundwater samples collected in Phase 2A will only include the primary indicators of radiological contamination in water at this site, isotopic U and Rn 222. These parameters were selected as primary radiological indicators in water because of their relatively high geochemical mobility and relatively high concentrations at this site. U and Rn222 are well-known and well-documented at numerous uranium mill and mine sites as having high mobility in groundwater, relative to many other metals and relative to Ra226. It is also well known that radon in water is a primary contributor to human health risk. Thus these two parameters are important indicators of mine-affected water, if present at levels elevated above background. Therefore, to augment the Phase 1A data for background characterization and to better define the full extent of mine-related water contamination, Phase 2A will include re-sampling of all previously sampled groundwater and surface water background locations for isotopic U and Rn222. MA and PIA groundwater samples collected in Phase 2A will also be analyzed for these radiological indicator parameters.

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A.7.2.2.6 Estimation of Ra226 Activity from Gamma Spectroscopy Methods

Analytical data for Ra226 for Phase 1A Round 1 sediment analyses are being obtained by two analytical methods: the de-emanation method specified in the Phase 1A QAPP and also through gamma spectroscopy by NAREL Method GAM-01. The gamma spectroscopy results are obtainable on a much faster analytical turnaround time than the de-emanation method results. However, Ra226 activities by gamma spectroscopy may be over-estimated due to interference from U235 decay. Thus the Ra226 data by gamma spectroscopy should provide an upper bound to the actual Ra226 activities.

The gamma spectroscopy method also provides for measurement of Bi214 and Pb214, both short-lived daughters of Rn222 which, in turn, is a daughter product of Ra226 decay. Thus, as long as the sample is properly prepared, the sample analysis container is sealed well enough to prevent leakage of radon, and sufficient time elapses to allow ingrowth of radon from the Ra-226, the Bi214 and Pb214 activities should provide an accurate measure of Ra-226 activities. Should the sample analysis container leak or should radon ingrowth not be complete, the Bi214 and Pb214 activities will provide a lower bound to the Ra226 activities.

Once all Ra226 data (by both methods) and U235 data are obtained from the Phase 1A Round 1 analyses, a site-specific evaluation will be made as to whether correction for U235 interference can be performed to provide gamma spectroscopy Ra226 data with accuracy adequate for risk assessment purposes. If an adequate correction method is developed, then it will be applied to gamma spectroscopy data obtained during analysis of surface material and sediment during Phase 2A and 1B sampling. If evaluation of these data for a given medium indicates that the Ra226 activities obtained from the gamma spectroscopy data are of adequate accuracy and sensitivity for risk assessment purposes, then no additional analyses of the Phase 2A and 1B samples by the de-emanation method will be conducted. If, on the other hand, the evaluations for a given medium indicate that the U235-corrected gamma spectroscopy results are not of adequate accuracy or sensitivity, the de-emanation method will be performed as originally specified in the Phase 1A QAPP.

Gamma spectroscopy measurements of Ra226 in groundwater and surface water do not have adequate sensitivity for risk assessment purposes so all Ra226 analyses conducted on water will be through the de-emanation method.

A.7.3 Background Characterization

Statistical Approach

The data analysis approach and the number of samples to be collected both within background and the site depends on the intended uses of the data. In general, the uses of the data are the same as for Phase 1. The key objective of the Phase 2 surface materials sampling is to determine whether the surface materials in the PIA have been affected by the mine operations. Similarly to Phase 1, background surface sampling locations have been selected to represent the natural range of concentrations present at the Midnite Mine site prior to mining operations.

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Sample locations have also been selected in the PIA and MA to determine whether surface materials have been affected above background levels. If the PIA surface material samples exceed background levels, these PCOCs will be addressed in the baseline risk assessment. Because of the exposure scenarios contemplated in the risk assessment, the Phase 2 statistical analysis of surface materials has been modified slightly from Phase 1 as described below.

Scenarios to be evaluated in the baseline risk assessment include a future resident in the PIA, a future resident in the MA and a youth visitor. The future resident scenarios assume that the residents will gather plants and wildlife for food, medicinal, and religious uses from across the PIA. These scenarios require two different expressions of an exposure area unit. The first scenario requires an exposure area unit comparable in size to a residential plot. The second requires an exposure area unit comparable to hunting and gathering across the PIA. Therefore, a randomized grid-sampling plan was designed to provide data useful for estimating concentrations of PCOCs in areas representative of residential size plots and estimates of average exposure concentrations across the PIA and MA.

The background statistical approach will evaluate whether an individual surface material sample (i.e., individual grid cell sample) exceeds background (i.e., null hypothesis: concentration of a PCOC in the PIA or MA surface material is less than or equal to background). In such a statistical approach, a maximum background limit is calculated for each PCOC using all the background sample data for the surface materials. The concentration measured in a given soil plot is then compared to the background limit. If the concentration of the chemical in the soil plot exceeds the background limit, it is retained as a PCOC to be evaluated in the risk assessment. If the concentration of the chemical in the surface material plot is at or below the background limit, the chemical is not considered a PCOC. The statistical method that will be used for this individual comparison is the same as that described in the Phase I statistical methods section (Section A.7.3.3) for groundwater, sediment, and surface water samples. A detailed description of the estimated number of background surface material samples required for this approach are the same as described in the Phase I QAPP Section A.7.3.4 for groundwater, surface water, and sediment.

The Phase 2 statistical approach will also evaluate whether average concentrations in defined areas of the PIA (e.g. each downwind area and roadside surface materials) exceed background (i.e., null hypotheses: average exposure concentration of a chemical in the downwind area is less than or equal to background). In such a statistical approach, the average or median concentration in the exposure area sample population is compared to the average or median concentration measured in the background sample population. If the average or median concentration of the PCOC in the exposure area exceeds background it is retained as a PCOC to be evaluated in the risk assessment. If the concentration of the chemical in the PIA area is at or below the background concentration, the chemical is not considered a PCOC in the risk assessment. The statistical method for comparison of the two populations of surface material samples is the same method as described in the Phase I Section A.7.3.3 for comparing between alluvium and bedrock background populations.

The sample size requirements needed for background characterization were calculated assuming that the nonparametric Mann-Whitney U test would be used to compare populations of the

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surface materials. This method uses the two-sample Student's t method for comparison between two population means and then adds 2 additional samples. This method is one of the EPA-recommended methods of statistical analysis to evaluate whether the differences between site and background data are statistically different. Because it is a nonparametric method, it is valid even when the background data do not follow a specific probability distribution (such as normal or lognormal).

The following table shows the estimated minimum number of background surface material samples for different numbers of independent future comparisons at a power of 95 percent.

Detectable Difference (Standard Deviations)	Alpha = 0.05 (5 out of 100 comparisons)	Alpha = 0.025 (5 out of 200 comparisons)	Alpha = 0.005 (5 out of 1000 comparisons)
0.5	90	107	147
1.0	25	29	40
1.5	11	15	20
2.0	9	10	13
3.0	6	6	8

Based on our understanding of site conditions, historic soil data at the site, and proposed sampling locations we are anticipating more than 100 comparisons. Based on EPA (1992b) recommendations for power requirements and detectable differences, between 15 and 20 samples are required to detect a difference of 1.5 standard deviations. Therefore, for this project, a total of 20 background surface material samples will be collected from each background surface material area, mineralized and non-mineralized.

Based on statistical methodology developed for background and PIA sediment in Phase 1A and background and MA and PIA surface materials in Phase 2A and assuming similar variability in concentrations, 16 to 20 locations should be adequate for statistical characterization of background airborne radon and radon flux.

A total of 200 background gamma radiation measurements will be obtained from both background areas, which should be adequate for characterization of background conditions.

A.7.4 Specifying Measurement Performance Criteria

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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A.7.4.1 Analytical Data Quality Levels

The only change in this section from the Phase 1A QAPP is for the table reference. Table B.4.4-1 is replaced by Table B.4.4-1-P2 in the Phase 2A/1B QAPP.

A.7.4.2 Data Quality Indicators

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

A.8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

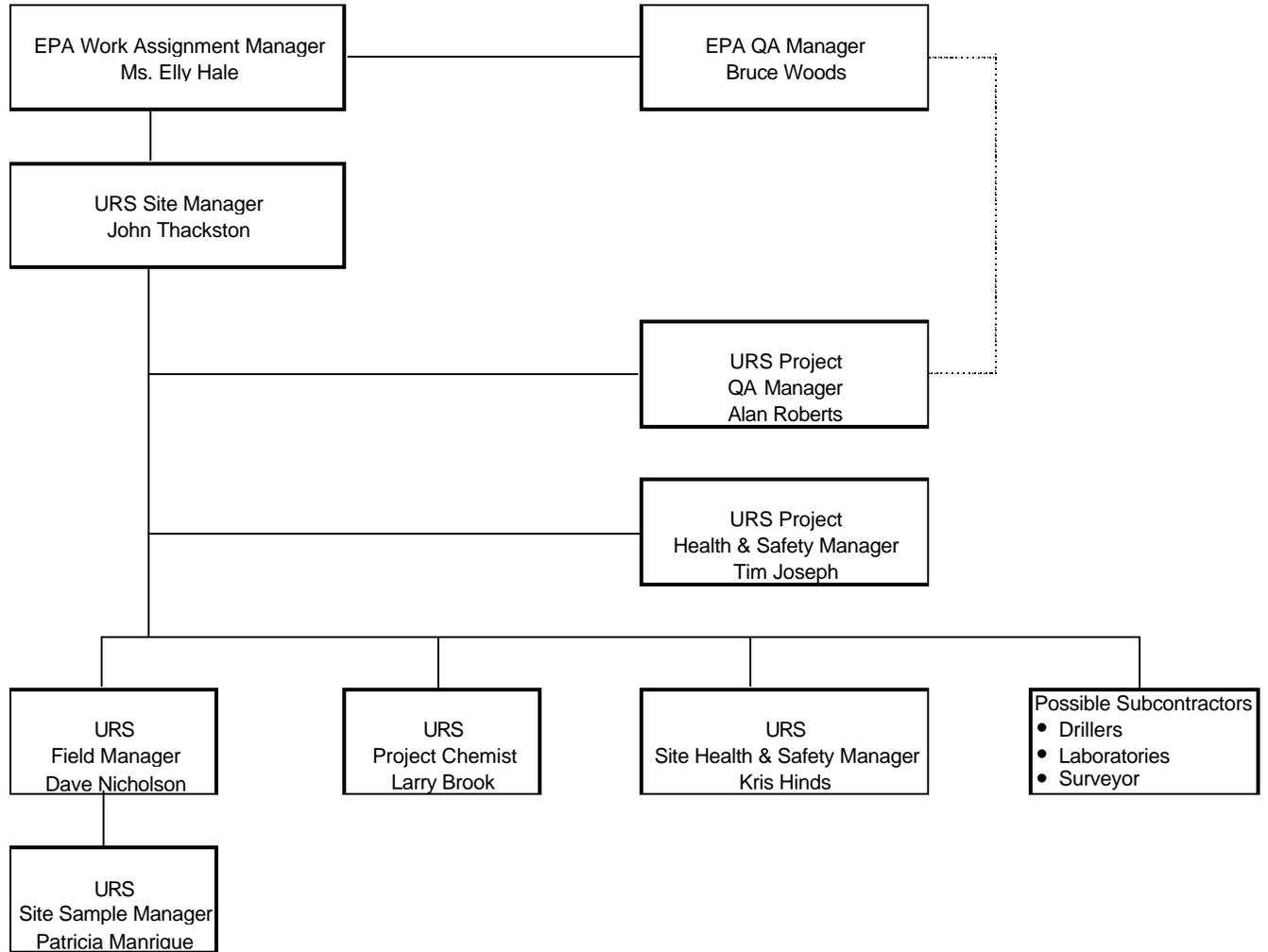
A.9 DOCUMENTATION AND RECORDS

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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Figure A.4-1
PROJECT ORGANIZATION CHART FOR THE MIDNITE MINE RI/FS



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**Table A.7-2
ECOLOGICAL RECEPTORS AND EXPOSURE PATHWAYS
MIDNITE MINE PHASE 2A/1B RI/FS**

Mined Area (MA) – Open Pits:

Producers Aquatic and Wetland Vegetation	Consumers Benthic Macroinvertebrates	Consumers Fish	Consumers Terrestrial Herbivores, Omnivores & Carnivores	Consumers Piscivores – Birds & Mammals
External Radiation	External Radiation	External Radiation	External Radiation	External Radiation
Pit Water • Direct Contact/Uptake	Pit Water • Direct Contact/Uptake	Pit Water • Direct Contact/Uptake	Pit Water • Direct Ingestion • Food-Chain Exposure	Pit Water • Direct Ingestion • Food-Chain Exposure
Pit Sediment • Direct Contact/Uptake	Pit Sediment • Direct Contact/Uptake	Pit Sediment • Incidental Ingestion • Food-Chain Exposure	Pit Sediment • Incidental Ingestion • Food-Chain Exposure	Pit Sediment • Incidental Ingestion • Food-Chain Exposure

Mined Area (MA) – Upland Habitat:

Producers Upland Vegetation	Detritivores Soil Invertebrates	Consumers Herbivores	Consumers Omnivores	Consumers Carnivores
External Radiation	External Radiation	External Radiation	External Radiation	External Radiation
Surface Material • Direct Contact/Uptake	Surface Material • Direct Contact/Uptake • Direct Ingestion	Surface Material • Incidental Ingestion • Food-Chain Exposure	Surface Material • Incidental Ingestion • Food-Chain Exposure	Surface Material • Incidental Ingestion • Food-Chain Exposure

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**Table A.7-2
ECOLOGICAL RECEPTORS AND EXPOSURE PATHWAYS
MIDNITE MINE PHASE 2A/1B RI/FS**

Potentially Impacted Area (PIA) – Upland Habitat¹:

Producers Upland Vegetation	Detritivores Soil Invertebrates	Consumers Herbivores	Consumers Omnivores	Consumers Carnivores
External Radiation	External Radiation	External Radiation	External Radiation	External Radiation
Surface Material • Direct Contact/Uptake	Surface Material • Direct Contact/Uptake • Direct Ingestion	Surface Material • Incidental Ingestion • Food-Chain Exposure	Surface Material • Incidental Ingestion • Food-Chain Exposure	Surface Material • Incidental Ingestion • Food-Chain Exposure

¹Includes upland areas adjacent to haul roads

Blue Creek Drainage²:

Producers Aquatic, Riparian and Wetland Vegetation	Detritivores Soil Invertebrates	Consumers Benthic Macroinvertebrates	Consumers Fish	Consumers Terrestrial Herbivores, Omnivores & Carnivores	Consumers Piscivores – Birds & Mammals
External Radiation	External Radiation	External Radiation	External Radiation	External Radiation	External Radiation
Surface Water • Direct Contact/ Uptake (aquatic vegetation)		Surface Water • Direct Contact/ Uptake	Surface Water • Direct Contact/ Uptake	Surface Water • Direct Ingestion • Food-Chain Exposure	Surface Water • Direct Ingestion • Food-Chain Exposure
Sediment • Direct Contact/ Uptake (wetland vegetation)		Sediment • Direct Contact/ Uptake	Sediment • Incidental Ingestion • Food-Chain Exposure	Sediment • Incidental Ingestion • Food-Chain Exposure	Sediment • Incidental Ingestion • Food-Chain Exposure
Riparian Sediment • Direct Contact/ Uptake (riparian vegetation)	Riparian Sediment • Direct Contact/ Uptake • Direct Ingestion			Riparian Sediment • Incidental Ingestion • Food-Chain Exposure	

²Includes Western, Central, and Eastern Drainages; does not include Oyachen Creek.

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**Table A.7-3
OPEN PITS IN THE MA
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do concentrations of PCOCs in open pit water or sediment exceed background, and, if so, do they pose an unacceptable risk?	<ul style="list-style-type: none"> 1 open pit water sample from each of Pits 3 and 4 (2 water samples total). Samples analyzed for surface water suite (see footnote) 1 open pit sediment sample from each of Pits 3 and 4 (2 sediment samples total). Samples to be collected over a depth interval of 0-20 cm from the bank or bottom of pit (if pit is dry) Samples analyzed for sediment suite (see footnote) 	<p>Historic data exist for open pit water for all PCOCs except radon, antimony, cobalt, vanadium, and radionuclide decay series. A complete suite of metals, radon, and radionuclide decay series are necessary for the risk assessment.</p> <p>Historic data for sediment represent bank sediments for a relatively high pit lake elevation. Sediments near the bottom of the pit are expected to have higher concentrations of PCOCs. Therefore, additional data collection from sediment nearer the bottom of the pit is necessary for the risk assessment.</p>	<p>SWP3-01 SWP4-01 (see Figure A.7-1)</p> <p>SDP3-01 SDP4-01 (see Figure A.7-1)</p>
Does external radiation from the open pit exceed background levels and, if so, does it pose an unacceptable risk?	Integrated and point gamma survey readings along each pit haul road extending from the southern pit rim to the pit bottom or pit lake (if water is present) (2 surveys total)	Gamma readings will be used to measure external radiation within the pits. Readings at various locations along the roads can be used to estimate external radiation for different pit lake level scenarios.	None. Locations of survey lines and gamma readings will be documented during the field surveys.
Do airborne radon concentrations in the open pits exceed background concentrations, and, if so, do they pose an unacceptable risk?	An airborne radon measurement device at 1 location in each open pit (2 airborne radon samples total)	No data exist regarding airborne radon concentrations in the open pits. These data are required for the human health risk assessment.	ARP3-01 ARP4-01 (see Figure A.7-1)

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**Table A.7-3
OPEN PITS IN THE MA
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
<p>Determine whether the open pits have the potential to be contaminant sources to the bedrock groundwater system. Assess the direction and rate of hydraulic communication between the open pits and the bedrock groundwater system.</p>	<ul style="list-style-type: none"> • Survey the elevations of the pit lakes or pit bottoms (if water is not present) (2 surveys total) • Install, measure water levels, and sample 3 wells; 1 deep bedrock well immediately south of Pit 4, and one water table/deep bedrock well pair installed immediately south of Pit 3 (3 wells total) • Samples analyzed for groundwater suite (see footnote) 	<p>The open pits in the MA may affect groundwater that migrates off-site to the PIA. Therefore, an understanding of the relationship between the open pits and the bedrock groundwater system is necessary to support the FS. Also, the direction and rate of groundwater inflow or outflow to/from the pits is an important parameter in evaluating pit dewatering and backfilling alternatives for the FS.</p>	<p>MWP3-01 and MWP3-02 MWP4-02 (see Figure A.7-1)</p>
<p>Evaluate and select remedial alternatives</p>	<ul style="list-style-type: none"> • Survey the elevation of the top of the sediment in each open pit, if exposed • Two sediment samples. Samples analyzed for TOC and grain size • Geologic mapping of pit walls 	<p>The sediment elevation data will be used to estimate sediment volume in the pit.</p> <p>The grain size data will be used to estimate sediment characteristics.</p> <p>The pit will be mapped to assess the feasibility of remedial alternatives and long-term pit wall stability.</p>	<p>SDP3-01 and SDP4-01 (collected concurrently with the chemical/radionuclide samples) (see Figure A.7-1)</p>

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Table A.7-3 OPEN PITS IN THE MA Sampling Strategy and Rationale

Notes:

Surface water analysis suite: total metals, dissolved metals, anions, pH (field), temperature (field), specific conductance (field), Eh (field), turbidity (field), dissolved oxygen (field), ferrous iron (field), COD, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Rn222, Pb210, Po210, gross alpha, gross beta, phosphorus, phosphate, ammonia, TSS, TDS, alkalinity, hardness. See Table A-4 of Appendix A for specific analyses by sample location number.

Sediment analysis suite: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, ammonia. See Table A-5 of Appendix A for specific analyses by sample location number.

Groundwater analysis suite: dissolved metals, anions, pH (field), temperature (field), specific conductance (field), turbidity (field), U234, U235, U238, Rn222, and TDS. See Table A-3 of Appendix A for specific analyses by sample location number.

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Table A.7-4
STOCKPILES, WASTE ROCK PILES, AND DISTURBED GROUND IN THE MA
Sampling Strategy and Rationale

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do concentrations of PCOCs in friable surface material on stockpiles, waste rock piles, or exposed rock areas of the MA exceed background, and, if so, do they pose an unacceptable risk?	16 composite samples of friable surface material. The 16 sample locations are centered in each of the cells selected randomly from within a grid of 100' x 100' cells covering the MA, which includes stockpiles, waste rock piles and disturbed ground. Samples collected at a depth of 0-5 cm. Samples analyzed for surface material suite (see footnote)	Historic data for surface materials within the MA do not include all metals or full radioactive decay series. By collecting full decay series data at locations in the MA, it will be possible to develop proper ratios for calculating activities of non-measured isotopes for historic data. Metals data at MA locations will provide data needed for risk assessment and for defining FS alternatives.	SMMA-01 through SMMA-16 (see Figure A.7-1)
Do airborne radon concentrations in the MA exceed background concentrations, and, if so, do they pose an unacceptable risk?	1 airborne radon measurement device at each of the 16 friable surface material sample locations (16 airborne radon samples total)	Limited data exist regarding airborne radon concentrations in the MA. Additional data are required for the human health risk assessment.	ARMA-01 through ARMA-16 (see Figure A.7-1)
Has the Hillside Dump affected groundwater?	Installation and sampling of 1 water bedrock table well immediately down gradient of the Hillside Dump. Samples analyzed for groundwater suite (see footnote).	Data from this well will be used to evaluate whether the Hillside Dump has affected groundwater.	MWHD-01 (see Figure A.7-1)
Has the MA affected deep bedrock groundwater?	Installation and sampling of 1 deep bedrock well immediately down gradient of the central portion of the MA. Samples analyzed for groundwater suite (see footnote).	Data from this well will be used to evaluate whether deep bedrock groundwater has been affected by MA sources.	MWDB-01 (see Figure A.7-1)

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**Table A.7-4
STOCKPILES, WASTE ROCK PILES, AND DISTURBED GROUND IN THE MA
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
What are radon flux rates for potentially capped areas in the MA?	18 radon flux measurements each on stockpiles, waste rock piles, and disturbed ground (54 measurements total)	Radon flux is needed in the FS to evaluate cover alternatives.	RFSP-01 through RFSP-18 RFRW-01 through RFRW-18 RFDG-01 through RFDG-18 (see Figure A.7-2)
Are materials available on site to serve as cover or buffer materials?	Site-wide lithologic mapping	Calc-silicate materials with low contamination potential may be present in sufficient quantity to supply needed cover material or in-pit lining/buffer material	None
What is the long-term stability of the South Spoils and Hillside Dump?	<ul style="list-style-type: none"> • 6 test holes and associated bulk subsurface material samples and standard penetration tests, completed as piezometers in the South Spoils. • 6 test pits and associated bulk subsurface material samples and field sand cone density tests in the South Spoils. • 3 test holes and associated bulk subsurface material samples and standard penetration tests, completed as piezometers in the Hillside Dump. • 3 test pits and associated bulk subsurface material samples and field sand cone density tests in the Hillside Dump. • Bulk subsurface material samples analyzed for geotechnical suite (see footnote). 	The south Spoils and Hillside Dump have the potential for long-term stability problems. These data are necessary to evaluate the feasibility of leaving the South Spoils and Hillside Dump in place.	THSS-01 through THSS-06 (see Figure A.7-5) TPSS-01 through TPSS-06 (see Figure A.7-5) THHD-01 through THHD-03 (see Figure A.7-5) TPHD-01 through TPHD-03 (see Figure A.7-5)

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Table A.7-4 STOCKPILES, WASTE ROCK PILES, AND DISTURBED GROUND IN THE MA Sampling Strategy and Rationale

Notes:

Surface material analysis suite: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234,U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, radon emanation fraction, total phosphorus, ortho-phosphate, ammonia. See Table A-8 of Appendix A for specific analyses by sample location number.

Groundwater analysis suite: dissolved metals, anions, pH (field), temperature (field), specific conductance (field), turbidity (field), U234, U235, U238, Rn222, and TDS. See Table A-3 of Appendix A for specific analyses by sample location number.

Geotechnical analysis suite: Standard proctor compaction, moisture content, grain size distribution, specific gravity, Atterberg limits, consolidated undrained triaxial strength with pore pressure on remolded samples, sand cone density (field), and standard penetration test (field). See Table A-10 of Appendix A for specific testing by sample location number.

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**Table A.7-5
PIA HAUL ROADS
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do concentrations of PCOCs in friable surface material on or adjacent to haul roads exceed background, and if so, do they pose an unacceptable risk?	16 composite samples of friable surface material (soil and road material). Sample locations randomly selected on separate on-road and off-road grid patterns. Samples collected at a depth of 0-5 cm at each location on the road and at two depths at each location adjacent to the road, 0-5 cm and 5-20 cm. 0-5 cm samples on and adjacent to haul roads analyzed for surface material suite (see footnote). Samples collected from 5-20 cm depth to be analyzed for a subset of parameters (see footnote) and a subset of 5-20 cm depth samples to be analyzed for agronomic parameters. Further detailed analyses of deeper samples will be determined following evaluation of the surface material (0-5 cm) data.	Limited historic data exist for surface materials on and adjacent to haul roads, but do not address all PCOCs. 2 samples will be collected on the east haul road and 10 will be collected adjacent to the east haul road. 1 sample will be collected on the west haul road and 3 will be collected adjacent to the west haul road.	SMEHR-01 through SMEHR-12 (see Figures A.7-1 and A.7-3) SMWHR-01 through SMWHR-04 (see Figure A.7-1)
Do concentrations of PCOCs in drainage sediment or surface water down stream of the East Haul Road exceed background, and if so, do they pose an unacceptable risk?	1 composite sediment sample and 1 surface water sample (if water is present) adjacent to well MWBA-01 downstream of the east haul road. Sediment sample collected over a depth interval of 0-20 cm. Sediment sample analyzed for sediment suite (see footnote). Surface water sample analyzed for surface water suite (see footnote).	The sediment and surface water samples will be used to evaluate potential affects from runoff of road material to adjacent drainages.	SDEHR-01 SWEHR-01 (see Figure A.7-3)

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**Table A.7-5
PIA HAUL ROADS
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do airborne radon concentrations adjacent to the haul roads exceed background concentrations, and if so, do they pose an unacceptable risk?	Airborne radon measurements at 1 location along each haul road (2 airborne radon measurements total)	No data exist regarding airborne radon concentrations adjacent to haul roads. These data are required for the human health risk assessment.	AREHR-01 (see Figure A.7-3) ARWHR-01 (see Figure A.7-1)
Does external radiation on or adjacent to haul roads exceed background, and if so, does it pose an unacceptable risk?	Longitudinal and transverse gamma surveys along the length of each haul road. Gamma measurements at each surface material sampling location.	Limited data exist regarding radiation levels along the haul roads. These data are needed for the risk assessment.	None. Locations of survey lines and gamma readings will be documented during the field surveys.

Notes:

Analysis suite for 0-5 cm surface material samples : metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, and ammonia. Based on comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210 and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanometry), and Ra228 may be cancelled (see Section A7.2.2.4). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231. See Table A-8 of Appendix A for specific analyses by sample location number.

Analysis suite for 5-20 cm subsurface material samples, paste pH, TOC, and moisture. A subset of the samples adjacent to the roads is also analyzed for the agronomic parameters cation exchange capacity, gravimetric clay content/grain size distribution, exchangeable bases, soluble/exchangeable phosphorus, soluble/exchangeable metals. A decision on potential additional analysis for metals, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, and Po210 will be made following evaluation of the surface material (0-5 cm) metals and radiological data. See Table A-9 of Appendix A for specific analyses by sample location number.

Surface water analysis suite: total metals, dissolved metals, anions, pH (field), temperature (field), specific conductance (field), Eh (field), turbidity (field), dissolved oxygen (field), ferrous iron (field), COD, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Rn222, Pb210, Po210, gross alpha, gross beta, phosphorus, phosphate, ammonia, TSS, TDS, alkalinity, hardness. See Table A-4 of Appendix A for specific analyses by sample location number.

Sediment analysis suite: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, ammonia. Based on comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210 and Po210 to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanometry), and Ra228 may be cancelled (see Section A7.2.2.4). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231. See Table A-5 of Appendix A for specific analyses by sample location number.

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**Table A.7-6
PIA DOWNWIND AREAS
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do concentrations of PCOCs in friable surface material in PIA downwind areas exceed background, and, if so, do they pose an unacceptable risk?	Composite samples of friable surface material collected at 16 locations in each of 2 PIA primary downwind areas (32 sample locations total). Sample locations were randomly selected from the 100'x100' cells within a grid of each area. Samples collected at two depths at each location, 0-5 cm and 5-20 cm. All samples from the depth of 0-5 cm to be analyzed for full surface materials suite (see footnote). Samples collected from 5-20 cm depth to be analyzed for a subset of parameters (see footnote), and a subset of 5-20 cm depth samples to be analyzed for agronomic parameters. Further detailed analyses of deeper samples will be determined following evaluation of the surface material (0-5 cm) data.	Based on site meteorological data, primary downwind areas in the PIA are located southwest and northeast of the MA. Limited historic data exist for friable surface material in PIA primary downwind areas but do not address all PCOCs. Additional data are necessary for the risk assessment. The selected analytes are necessary for human and ecological risk assessment.	SMDWSW-01 through SMDWSW-16 SMDWNE-01 through SMDWNE-16 (see Figure A.7-1)
Do airborne radon concentrations in PIA downwind areas exceed background, and, if so, do they pose an unacceptable risk?	One airborne radon measurement in each PIA primary downwind area (2 airborne radon measurements total)	No data exist regarding airborne radon concentrations in PIA downwind areas. These data are needed to for the human health risk assessment.	ARDWSW-01 ARDWNE-01 (see Figure A.7-1)

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**Table A.7-6
PIA DOWNWIND AREAS
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do external radiation levels in PIA downwind areas exceed background, and, if so, do they pose an unacceptable risk?	1 point external gamma radiation measurement at each friable surface material increment sample location (160 gamma survey measurements total)	Limited data exist regarding external radiation in the PIA downwind areas. These data are needed to for the human health risk assessment.	None. Locations of gamma readings will be documented during the field surveys.

Note:

Analysis suite for 0-5 cm surface material samples: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, and ammonia. Based on comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210 and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanometry) and Ra228 may be cancelled (see Section A7.2.2.4). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231. See Table A-8 of Appendix A for specific analyses by sample location number.

Analysis suite for 5-20 cm subsurface material samples: paste pH, TOC, and moisture. A subset of the samples is also analyzed for the agronomic parameters cation exchange capacity, gravimetric clay content/grain size distribution, exchangeable bases, soluble/exchangeable phosphorus, soluble/exchangeable metals. A decision on potential additional analyses for metals, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, and Po210 will be made following evaluation of the surface material (0-5 cm) metals and radiological data. See Table A-9 of Appendix A for specific analyses by sample location number.

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Project Management

**Table A.7-7
PHASE 2A BACKGROUND CHARACTERIZATION
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Determine range of background PCOC concentrations in friable surface materials	<p>Composite samples of friable surface material collected at 20 locations in each of 2 background areas (40 sample locations total). Sample locations were randomly selected from available 100' x 100' cells within grid of each area. Samples collected at two depths at each location, 0-5 cm and 5-20 cm. All samples of 0-5 cm depth to be analyzed for full surface materials suite (see footnote).</p> <p>Samples collected from 5-20 cm depth to be analyzed for a subset of parameters (see footnote), and a subset of 5-20 cm depth samples to be analyzed for agronomic parameters. Further detailed analyses of the deeper samples will be determined following evaluation of the surface material (0-5 cm) data.</p>	<p>Two background sampling areas have been selected; one in a mineralized zone (BKMIN) and one in a non-mineralized zone (BKNON).</p> <p>The mineralized area is northeast of the MA on the north side of Spokane Mountain. This area is 1 mile or more distant from the MA to avoid wind-blown deposition of dust from the MA.</p> <p>The non-mineralized zone is 1½ miles or more northeast of the MA.</p>	SMBKMIN-01 through SMBKMIN-20 SMBKNON-01 through SMBKNON-20 (see Figure A.7-3)
Determine range of background airborne radon concentrations	Airborne radon measurements at 9 locations in each background area (18 airborne radon measurements total)	No data exist regarding background airborne radon concentrations. These data are needed to determine whether airborne radon concentrations in investigation areas are elevated above background levels due to mining activities. These data may also be used to establish cleanup levels, if necessary.	ARBKMIN-01 through ARBKMIN-09 ARBKNON-01 through ARBKNON-09 (see Figure A.7-3)

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Table A.7-7
PHASE 2A BACKGROUND CHARACTERIZATION
Sampling Strategy and Rationale

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Determine range of background radon flux	9 radon flux measurements at each background area (18 radon flux measurements total)	No data exist regarding background radon flux concentrations. These data are needed to determine whether radon flux in MA is elevated due to mining activities. These data may also be used to establish cover thicknesses, if necessary.	RFBKMIN-01 through RFBKMIN-09 RFBKNON-01 through RFBKNON-09 (see Figure A.7-3)
Determine range of background external radiation	1 gamma radiation measurement at each friable surface material increment sample site (200 gamma radiation measurements total)	Limited data exist regarding background gamma radiation levels. These data are needed to determine whether gamma radiation levels in investigation areas are elevated due to mining activities. These data may also be used to establish cleanup levels, if necessary.	None. Locations of gamma readings will be documented during the field surveys.

Notes:

Analysis suite for 0-5 cm surface material samples: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234,U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, radon emanation fraction, total phosphorus, ortho-phosphate, ammonia. See Table A-8 of Appendix A for specific analyses by sample location number.

Analysis suite for 5-20 cm subsurface material samples: paste pH, TOC, and moisture. A subset of the samples will also be analyzed for the agronomic parameters cation exchange capacity, gravimetric clay content/grain size distribution, exchangeable bases, soluble/exchangeable phosphorus, soluble/exchangeable metals. A decision on potential additional analyses for metals, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, and Po210 will be made following evaluation of the surface material (0-5 cm) metals and radiological data. See Table A-9 of Appendix A for specific analyses by sample location number.

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Project Management

**Table A.7-8
PHASE 1B
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Do concentrations of PCOCs in sediment in PIA riparian areas exceed background, and if so, do they pose an unacceptable risk?	10 randomly located composite samples and 3 additional selected composite samples of sediment from riparian depositional areas along the Western, Central, and Eastern Drainages and Blue Creek (13 samples total). The randomly located samples are based on a 30'x333' grid pattern. The 3 additional selected samples are located at seep locations along the drainages. Samples collected at a depth of 0-20 cm. Samples analyzed for sediment suite (see footnote).	<p>The riparian areas are composed of fine-grained overbank deposits deposited outside the main stream channel during high flow conditions. The overbank deposits are outside, but adjacent to, the coarse-grained stream channel deposits.</p> <p>The 3 additional selected locations are riparian areas observed to receive groundwater seepage.</p> <p>The selected analyses are necessary to support human health and ecological risk assessment. These data are anticipated to be sufficient for FS needs.</p>	RSWD-01 through RSWD-03 RSCD-01 and RSCD-02 RSED-01 through RSED-03 RSBC-01 through RSBC-05 (see Figure A.7-4)
Do concentrations of PCOCs in groundwater along Blue Creek exceed background?	Installation and sampling of 1 water table well immediately down gradient of the confluence of Blue Creek and the Eastern Drainage. Sample analyzed for groundwater suite (see footnote).	Based on data from well MWED-10, the furthest down gradient unconsolidated material well in the Eastern Drainage, groundwater may be affected beneath Blue Creek. Data from the new well will be used to evaluate whether alluvial groundwater along Blue Creek is affected.	MWBC-01 (see Figure A.7-4)
Estimate hydraulic conductivity of alluvial materials in the southern drainages	Perform 1 slug test in each alluvial well in the Western, Central, and Eastern Drainages south of the MA and the new Blue Creek alluvial well to estimate hydraulic conductivity (11 slug tests total).	No information is available regarding hydraulic parameters in the alluvium in the southern drainages. This information is necessary for groundwater flow and fate and transport modeling in support of the FS.	MW-1, MW-2, MW-4, MW-5, MW-6, GW-35A, GW-36A, GW-19, MWNE-05, MWED-10, MWBC-01 (see Figures A.7-4 and A.7-5)

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**Table A.7-8
PHASE 1B
Sampling Strategy and Rationale**

Types of Decisions	Required Samples/Activities	Rationale	Associated Sample Location Numbers
Determine background groundwater PCOC concentrations	Sampling of 19 existing background monitoring wells. Samples analyzed for groundwater suite (see footnote).	The results of Phase 1A background groundwater statistical analysis indicate the need for additional sampling of unconsolidated and bedrock wells.	MWBA-02 through MWBA-10 MWBB-01 through MWBB-05 MWNW-01 through MWNW-04 and MWNW-06 (see Figure A.7-3)
Determine background surface water PCOC concentrations	Sampling of 27 background surface water locations. Samples analyzed for surface water suite (see footnote).	The results of Phase 1A background surface water statistical analysis indicate the need for additional sampling of surface water.	SWBK-01 through SWBK-24 SWNW-01 through SWNW-03 (see Figure A.7-3)
Determine background sediment PCOC concentrations	Sampling of 4 new background sediment locations. Samples analyzed for sediment suite (see footnote).	These locations are to supplement the background sediment population with additional fine-grained riparian sediment samples. A grab sample and a composite sample of the sediment will be collected at each location.	SDBK-17 through SDBK-19 and SDBK-23 (see Figure A.7-3)
Verify concentrations of PCOCs in PIA sediment	Sampling of 7 existing sediment locations. Samples analyzed for sediment suite (see footnote).	PCOCs were detected at concentrations exceeding background levels in Phase 1A samples. Verification sampling is being performed to verify these concentrations. A composite sample of sediment will be collected at each location.	SDND-01 SDNE-01 and SDNE-02 SDED-02, SDED-03 and SDED-06 SDSW-01 (see Figure A.7-4)

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Table A.7-8 PHASE 1B Sampling Strategy and Rationale

Notes:

Background groundwater analysis suite: total metals, dissolved metals, anions, pH (field), temperature (field), specific conductance (field), Eh (field), turbidity (field), dissolved oxygen (field), ferrous iron (field), COD, isotopic uranium, Rn222, phosphorus, phosphate, ammonia, TSS, TDS, alkalinity, hardness. See Table A-3 of Appendix A for specific analyses by sample location number.

Blue Creek well groundwater analyses: dissolved metals, anions, pH (field), temperature (field), specific conductance (field), turbidity (field), isotopic uranium, Rn222 and TDS.

Surface water analysis suite: total metals, dissolved metals, anions, pH (field), temperature (field), specific conductance (field), Eh (field), turbidity (field), dissolved oxygen (field), ferrous iron (field), COD, isotopic uranium, Rn222, phosphorus, phosphate, ammonia, TSS, TDS, alkalinity, hardness. See Table A-4 of Appendix A for specific analyses by sample location number.

Background sediment analysis suite: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, ammonia. A subset of sediment samples will also be analyzed for the agronomic parameters cation exchange capacity, gravimetric clay content/grain size distribution, exchangeable bases, soluble/exchangeable phosphorus, soluble/exchangeable metals. See Table A-5 of Appendix A for specific analyses by sample location number.

PIA sediment analysis suite: metals, mercury, anions, carbonate/bicarbonate, paste pH, TOC, grain size distribution, U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231, Pb210, Po210, total phosphorus, ortho-phosphate, and ammonia. Based on a comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210 and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanometry), and Ra228 may be cancelled (see Section A.7.2.2.4). NAREL Method GAM-10 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231. A subset of the samples is also analyzed for the agronomic parameters cation exchange capacity, gravimetric clay content/grain size distribution, exchangeable bases, soluble/exchangeable phosphorus, soluble/exchangeable metals. See Table A-5 of Appendix A for specific analyses by sample location number.

SECTION B

Measurement/Data Acquisition

B.1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

B.1.1 Purpose and Background

The purpose of the Phase 2A/1B data collection program is to gather, to the extent practical, the data necessary to complete the Midnite Mine RI/FS, including human health and ecological risk assessment and the feasibility study. The field investigation consists of two RI/FS phases to be conducted concurrently in the fall of 2000. Phase 2A is designed to gather data (if necessary) to characterize all potentially contaminated environmental media within the MA, and surface materials, radon, and radiation in the PIA. Phase 1B is a follow-on to Phase 1A, which was conducted in fall 1999 and spring 2000. Phase 1B is designed to provide supplementary data to complete the characterization of groundwater, surface water, and sediment in the PIA. Both phases also include background characterization activities for the relevant media.

B.1.2 Schedule of Project Activities, Including Measurement Activities

The estimated schedule for planning and field investigation activities is presented in Section A.6 and on Figure A.6-1.

B.1.3 Rationale for the Design

The rationale for the design of the sampling program is presented in Tables A.7-3 through A.7-8.

B.1.4 Design Assumptions

Design assumptions for the sampling program are discussed in Section A.7.

B.1.5 Procedures for Locating and Selecting Environmental Samples

The basis for locating and selecting environmental samples for the sampling program is discussed in Section A.7. Sampling locations are shown on Figures A.7-1 through A.7-5.

B.1.6 Classification of Measurements as Critical or Noncritical

All proposed measurements are critical for resolving the decision statements identified in Section A.7.

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Measurement/Data Acquisition

B.2 SAMPLING METHODS REQUIREMENTS

B.2.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.2.2 Sample Collection, Preparation, and Decontamination Procedures

Standard sample collection procedures and data collection forms have been developed for sampling and related data gathering activities. The purpose for these procedures is to obtain samples that represent the environment under investigation. The procedures that will be used for sample collection and preparation for this investigation are included in the project Standard Operating Procedures (SOPs) (Appendix B), while the data collection forms used to document this investigation are included as Appendix C. Should samples be analyzed through the EPA Contract Laboratory Program, samples will be handled and documented in accordance with the EPA Sampler's Guide to the Contract Laboratory Program (EPA 1996). Decontamination is discussed in the Sampling and Analysis Plan (SAP) (Appendix A) and within the SOP for decontamination (Appendix B).

A discussion of sample type (grab or composite), location and collection technique is included in the SAP, while a summary of sample containers, volume and preservation is included in Table B.4.3-1-P2. Sediment and surface material samples will be homogenized in the field prior to collection into sample containers and again at the laboratory prior to analysis.

While recognizing the importance of striving to meet all project-required detection/quantitation limits, an effort will be made to have one laboratory complete all analytes from a given analytical suite (e.g., anions, metals, etc.). However, laboratory limitations may necessitate that an analytical suite be split amongst two (or more) laboratories.

A Management Systems Review (MSR) may be scheduled for each subcontracted laboratory prior to sample collection (Section C.1.2.1). As part of the laboratory MSR, the contracted laboratory should provide at least the most recent two sets of Performance Evaluation (PE) sample results for each method to be performed from their participation in the National Voluntary Laboratory Accreditation Program, EPA laboratory proficiency program, or EPA interlaboratory studies. Additional PE samples specific to project-related contaminants of concern may be submitted with the Phase 2A/1B environmental samples. Historical PE sample performance, participation in accreditation programs, participation in interlaboratory studies, and completion of project PE samples can all be used to understand the laboratory's ability to successfully perform a given method. Laboratory performance within these programs will assist in a quantitative understanding of laboratory bias and can be used to increase (or at least measure) comparability between laboratories contracted to complete a split analytical suite.

B.2.3 Sampling/Measurement System Failure Response and Corrective Action Process

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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B.2.4 Sampling Equipment, Preservation, and Holding Time Requirements

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

B.3.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3.2 Sample Custody

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3.3 Sample Identification System

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3.4 Sample Shipment

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3.5 Sample Container Tampering

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.3.6 Sample Archival and Disposal

Groundwater, surface water, sediment, and surface material sample aliquots will not be archived as a part of the Phase 2A/1B field investigation for future analysis or consideration. Subsurface material samples will be temporarily held for potential additional analyses of metals and radionuclides. A decision will be made on which subsurface material samples will be analyzed for these parameters following review and evaluation of Phase 2A surface material sample data. Any subsurface material samples not analyzed for metals and radionuclides at this time will be archived to permit future laboratory analyses if warranted.

Any sample volume not consumed during sample analysis will be disposed of by the laboratories, and in accordance with all applicable rules and regulations or returned to the site for disposition as defined in the laboratory contract. Laboratory contracts state that residual sample volumes will be retained by the laboratories for sixty days following delivery of the final data package before disposal or return shipment to the site.

SECTION B

Measurement/Data Acquisition

B.4 ANALYTICAL METHODS REQUIREMENTS

B.4.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.4.2 Subsampling

Samples collected during the Phase 2A/1B field investigation will consist of both grab and composite samples. URS will not collect any split samples for concurrent analysis by a second URS laboratory for QA purposes. As part of Phase 1A activities, split samples were collected and analyzed by laboratories used for Phase 1A sample analysis. Split sample results were generally found to be in good agreement and considered acceptable. As the same laboratories used for Phase 1A work will be used for Phase 2A/1B, no additional split samples will be collected.

Upon request, and when sample containers are provided, URS will collect split samples for another agency or interested group in instances where ample sample volume is available and aquifer or stream recharge is not limiting. Sediment, surface material, and subsurface material samples will be homogenized in the field prior to collection into sampling containers and again at the laboratory prior to removal of a sample aliquot for preparation or analysis.

B.4.3 Preparation of Samples

The only change in this section from the Phase 1A QAPP is for table references. Table B.4.3-1 is replaced by Table B.4.3-1-P2, Table B.4.4-2f is replaced by Table B.4.4-2f-P2, Table B.4.4-3a is replaced by Table B.4.4-3a-P2, Table B.4.4-3b is replaced by Table B.4.4-3b-P2, and Table B.4.4-3c is replaced by Table B.4.4-3c-P2 in the Phase 2A/1B QAPP.

B.4.4 Analytical Methods

Table B.4.3-1-P2 summarizes the analyses that will be completed during this investigation. All definitive methods and some screening methods will be conducted at an analytical laboratory. (Refer to Section A.7.4 for a discussion of analytical data quality levels.) The following screening methods will be performed in the field at the time of sampling: pH, temperature, specific conductance, Eh, turbidity, dissolved oxygen, and ferrous iron. Additionally, a gamma survey and sand cone density testing and standard penetration testing will be performed on those areas identified in the SAP (Appendix A). Field measurements will be taken at the sampling location using portable field instruments at the time of sample collection. Calibrations, quality control (QC) checks, frequency of QC checks, acceptance criteria, and corrective actions for the field parameters and all other screening methods are summarized in Table B.4.4-1-P2. A discussion of field instrument calibrations and QC checks is also included in SOP No. 7 Field Parameter Measurements. All field instrument calibration, QC check, and corrective action information will be recorded in a field log book. For all definitive methods of analysis used

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during this investigation, method performance requirements are specified in the methods, and augmented by this QAPP.

Tables B.4.4-2a-P2 through B.4.4-2h-P2 summarize the QC acceptance criteria including the required detection limit or quantitation limit and accuracy and precision requirements for each analyte of interest in each analysis. For convenience, Tables B.4.4-3a-P2 through B.4.4-3c-P2 summarize the QC acceptance criteria including the required lower limit of detection, the counting error goal and the precision requirements for each analyte of interest in each of the three decay series analyses.

Desired detection limits should be attained when analyzing clean samples. However, sample dilutions may be necessary to bring high-level analyte concentrations into an accepted calibration range. Detection limits for non-detected analytes within those samples will be raised according to the level of the necessary dilution. Additionally, for a given method, intra-element interference and/or matrix effects may preclude the attainment of the desired detection limits listed in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and B.4.4-3a-P2 through B.4.4-3c-P2. Consequently, while the limits of detection and quantitation listed in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and B.4.4-3a-P2 through B.4.4-3c-P2 are the true analytical goal, they may not be attained for all samples.

Radioanalytical results will be for only selected radionuclides in the three naturally-occurring decay series of interest, principally due to technical limitations in the measurement of activity concentrations of relatively short half-lived radionuclides (Tables B.4.4-3a-P2, B.4.4-3b-P2, and B.4.4-3c-P2). This is especially true regarding non-gamma-emitting radionuclides in aqueous solutions. However, activity concentrations for radionuclides *not* measured may still be necessary input data for risk assessment purposes, in the cases where subchains of the naturally-occurring decay series are not in radiological equilibrium. Where such data are required, those data will be estimated from the radionuclide activity concentrations that are empirically determined by the analytical laboratory.

All sediment and surface and subsurface material sample results will be reported on a dry-weight basis. However, laboratories will also report the percent solids for each sediment and surface and subsurface material sample analyzed. The end use of the data may be either a wet-weight basis or a dry-weight basis depending on the criteria to be satisfied.

The turn around time for sample analysis and data reporting will be determined based on the laboratories selected and the project schedule once a field investigation start date has been established. Laboratory-required turn around times will be defined in the laboratory technical scopes of work.

The analytical laboratories will be required to submit case narratives with each analytical data package. The case narrative must document out-of-control events. In addition, any out-of-control occurrence must be reported to the Project QA Manager or designee as soon as possible so that the Project QA Manager can assess the out-of-control event and determine the appropriate course of action based on the overall project objectives, critical nature of the data, and project schedule. At a minimum, the laboratory will report the types of out-of-control occurrences, how these occurrences are documented, and who is responsible for correction and documentation.

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Corrective action will be taken at any time during the analytical process when deemed necessary based on analytical judgment or when QC data indicate a need for action. Laboratory corrective actions may include, but are not limited to:

- reanalysis,
- calculation checks,
- instrument recalibration,
- preparation of new standards/blanks,
- re-extraction/digestion, and
- additional training of analysts.

The following items must be documented for out-of-control incidents so that corrective action may be taken to set the system back “in control.” These items will constitute a corrective action report and will be signed by the laboratory director and the laboratory QA contact:

- where the out-of-control incident occurred,
- when the incident occurred and was corrected,
- who discovered the out-of-control incident,
- who verified the incident,
- the scope of the problem,
- the corrective action implemented, and
- who corrected the problem.

B.5 QUALITY CONTROL REQUIREMENTS

B.5.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2 QC Procedures

The only change in this section from the Phase 1A QAPP is for table references. Tables B.4.4-2a through B.4.4-2g are replaced by Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Tables B.4.4-3a through B.4.4-3c are replaced by Tables B.4.4-3a-P2 through B.4.4-3c-P2 in the Phase 2A/1B QAPP.

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Measurement/Data Acquisition

B.5.2.1 QC Samples

The only change in this section from the Phase 1A QAPP is for table references. Table B.4.3-1 is replaced by Table B.4.3-1-P2 and Table B.4.4-1 is replaced by Table B.4.4-1-P2 in the Phase 2A/1B QAPP.

B.5.2.1.1 Laboratory Control Sample

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.2 Matrix Spike/Matrix Spike Duplicate

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.3 Surrogates

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.4 Internal Standards

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.5 Interference Check Sample

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.6 Method Blank

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.7 Ambient Blank

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.8 Equipment Blank

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.9 Trip Blank

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.1.10 Field Duplicates

A field duplicate sample is a second discrete sample volume collected at the same location as the original sample; homogenization is not performed between the original sample and the field duplicate. Aqueous field duplicate samples are collected from successive volumes from the same sample source and device (e.g., bailers). Sediment, surface material, and subsurface material field duplicates are collected in succession from the same sample source and device.

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Radon flux and airborne radon field duplicates are collected using collocated detectors/collectors. Duplicate samples are collected using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Field duplicate sample results are used to assess precision of the sample collection process. The frequency of collection for field duplicates is a minimum of 1 duplicate sample from each group of 20 environmental samples of a given matrix.

B.5.2.2 Comparison of Total and Dissolved Metals Concentrations

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.3 Cation-Anion Balance

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.5.2.4 Reconciliation of Data with Quality Objectives

The only change in this section from the Phase 1A QAPP is for table references. Tables B.4.4-2a through B.4.4-2g are replaced by Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Tables B.4.4-3a through B.4.4-3c are replaced by Tables B.4.4-3a-P2 through B.4.4-3c-P2 in the Phase 2A/1B QAPP.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

B.6.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.6.2 Testing, Inspection, and Maintenance

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.6.2.1 Field Equipment

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.6.2.2 Laboratory Equipment

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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B.7 INSTRUMENT CALIBRATION AND FREQUENCY

B.7.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.7.2 Identification of Instrumentation Requiring Calibration

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.7.2.1 Field Equipment

The only change in this section from the Phase 1A QAPP is for a table reference. Table B.4.4-1 is replaced by Table B.4.4-1-P2 in the Phase 2A/1B QAPP.

B.7.2.2 Laboratory Equipment

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.7.3 Documentation of Instrument Calibrations

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.7.4 Documentation of Calibration Standards

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10 DATA MANAGEMENT

B.10.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.2 Data Recording

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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B.10.3 Data Validation

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.4 Data Transformation

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.5 Data Transmittal

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.6 Data Reduction

This section outlines the methodology for assuring the correctness of the data reduction process.

B.10.6.1 Non-Laboratory Data Reduction

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.6.2 Laboratory Data Reduction

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.7 Data Analysis

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.8 Data Tracking

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

B.10.9 Data Storage and Retrieval

All data generated during this field investigation will be maintained in the project files located in the URS office in Seattle, Washington or the URS office in Denver, Colorado. As soon as possible after generation, original hardcopy data will be placed in the project data files. If the information or data are needed for interpretation of results or report completion, copies will be used. Copies will be stamped as such to avoid multiple copies of the same document in the files. All field-generated data, such as field forms and logbooks, will be reviewed for completeness and legibility prior to incorporation in the data files. If corrections are needed, the document will be returned to the originator for correction. Laboratory data will be copied immediately upon receipt (or a second copy delivered by the laboratory) and the original placed in the data files. Information obtained from outside sources will be maintained in the project files only if the information is not publicly available. For instance, documents used as guidance (e.g., EPA

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1998b) will not be maintained in the project files. Historical information specific to the site may also be maintained in the project files.

A document control system is used to uniquely identify Work Assignment deliverable documents contained in the project files. The document control system incorporates the URS project number, the file code, and a unique number assigned to each document. At the time of Work Assignment closeout, all project file originals will be turned over to EPA.

Electronic data and electronically generated reports and data interpretations will be stored on the URS Seattle office network or the URS Denver office network. The networks are backed up daily and weekly to avoid data loss. Retrieval of documents may be limited to personnel who have been granted access to the appropriate network drive. Sensitive or final electronic documents may become password protected to prevent inadvertent changes. Electronic laboratory data will be copied to the Seattle office network prior to incorporation into any databases to maintain an original copy. Electronic project correspondence may be printed, and a hardcopy may be maintained in the central files. It is the URS Project Manager's responsibility to assure that project personnel comply with this requirement. At project or Work Assignment closure, these electronic documents may be copied onto disks or CD-ROM and, if requested, delivered to EPA; one copy may be archived by URS.

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
GROUNDWATER														
Total Metals	ILM04.0	Definitive	Groundwater	19	1	1	1	0	0	1	0	pH < 2 with HNO ₃	1 1-liter poly	180 days
Diss. Metals	ILM04.0	Definitive	Groundwater	25	2	2	2	0	0	2	0	Filtration through a 0.45 µm filter followed by pH < 2 with HNO ₃	1 1-liter poly	180 days
Ammonia	EPA 350.1	Definitive	Groundwater	19	1	1	1	0	0	1	0	pH < 2 with H ₂ SO ₄ and Cool to 4 °C	1 500-ml poly	28 days
Anions	SW-846 9056 or EPA 300.0	Definitive	Groundwater	25	2	2	2	0	0	2	0	Cool to 4°C	1 250-ml poly	48 hours for NO ₂ and NO ₃ , 28 days for all else
pH (Field-Measured)	SW-846 9040B	Screening	Groundwater	25	0	2	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Temperature (Field-Measured)	EPA 170.1	Screening	Groundwater	25	0	2	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Specific Conductance (Field-Measured)	EPA 120.1	Screening	Groundwater	25	0	2	0	0	0	0	0	NA	Poly or glass	Analyze Immediately

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)	
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE				
Eh (Field-Measured)	ASTM 1498	Screening	Groundwater	19	0	1	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Turbidity (Field-Measured)	EPA 180.1	Screening	Groundwater	25	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Dissolved Oxygen (Field-Measured)	EPA 360.1	Screening	Groundwater	19	0	1	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Ferrous Iron (Field-Measured)	HACH #8146 or equivalent	Screening	Groundwater	19	0	1	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
TSS	EPA 160.2	Screening	Groundwater	19	0	1	1	0	0	1	0	0	Cool to 4 °C	1 100-ml poly	7 days
TDS	EPA 160.1	Screening	Groundwater	25	0	2	2	0	0	2	0	0	Cool to 4 °C	1 100-ml poly	7 days
Alkalinity	Std. Method 2320B	Screening	Groundwater	19	1	1	1	0	0	1	0	0	Cool to 4 °C	1 250-ml poly	14 days
Hardness	Std. Method 2340 B	Screening	Groundwater	19	0	0	1	0	0	1	0	0	NA	NA (calculated)	NA
Phosphorus and phosphate	Std. Method 4500 + EPA 365.1	Definitive	Groundwater	19	1	1	1	0	0	1	0	0	Cool to 4 °C	1 500-ml poly	28 days
COD	EPA 410.4	Screening	Groundwater	19	0	1	1	0	0	1	0	0	pH < 2 with H ₂ SO ₄ Cool to 4 °C	1 100-ml poly	28 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
U-234, U-235, U-238	NAREL U/Th-01	Definitive	Groundwater	25	2 (a)	2 (a)	2	0	0	2	0	pH < 2 with HNO ₃	1 1-liter poly (f)	6 months
Rn-222	NAREL Gam-01	Definitive	Groundwater	25	0	2	2	0	0	2	0	pH < 2 with HNO ₃	1 1-liter marinelli (g)	4 days
SURFACE WATER														
Total Metals	ILM04.0	Definitive	Surface Water	30	2	2	2	0	0	2	0	pH < 2 with HNO ₃	1 1-liter poly	180 days
Diss. Metals	ILM04.0	Definitive	Surface Water	30	2	2	2	0	0	2	0	Filtration through a 0.45 µm filter followed by pH < 2 with HNO ₃	1 1-liter poly	180 days
Ammonia	EPA 350.1	Definitive	Surface Water	30	2	2	2	0	0	2	0	pH < 2 with H ₂ SO ₄ and Cool to 4 °C	1 500-ml poly	28 days
Anions	SW-846 9056 or EPA 300.0	Definitive	Surface Water	30	2	2	2	0	0	2	0	Cool to 4°C	1 250-ml poly	48 hours for NO ₂ and NO ₃ , 28 days for all else
pH (Field-Measured)	SW-846 9040B	Screening	Surface Water	30	0	2	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Temperature (Field-Measured)	EPA 170.1	Screening	Surface Water	30	0	2	0	0	0	0	0	NA	Poly or glass	Analyze Immediately

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)	
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE				
Specific Conductance (Field-Measured)	EPA 120.1	Screening	Surface Water	30	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Eh (Field-Measured)	ASTM 1498	Screening	Surface Water	30	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Turbidity (Field-Measured)	EPA 180.1	Screening	Surface Water	30	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Dissolved Oxygen (Field-Measured)	EPA 360.1	Screening	Surface Water	30	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
Ferrous Iron (Field-Measured)	HACH #8146 or equivalent	Screening	Surface Water	30	0	2	0	0	0	0	0	0	NA	Poly or glass	Analyze Immediately
TSS	EPA 160.2	Screening	Surface Water	30	0	2	2	0	0	2	0	0	Cool to 4 °C	1 100-ml poly	7 days
TDS	EPA 160.1	Screening	Surface Water	30	0	2	2	0	0	2	0	0	Cool to 4 °C	1 100-ml poly	7 days
Alkalinity	Std. Method 2320B	Screening	Surface Water	30	2	2	2	0	0	2	0	0	Cool to 4 °C	1 250-ml poly	14 days
Hardness	Std. Method 2340 B	Screening	Surface Water	30	0	0	2	0	0	2	0	0	NA	NA (calculated)	NA
Phosphorus and phosphate	Std. Method 4500 + EPA 365.1	Definitive	Surface Water	30	2	2	2	0	0	2	0	0	Cool to 4 °C	1 500-ml poly	28 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
COD	EPA 410.4	Screening	Surface Water	30	0	2	2	0	0	2	0	pH < 2 with H ₂ SO ₄ Cool to 4 °C	1 100-ml poly	28 days
U-234, U-235, U-238	NAREL U/Th-01	Definitive	Surface Water	30	2 (a)	2 (a)	2	0	0	2	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months
Th-227, Th-228, Th-230, Th-232	NAREL U/Th-01	Definitive	Surface Water	3	1 (a)	1 (a)	1	0	0	1	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months
Ra-226	NAREL Ra-04	Definitive	Surface Water	3	1 (a)	1 (a)	1	0	0	1	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months
Ra-228	NAREL Ra-05	Definitive	Surface Water	3	1 (a)	1 (a)	1	0	0	1	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months
Rn-222	NAREL Gam-01	Definitive	Surface Water	30	0	2	2	0	0	2	0	pH < 2 with HNO ₃	1 1-liter marinelli (g)	4 days
Pb-210	Mod. HASL 300	Definitive	Surface Water	3	1 (a)	1 (a)	1	0	0	1	0	pH < 2 with HNO ₃	1 1-liter poly (h)	6 months
Po-210	Mod. HASL 300	Definitive	Surface Water	3	1 (a)	1 (a)	1	0	0	1	0	pH < 2 with HNO ₃	1 1-liter poly (h)	6 months
Gross Alpha	NAREL Gr-01 (q)	Definitive	Surface Water	3	0	1	1	0	0	1	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months
Gross Beta	NAREL Gr-01	Definitive	Surface Water	3	0	1	1	0	0	1	0	pH < 2 with HNO ₃	2 1-gallon poly (g)	6 months

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
SEDIMENT														
Metals	ILM04.0	Definitive	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 16-oz poly or glass	180 days
Mercury	ILM04.0	Definitive	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 16-oz poly or glass	28 days
Ammonia	EPA 350.1	Definitive	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 16-oz glass	28 days
Anions	SW-846 9056 or EPA 300.0	Definitive	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 16-oz glass	28 days
Carbonate, Bicarbonate	Std. Methods 2320B	Screening	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 250-ml poly	14 days
pH	SW-846 9045C	Screening	Sediment	34	0	2	0	0	0	0	0	Cool to 4 °C	1 4 oz. Poly or glass	Analyze as soon as possible following receipt at laboratory
TOC	Agronomy No. 9	Screening	Sediment	34	0	2	2	0	0	0	0	Cool to 4 °C	1 500-ml amber glass	28 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
Total Phosphorus and Ortho phosphate	Std. Method 4500-P B.4 + 4500-PE (total) and EPA 365.1	Definitive	Sediment	34	2	2	2	0	0	2	0	Cool to 4 °C	1 16-oz glass	28 days for Total Phosphorus, 96 hours for Ortho-phosphate (r)
Particle Size Distribution	ASTM D422-63	Screening	Sediment	30	0	2	0	0	0	0	0	None required	1 8-oz glass (l)	None
U-234, U-235, U-238	NAREL U/Th-01	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 1-liter poly (i)	6 months
Th-227, Th-228, Th-230, Th-232	NAREL U/Th-01	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 1-liter poly (i)	6 months
Ra-226	NAREL Ra-01, Ra-04	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 1-liter poly (i)	6 months
Ra-228	NAREL Ra-01, Ra-05	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 1-liter poly (i)	6 months
Pa-231	NAREL Gam-01	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 1-liter poly (i)	6 months
Pb-210	Mod. HASL 300	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 4-oz poly (j)	6 months
Po-210	Mod. HASL 300	Definitive	Sediment	34	2 (a)	2 (a)	2	0	0	2	0	None	1 4-oz poly (j)	6 months

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)	
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE				
Cation Exchange Capacity	Modified SW-846 9081(m)	Screening	Sediment	4	0	1	0	0	0	0	0	0	Cool to 4 °C	1 8-oz poly or glass (n)	28 days
Soluble Exchangeable Metals	Ammonium Bicarbonate, Diethylene Triamine Pentaacetic Acid (DTPA) extraction followed by metals analysis of extraction fluid by ILM04.0 (o)	Screening	Sediment	4	1	1	0	0	0	0	0	0	Cool to 4 °C	1 8-oz poly or glass (n)	28 days
Gravimetric Clay Content Plus Particle Size Distribution	Plumb Method AD/A103, 788, May 1981	Screening	Sediment	4	0	1	0	0	0	0	0	0	None Required	1 8-oz poly or glass (n)	None
SURFACE MATERIAL															
Metals	ILM04.0	Definitive	Surface Material	108	6	6	6	0	0	6	0	0	Cool to 4 °C	1 16-oz poly or glass	180 days
Mercury	ILM04.0	Definitive	Surface Material	108	6	6	6	0	0	6	0	0	Cool to 4 °C	1 16-oz poly or glass	28 days
Ammonia	EPA 350.1	Definitive	Surface Material	108	6	6	6	0	0	6	0	0	Cool to 4 °C	1 16-oz glass	28 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
Anions	SW-846 9056 or EPA 300.0	Definitive	Surface Material	108	6	6	6	0	0	6	0	Cool to 4°C	1 16-oz glass	28 days
Carbonate, Bicarbonate	Std. Methods 2320B	Screening	Surface Material	108	6	6	6	0	0	6	0	Cool to 4°C	1 250-ml poly	14 days
pH	SW-846 9045C	Screening	Surface Material	108	0	6	0	0	0	0	0	Cool to 4°C	1 4 oz. Poly or glass	Analyze as soon as possible following receipt at laboratory
TOC	Agronomy No. 9	Screening	Surface Material	108	0	6	6	0	0	0	0	Cool to 4°C	1 500-ml amber glass	28 days
Total Phosphorus and Ortho phosphate	Std. Method 4500-P B.4 + 4500-PE (total) and EPA 365.1	Definitive	Surface Material	108	6	6	6	0	0	6	0	Cool to 4°C	1 16-oz glass	28 days for Total Phosphorus 96 hours for Ortho-phosphate (r)
Particle Size Distribution	ASTM D422-63	Screening	Surface Material	108	0	5	0	0	0	0	0	None required	1 8-oz glass (i)	None
U-234, U-235, U-238	NAREL U/Th-01	Definitive	Surface Material	108	6 (a)	6 (a)	6	0	0	6	0	None	1 1-liter poly (i)	6 months

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
Th-227, Th-228, Th-230, Th-232	NAREL U/Th-01	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 1-liter poly (i)	6 months
Ra-226	NAREL Ra-01, Ra-04	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 1-liter poly (i)	6 months
Ra-228	NAREL Ra-01, Ra-05	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 1-liter poly (i)	6 months
Pa-231	NAREL Gam-01	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 1-liter poly (i)	6 months
Pb-210	Mod. HASL 300	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 4-oz poly (j)	6 months
Po-210	Mod. HASL 300	Definitive	Surface Material	108	5 (a)	5 (a)	5	0	0	5	0	None	1 4-oz poly (j)	6 months
Radon Emanation Fraction	Gamma spectrometry	Definitive	Surface Material	56	0	3	3	0	0	0	0	None	1 16-oz poly or glass	None
SUBSURFACE MATERIAL														
Metals (HOLD)	ILM04.0	Definitive	Subsurface Material	85	5	5	5	0	0	5	0	Cool to 4 °C	1 16-oz poly or glass	180 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)	
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE				
Radiological Parameters (HOLD) - same as those listed for surface material except radon emanation fraction	Same as those listed for surface material	Definitive	Subsurface Material	85	5 (a)	5 (a)	5	0	0	0	0	0	None	1 1-liter poly (i)	6 months
pH	SW-846 9045C	Screening	Subsurface Material	85	0	5	5	0	0	0	0	0	Cool to 4 °C	1 4 oz. Poly or glass	Analyze as soon as possible following receipt at laboratory
TOC	Agronomy No. 9	Screening	Subsurface Material	85	0	5	5	0	0	0	0	0	Cool to 4 °C	1 500-ml amber glass	28 days
Moisture	As described in ILM04.0	Screening	Subsurface Material	85	0	0	5	0	0	0	0	0	Cool to 4 °C	1 4-oz poly glass	As soon as possible
Cation Exchange Capacity	Modified SW-846 9081(m)	Screening	Subsurface Material	21	0	2	0	0	0	0	0	0	Cool to 4 °C	1 8-oz poly or glass (n)	28 days

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
Soluble Exchangeable Metals	Ammonium Bicarbonate, Diethylene Triamine Pentaacetic Acid (DTPA) extraction followed by metals analysis of extraction fluid by ILM04.0 (o)	Screening	Subsurface Material	21	2	2	0	0	0	0	0	Cool to 4 °C	1 8-oz poly or glass (n)	28 days
Gravimetric Clay Content Plus Particle Size Distribution	Plumb Method AD/A103, 788, May 1981	Screening	Subsurface Material	21	0	2	0	0	0	0	0	None Required	1 8-oz poly or glass (n)	None

SUBSURFACE MATERIAL GEOTECHNICAL PARAMETERS FOR FEASIBILITY STUDY

Standard Proctor Compaction	ASTM D 698	Screening	Subsurface Material for geotech	6	0	0	0	0	0	0	0	None Required	25 pounds (p)	None
Specific Gravity	ASTM D 854	Screening	Subsurface Material for geotech	16	0	0	0	0	0	0	0	None Required	25 pounds (p)	None

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Measurement/Data Acquisition

**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)	
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE				
Particle Size Distribution	ASTM D 422	Screening	Subsurface Material for geotech	105	0	0	0	0	0	0	0	0	None Required	25 pounds (p)	None
Atterburg Limits	ASTM D 4318	Screening	Subsurface Material for geotech	105	0	0	0	0	0	0	0	0	None Required	25 pounds (p)	None
Six Inch Diameter Consolidated Undrained Triaxial Strength	ASTM D 4767	Screening	Subsurface Material for geotech	4 (3 tests per envelope or 12 total tests)	0	0	0	0	0	0	0	0	None Required	25 pounds (p)	None
Moisture	ASTM D 2216	Screening	Subsurface Material for geotech	105	0	0	0	0	0	0	0	0	None Required	25 pounds (p)	As soon as possible
Field-Measured Sand Cone Density Testing	ASTM D 1556	Screening	Subsurface Material for geotech	120	0	0	0	0	0	0	0	0	None Required	Field Tested	None
Field-Measured Standard Penetration Testing (SPT)	ASTM D 1586	Screening	Subsurface Material	120	0	0	0	0	0	0	0	0	None Required	Field Tested	None

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**Table B.4.3-1-P2
PHASE 2 QC SAMPLE SUMMARY AND SAMPLE CONTAINERS AND PRESERVATIVES**

Analytical Parameter	Analytical Method (e)	Definitive or Screening Method (c)	Sample Matrix	Estimated Number of Field Samples (b)	Estimated Number of LAB QC Samples (b)		Estimated Number of FIELD QC Samples (b)					Preservation	Number/Minimum Volume of Container(s) (k)	Sample Hold Time (from collection)
					MS	MSD or DUP	Field Dup	Trip Blank	Ambient Blank	Equip. Blank (d)	PE			
RADON FLUX														
Radon Flux	Modified EPA 115	Definitive	Radon Emanation from the Ground	72	0	8	4	0	4	0	0	None	1 canister	1 week
AIRBORNE RADON														
Airborne Radon	Alpha Track	Definitive	Ambient Air	37	0	2	2	0	2	0	0	None	3 Alpha Track Detectors per location	None

Table B.4.3-1-P2 Footnotes:

- (a) As spiking standards are available and as appropriate for the contracted laboratory.
- (b) Sample quantities are estimates and may change prior to sampling. Estimated number of field QC samples and laboratory QC samples will be based on the frequencies stated in Section B.5 unless otherwise required by the method.
- (c) All definitive methods and some screening methods will be conducted at an analytical laboratory. The following screening methods will be performed in the field at the time of sampling: pH (water only), temperature, specific conductance, Eh, turbidity, dissolved oxygen, ferrous iron, sand cone density testing, and standard penetration testing.
- (d) Assumes no dedicated or disposable sampling equipment will be used and therefore, equipment blanks are necessary for groundwater, surface water, sediment and surface material samples.
- (e) Analysis completed using the listed method or more recent revision of the listed method. Refer to tables B.4.4-2a-P2 – B.4.4-2h-P2 for details of specific analytes and methods. Proposed/equivalent analytical methods may be used pending EPA approval.
- (f) An aggregate volume of 2 liters is required for one in ten samples for laboratory QC.

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- (g) Assuming all radiological parameters are sent to USEPA NAREL for analysis, an aggregate volume of 2 gallons of water will be used to complete all radiological parameters except radon. One in ten samples collected will have an aggregate volume of 4 gallons for laboratory QC (MS/MSD, method duplicate) for analyses other than radon. One in twenty samples collected for radon will require 2 1-liter Marinelli Beakers for laboratory QC.
- (h) One 1-liter poly for Pb-210 and a separate 1-liter poly for Po-210; one in twenty samples will have an aggregate volume of six 1-liter containers for Pb-210 and Po-210 laboratory QC (MS/MSD, method duplicate).
- (i) Assuming all radiological parameters other than Pb-210 and Po-210 are sent to USEPA NAREL for analysis, an aggregate volume of 1 liter of sediment/surface material with a sieve size less than 1/8 inch will be used to complete all non-Pb-210 and non-Po-210 radiological parameters. One in twenty samples sent to NAREL should have a volume of 2 liters for laboratory QC.
- (j) Assuming Pb-210 and Po-210 are analyzed by the same laboratory, a total volume of 1-liter of sediment/surface material with a sieve size less than 1/8 inch will be sent for analysis of both isotopes. One in twenty samples sent for these isotopes should have a volume of 2 liters for laboratory QC.
- (k) Parameters requiring the same preservation, similar container type and being analyzed by the same laboratory may be collected as one aggregate volume pending laboratory concurrence.
- (l) Collect an additional 8 oz volume for every tenth sample for laboratory QC.
- (m) Includes Cation Exchange Capacity and Exchangeable Bases (Ammonium Acetate Extractable Mg, Ca, Na and K by ILM04.0)
- (n) One 8-oz container is sufficient volume for cation exchange capacity including exchangeable bases, soluble exchangeable metals and gravimetric clay content plus particle size distribution.
- (o) Metals analyzed by ILM04.0 include the Target Analyte List (TAL) metals plus uranium and phosphorus.
- (p) One 25-pound bulk sample is required to perform all listed geotechnical methods.
- (q) Assumes NAREL will modify gross alpha analytical procedures to reflect those required for MCL comparison.
- (r) The holding time for ortho-phosphate in water is 48 hours. No holding time exists for ortho-phosphate in non-aqueous samples. Because ortho-phosphate should be more stable in a solid matrix than in an aqueous matrix, a holding time of 2x the aqueous holding time was adopted.

Definitions for Table B.4.3-1-P2:

OLC02.0:	USEPA CLP Program, Statement of Work for Organics Analysis, Low Concentration Water, Document # OLC02.0
OLM03.0:	USEPA CLP Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Document # OLM03.0
ILM04.0:	USEPA CLP Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Document # ILM04.0
SW846:	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update III, December 1996.
EPA:	USEPA Office of Research and Development, Environmental Monitoring and Support Laboratory, Methods for Chemical Analyses of Water and Wastes, March 1983
Agronomy:	American Society of Agronomy, Method of Soil Analysis, 2 nd Edition, 1982
ASTM:	Annual Book of American Society for Testing and Materials Standards, 2000
Std. Methods:	Standard Methods for the Examination of Water and Wastewater, 17 th Edition, 1989
HASL:	USDOE Environmental Measurements Laboratory Procedures Manual, 27 th Edition, Revised February 1992
NAREL:	USEPA National Air and Radiation Environmental Laboratory

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QC:	Quality Control
VOA:	Volatile Organics Analysis
MS:	Matrix Spike
MSD:	Matrix Spike Duplicate
DUP:	Matrix Duplicate
Equip:	Equipment
PE:	Performance Evaluation
VOC:	Volatile Organic Compounds
SVOC:	Semivolatile Organic Compounds
TAL	Target Analyte List
TPH:	Total Petroleum Hydrocarbons
TVPH:	Total Volatile Petroleum Hydrocarbons
TEPH:	Total Extractable Petroleum Hydrocarbons
Eh:	Oxidation reduction potential
Diss:	Dissolved
TSS:	Total Suspended Solids
TDS:	Total Dissolved Solids
TOC:	Total Organic Carbon
COD:	Chemical Oxygen Demand
HCl:	Hydrochloric Acid
HNO ₃ :	Nitric Acid
H ₂ SO ₄ :	Sulfuric Acid
°C:	Degrees Celsius
ml:	milliliter
oz:	ounce
poly:	polyethylene
NA:	Not Applicable

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Measurement/Data Acquisition

**Table B.4.4-1-P2
SUMMARY OF CALIBRATION AND
QC PROCEDURES FOR SCREENING METHODS**

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
EPA 120.1	Field-Measured Specific Conductance	Calibration check with KCl standard	Once per day at beginning of testing	± 5%	If calibration is not achieved, check meter, standards, and probe; recalibrate
		Method blank (using DI water)	Once per day at the beginning of testing	< Quantitation Limit (1 µS/cm)	Check meter, replace if necessary, check water, recalibrate
		Standard check	At each sample location ^c	± 5%	Correct problem, recalibrate
		Method duplicate	5% of field samples	RPD ≤ 10%	Correct problem, repeat measurement
EPA 180.1	Field-Measured Turbidity	Calibration check with one formazin standard per instrument range used	Once per day at the beginning of testing	± 5 units 0-100 range ± 0.5 units 0-20 range ± 0.2 units 0-1 range	If calibration is not achieved, check meter; replace if necessary, recalibrate
		Method blank (using DI water)	Once per day at the beginning of testing	< Quantitation Limit (1 NTU)	Check meter, replace if necessary, check water, recalibrate
		Method duplicate	5% of field samples	RPD ≤ 20%	Correct problem, repeat measurement
SW-846 9040B 9045C	Field-measured pH (water) pH (sediment/surface material)	2-point calibration with pH buffers	Once per day	± 0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration
		pH 7 buffer (standard check)	At each sample location (water only) ^c	± 0.2 pH units	Correct problem, recalibrate
		Method duplicate	5% of field samples	± 0.2 pH units	Correct problem, repeat measurement
EPA 170.1	Field-Measured Temperature	Method duplicate	5% of field samples	± 1.0 °C	Correct problem, repeat measurement
		Factory calibration	Once at factory	± 1.0 °C	Check meter, replace if necessary

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**Table B.4.4-1-P2
SUMMARY OF CALIBRATION AND
QC PROCEDURES FOR SCREENING METHODS**

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
EPA 360.1	Field-Measured Dissolved Oxygen	Calibration (as applicable for instrument used)	Once per day	To barometric pressure uncorrected for altitude	NA
		Method Duplicate	5% of field samples	± 0.2 mg/L	Correct Problem, repeat measurement
		Colorimetric check	5% of field samples	RPD ≤ 20%	Correct problem, repeat measurement
ASTM 1498	Field-Measured Eh	Sensitivity Verification	Daily	Eh should decrease when pH is increased	If Eh increases, correct the polarity of electrodes. If Eh still does not decrease, clean electrodes and repeat procedure
		Calibration check with one standard	Once per day	Two successive readings ± 10 millivolts	Correct problem, recalibrate
		Standard check	At each sample location ^c	± 10 millivolts	Correct problem, recalibrate
		Method Duplicate	5% of field samples	± 50 millivolts	Correct problem, repeat measurement
Agronomy No. 9 (sediment and surface material)	Total organic carbon	Method blank	Daily or one per batch, whichever is more frequent	< Quantitation Limit (0.2%)	Clean system; reanalyze blank. Repeat until analyte < quantitation limit
		Method Duplicate	5% of samples	RPD ≤ 20%	Repeat measurement
Colormetric Hach Method 8146 or equivalent	Field-Measured Ferrous Iron	Method Blank	Once per day at the beginning of testing	< Quantitation Limit (0.5 mg/l)	Check blank for optical interference, reanalyze blank, repeat until < Quantitation Limit
		Method Duplicate	5% of field samples	RPD ≤ 20%	Analyze third aliquot. If still out, flag data
ASTM D422-63 ^b	Particle Size Distribution	Method Duplicate	1 per batch or 5%	RPD ≤ 30%	Analyze third aliquot. If still out, flag data

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Measurement/Data Acquisition

**Table B.4.4-1-P2
SUMMARY OF CALIBRATION AND
QC PROCEDURES FOR SCREENING METHODS**

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
EPA 160.1	Filterable Residue	Analytical Balance check with a standard weight	Once per day at the beginning of testing	± 0.1 milligram	Correct problem, adjust balance
		Method Duplicate	1 per batch or 5%	RPD ≤20%	Analyze third aliquot. If still out, flag data
EPA 160.2	Non-filterable Residue	Analytical Balance check with a standard weight	Once per day at the beginning of testing	± 0.1 milligram	Correct problem, adjust balance
		Method Duplicate	1 per batch or 5%	RPD ≤20%	Analyze third aliquot. If still out, flag data
Std. Method 2320B	Alkalinity	Method Duplicate	1 per batch or 5%	RPD ≤20%	Analyze third aliquot. If still out, flag data
EPA 410.4	Chemical Oxygen Demand	Method Duplicate	1 per batch or 5%	RPD ≤20%	Analyze third aliquot. If still out, flag data
		Method Blank	1 per batch or 5%	< Quantitation Limit (5 mg/l)	Clean system, reanalyze blank, repeat until < Quantitation Limit
Field Survey	Gross Gamma Survey	Instrument Calibration-NIST Traceable	Annual	Standard vendor criteria	Repair if necessary
		Battery check	Twice daily; beginning and end of work day	Voltage in acceptance range on meter	Replace batteries if necessary.
		Background response check	Twice daily; beginning and end of work day	The larger of ± 20% or ±3-sigma	Repair/remove from service until performance problem is resolved
		Response check with standard check source	Twice daily; beginning and end of work day	The larger of ± 20% or ±3-sigma	Repair/remove from service until performance problem is resolved
		Method duplicate	5% of Field Measurements	The larger of ± 20% or ±3-sigma	Correct problem, repeat measurement

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Measurement/Data Acquisition

**Table B.4.4-1-P2
SUMMARY OF CALIBRATION AND
QC PROCEDURES FOR SCREENING METHODS**

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Mod. SW-846 9081 ^d	Cation Exchange Capacity	Method Duplicate	1 per batch or 5%	RPD <30%	Correct problem, repeat measurement
Ammonium Bicarbonate, Diethylene Triamine Pentaacetic Acid (DTPA) Extraction followed by Metals Analysis of the Extraction Fluid by ILM04.0	Soluble/ Exchangeable Metals ^c	Refer to Method ILM04.0 (modified to include molybdenum and uranium)	Refer to Method ILM04.0 (modified to include molybdenum and uranium)	Refer to Method ILM04.0 (modified to include molybdenum and uranium)	Refer to Method ILM04.0 (modified to include molybdenum and uranium)
Ammonium Bicarbonate, Diethylene Triamine Pentaacetic Acid (DTPA) Extraction followed by Phosphorus Analysis of the Extraction Fluid by Modified ILM04.0	Soluble/ Exchangeable Phosphorus ^c	Refer to Method ILM04.0 (modified to include phosphorus)	Refer to Method ILM04.0 (modified to include phosphorus)	Refer to Method ILM04.0 (modified to include phosphorus)	Refer to Method ILM04.0 (modified to include phosphorus)
Plumb Method AD/A103 788, May 1981 ^b	Gravimetric clay content plus particle size distribution	Method Duplicate	1 per batch or 5%	RPD ≤30%	Analyze third aliquot. If still out, flag data.

^aAll corrective actions shall be completed as necessary upon QC check failure, documented, and the records shall be maintained.

^bRefer to Table B.4.4-2g-P2 for a discussion of precision assessment.

^cStandard check will be completed at each sample location prior to sampling for the first ten sample locations. If acceptance criteria are met for these ten locations, the standard check at each sample location will be discontinued. Daily instrument calibration checks will continue; should the daily instrument calibration check fail, the standard check at each sample location will be reinstated for that parameter for the balance of the field sampling event.

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^dCation exchange capacity (CEC) samples will be prepared by SW-846 method 9081 which saturates the sample with sodium ions in an acetate buffer, removes excess sodium ions with an alcohol wash and then extracts the exchanged sodium ions by replacement with ammonium ions in an acetate buffer. The extract will be analyzed via ICP for sodium as per ILM04 after filtration followed by acidification. No digestion step will be performed. All required ILM04 QA/QC for ICP will be run and the ILM04 acceptance criteria will be used.

^eThe extraction of the metals will be done per Agronomy #9, Part 1, Chapter 3, Section 3-5.2.3. The extract will be analyzed via ICP using ILM04 as a guide. No digestion step will be performed. Metals to be analyzed include the TAL plus phosphorus, uranium, and molybdenum. All metals will be run using the ILM04 acceptance requirements per ILM04. Phosphorus, uranium, and molybdenum will be added to the QC samples including the ICV, CCV, MS, LCS, CRI and ICS solutions. All QC criteria for phosphorus, uranium, and molybdenum will be consistent with ILM04 acceptance requirements for other elements.

Definitions for Table B.4.4-1-P2:

SW846:	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update III, December 1996.
ILM04.0:	USEPA CLP Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Document # ILM04.0
ASTM:	Annual Book of American Society for Testing and Materials Standards, 2000
Agronomy:	American Society of Agronomy, Method of Soil Analysis, 2 nd Edition, 1982
EPA:	USEPA Office of Research and Development, Environmental Monitoring and Support Laboratory, Methods for Chemical Analyses of Water and Wastes, March 1983
Std. Methods:	Standard Methods for the Examination of Water and Wastewater, 17 th Edition, 1989
QC:	Quality Control
KCl:	Potassium Chloride
%:	Percent
RPD:	Relative Percent Difference
°C:	Degrees Celsius
mg/l:	milligrams per liter
NA:	Not Applicable

SECTION B

Measurement/Data Acquisition

**Table B.4.4-2d-P2
METALS – QC ACCEPTANCE CRITERIA**

Analyte	Water ⁶				Sediment/Surface Material			
	Analytical Method ²	PRDL (µg/l) ⁷	Accuracy (%R) ¹	Precision (%RPD) ¹	Analytical Method ²	PRDL (mg/kg)	Accuracy (%R) ¹	Precision (%RPD) ¹
Aluminum	ILM04.0	25	ILM04.0	ILM04.0	ILM04.0	20	ILM04.0	ILM04.0
Antimony	ILM04.0 ⁴	3	ILM04.0	ILM04.0	ILM04.0 ⁴	1	ILM04.0	ILM04.0
Arsenic	Mod. ILM04.0 ³	0.2	ILM04.0	ILM04.0	ILM04.0 ⁴	4	ILM04.0	ILM04.0
Barium	ILM04.0	200	ILM04.0	ILM04.0	ILM04.0	20	ILM04.0	ILM04.0
Beryllium	ILM04.0	2	ILM04.0	ILM04.0	ILM04.0	0.5	ILM04.0	ILM04.0
Cadmium	ILM04.0	0.4	ILM04.0	ILM04.0	ILM04.0	0.35	ILM04.0	ILM04.0
Calcium	ILM04.0	5000	ILM04.0	ILM04.0	ILM04.0	50	ILM04.0	ILM04.0
Chromium	ILM04.0	7.5	ILM04.0	ILM04.0	ILM04.0	1	ILM04.0	ILM04.0
Cobalt	ILM04.0	50	ILM04.0	ILM04.0	ILM04.0	5	ILM04.0	ILM04.0
Copper	ILM04.0	2	ILM04.0	ILM04.0	ILM04.0	2.5	ILM04.0	ILM04.0
Iron	ILM04.0	100	ILM04.0	ILM04.0	ILM04.0	10	ILM04.0	ILM04.0
Lead	ILM04.0 ⁴	1	ILM04.0	ILM04.0	ILM04.0 ⁴	0.3	ILM04.0	ILM04.0
Magnesium	ILM04.0	5000	ILM04.0	ILM04.0	ILM04.0	50	ILM04.0	ILM04.0
Manganese ¹³	ILM04.0	15	ILM04.0	ILM04.0	ILM04.0	1.5	ILM04.0	ILM04.0
Mercury	NA	NA	NA	NA	ILM04.0 ⁵	0.1	ILM04.0	ILM04.0
Molybdenum ¹¹	Mod. ILM04.0 ¹²	100	ILM04.0	ILM04.0	Mod. ILM04.0	10	20 – 120 ⁹	35%
Nickel	ILM04.0	10	ILM04.0	ILM04.0	ILM04.0	4	ILM04.0	ILM04.0
Phosphorus	Mod. ILM04.0 ^{8,12}	20000	ILM04.0	ILM04.0	NA	NA	NA	NA
Potassium ¹³	ILM04.0	5000	ILM04.0	ILM04.0	ILM04.0	50	ILM04.0	ILM04.0
Selenium	ILM04.0 ⁴	2.5	ILM04.0	ILM04.0	ILM04.0 ⁴	0.5	ILM04.0	ILM04.0
Silver	ILM04.0 ⁴	1.5	ILM04.0	ILM04.0	ILM04.0	3	ILM04.0	ILM04.0

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**Table B.4.4-2d-P2
METALS – QC ACCEPTANCE CRITERIA**

Analyte	Water ⁶				Sediment/Surface Material			
	Analytical Method ²	PRDL (µg/l) ⁷	Accuracy (%R) ¹	Precision (%RPD) ¹	Analytical Method ²	PRDL (mg/kg)	Accuracy (%R) ¹	Precision (%RPD) ¹
Sodium ¹³	ILM04.0	5000	ILM04.0	ILM04.0	ILM04.0	50	ILM04.0	ILM04.0
Thallium	ILM04.0 ⁴	1.5	ILM04.0	ILM04.0	ILM04.0 ⁴	1	ILM04.0	ILM04.0
Vanadium	ILM04.0	50	ILM04.0	ILM04.0	ILM04.0	5	ILM04.0	ILM04.0
Zinc	ILM04.0	20	ILM04.0	ILM04.0	ILM04.0	2	ILM04.0	ILM04.0
Total Uranium	Mod. ILM04.0 ^{10,12}	20	Mod. ILM04.0	Mod. ILM04.0	Calculated ¹⁰	100	NA	NA

- 1 Accuracy and precision criteria will be in accordance with the specified method, or more recent version. Listed precision limits are for laboratory duplicates; field duplicate precision limits are discussed in Section D.1.3.
- 2 Except where noted, analysis will be performed by ICP-AES methods or trace ICP, in accordance with the specified method or more recent version.
- 3 Analysis by ICP-MS. The As is analyzed by ICP-MS using a slightly modified ILM04 method. The frequency and acceptance criteria for the ICP method by ILM04 are applied to the ICP-MS analysis. All ICV/CCV's, ICB/C CB's, IC SA/AB's and CRI's are run per ILM04 but the concentrations of the CRI's and ICS's are modified to be more appropriate to ICP-MS sensitivities. The CRI is run at a lower concentration as are the "B" analytes in the ICSAB solution. ICP-MS criteria not already covered by ILM04 (e.g., tuning and IS recoveries) will be consistent with SW-846 method 6020.
- 4 Analysis may be by GFAA
- 5 Analysis may be by CVAA
- 6 Listed limits apply to both total and dissolved metal analyses.
- 7 PRDL = Project Required Detection Limit to Meet Applicable and Appropriate Levels of Concern. The laboratory lower limit of detection must be less than or equal to the PRDL; the laboratory must report down to their lower limit of detection.
- 8 Phosphorus will be analyzed only in the AB DTPA Extraction Fluid as soluble/exchangeable phosphorus
- 9 Accuracy Limits are for matrix spike recoveries. Laboratory Control Sample (LCS) recoveries should be evaluated using the LCS provider-recommended limits.
- 10 The total uranium mass concentration will be calculated from the measured radioactivity of U-234, U-235, and U-238 for those samples not chemically analyzed. Uranium will be analyzed only in the AB DTPA Extraction Fluid as part of the soluble/exchangeable metals analysis. Uranium mass concentrations will be calculated from measured radioactivities as follows:
Uranium (mg/kg) = (2.8 x 10E-12) x A x T ½ (years) x pCi/g; summed for the three uranium isotopes.
Uranium (mg/l) = (2.8 x 10E-15) x A x T ½ (years) x pCi/l; summed for the three uranium isotopes.
Where pCi/g and pCi/l are the reported activities for each uranium isotope and A and T ½ are defined as:

	A (amus)	T ½ (years)
U-234	234.0409	2.455 E5
U-235	235.0439	7.038 E8
U-238	238.0508	4.468 E9

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- 11 Molybdenum has been added to the analyte list for this phase of work because Bendix (1981) reported that molybdenum is a potential indicator of uranium mineralization. Also, molybdenum is relatively mobile in water and is thus a potential indicator of mine effects.
- 12 Metals will be analyzed using the ILM04 acceptance requirements per ILM04. Phosphorus, uranium, and molybdenum will be added to the QC samples including the ICV, CCV, MS, LCS, CRI, and ICS solutions. All QC criteria for phosphorus, uranium, and molybdenum will be consistent with ILM04 acceptance requirements for other elements.
- 13 In addition to being reported as part of the normal TAL for aqueous and non-aqueous samples, these metals will be evaluated as exchangeable bases in some sediment and subsurface material samples. Exchangeable Base samples will be prepared by the method described in Agronomy #9 Part 2 Chapter 9, Section 9-3.1.2.3 "Centrifuge Procedure". This method extracts the exchangeable bases by replacement of the cations with ammonium ions in a pH 7 acetate buffer solution. The extract will be analyzed via ICP for the requested bases (Ca, Mg, Na, and K) as per ILM04 after filtration followed by acidification. No digestion step will be performed. All required ILM04 QA/QC for ICP will be run and the ILM04 acceptance criteria will be used.

Mod. = Method Modified to attain a PRDL or to include a Non-Target Analyte List Metal.

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**Table B.4.4-2e-P2
INORGANICS – QC ACCEPTANCE CRITERIA**

Analyte	Water				Sediment/Surface Material			
	Analytical Method	PRQL ⁵ (µg/l)	Accuracy (%R) ⁴	Precision (%RPD) ⁶	Analytical Method	PRQL ⁵ (µg/kg)	Accuracy (%R) ⁴	Precision (%RPD) ⁶
Chloride (Cl-)	SW-846 9056 ³	200	90-110	15	SW-846 9056 ^{2,3}	100	80-120	20
Sulfate (SO4 2-)	SW-846 9056 ³	2000	85-115	15	SW-846 9056 ^{2,3}	2000	80-120	20
Nitrate (NO3-)	SW-846 9056 ³	600	88-110	15	SW-846 9056 ^{2,3}	600	80-120	20
Nitrite (NO2-)	SW-846 9056 ³	400	88-110	15	SW-846 9056 ^{2,3}	600	80-120	20
Carbonate (CO3 2-) ¹	Std. Methods 2320B	10000	NA	15	Std. Methods 2320B ²	10000	NA	20
Bicarbonate (HCO3-) ¹	Std. Methods M2320B	10000	NA	15	Std. Methods 2320B ²	10000	NA	20
Phosphate (PO4 3-)	EPA 365.1	10	80-120	50	Mod. EPA 365.1 ²	500	80-120	50
Phosphorus	EPA 365.1	10	80-120	50	Std. Methods 4500-P B.4 + 4500-P E	500	80-120	50
Ammonia	EPA 350.1	10	80-120	20	Mod. EPA 350.1 ²	100	80-120	20

- Standard Method 2320B for alkalinity determines carbonate and bicarbonate concentrations as CaCO₃ equivalents by stoichiometric calculation.
- An aqueous extraction will be performed on the sediment/surface material and the aqueous extract will be analyzed by the method indicated. Ten grams of sediment/surface material is placed in a centrifuge tube and is leached with 10 milliliters of deionized water by tumbling for 1 hour. The tube is centrifuged and the resulting liquid is filtered and analyzed for anions.
- Or by EPA 300.0
- Accuracy limits for LCS and MS recoveries as applicable.
- PRQL = Project Required Quantitation Limit. The laboratory lower limit of detection must be less than the PRQL.
- Listed precision limits are for laboratory duplicates and MS/MSD analyses as applicable; field duplicate precision limits are discussed in Section D.1.3.

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Measurement/Data Acquisition

**Table B.4.4-2f-P2
RADIONUCLIDES – QC ACCEPTANCE CRITERIA**

Analyte	Water				Sediment/Surface Material			
	Analytical Method ¹	Lower Limit of Detection (pCi/l) ²	Counting Error Goal (pCi/l)	Precision (DER) ³	Analytical Method ¹	Lower Limit of Detection (pCi/g) ²	Counting Error Goal (pCi/g)	Precision (DER) ³
Uranium-238	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Uranium-235	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Uranium-234	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Thorium-232	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Thorium-230	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Thorium-228	NAREL U/Th-01	0.2	1.5	2	NAREL U/Th-01	0.2	0.2	2
Thorium-227 ⁵	NAREL U/Th-01	2	2	2	NAREL U/Th-01	2	2	2
Radium-226	NAREL Ra-04	1.0	0.5	2	NAREL Ra-01, Ra-04	0.5	1.5	2
Radium-228	NAREL Ra-05	3.0	1.5	2	NAREL Ra-01, Ra-05	0.5	1.5	2
Protactinium-231	NA	NA	NA	NA	NAREL Gam-01	0.2	0.5	2
Radon-222	NAREL Gam-01	100	150	2	NA	NA	NA	NA
Lead-210	Mod. HASL 300	5.0	4	2	Mod. HASL 300	3.0	2.0	2
Polonium-210	Mod. HASL 300	0.5	0.15	2	Mod. HASL 300	0.5	0.15	2
Gross alpha ⁴	NAREL Gr-01	1.0	7.5	2	NA	NA	NA	NA
Gross beta	NAREL Gr-01	3.0	15	2	NA	NA	NA	NA

1. Or equivalent protocol pending approval by EPA.
2. Laboratory Lower Limit of Detection (LLD) must be ≤ the QAPP-listed LLD. The laboratory must report down to their LLD.
3. Precision Duplicate Error Ratio (DER) discussed in Section D.3.1.
Other applicable means of calculating and evaluating precision thresholds (DER or RER) exist and will be considered as necessary and appropriate.
Listed precision limits are for laboratory duplicates and MS/MSD analyses as applicable; field duplicate precision limits are discussed in Section D.1.3.
4. Laboratory must subtract contribution from radon and uranium before reporting gross alpha to permit comparison to the MCL. Assumes NAREL will modify gross alpha analytical procedures to reflect those required for MCL comparison.
5. Aqueous samples will be held at least 54 days to allow in growth of Th227 such that it is an accurate indication of Ac227 activity.

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**Table B.4.4-2g-P2
OTHER PARAMETERS – QC ACCEPTANCE CRITERIA**

Analyte	Water	Groundwater		Surface Water		Sediment/Surface Material		
	Analytical Method	PRQL ¹	Precision ⁶	PRQL ¹	Precision ⁶	Analytical Method	PRQL ¹	Precision ⁶
pH	SW-846 9040B	NA	± 0.2 pH units	NA	± 0.2 pH units	SW-846 9045C	NA	± 0.2 pH units
Temperature	EPA 170.1	NA	± 1.0 °C	NA	± 1.0 °C	NA	NA	NA
Specific Conductance	EPA 120.1	1µS/cm	10 %RPD	1µS/cm	10 %RPD	NA	NA	NA
Eh	ASTM 1498	± 300 mV	± 50 mV	± 300 mV	± 50 mV	NA	NA	NA
Dissolved oxygen	EPA 360.1	0.2 mg/L	20 %RPD	0.2 mg/L	20 %RPD	NA	NA	NA
Ferrous iron	Hach #8146 or equivalent	0.5 mg/L	20 %RPD	0.5 mg/L	20 %RPD	NA	NA	NA
Total suspended solids	EPA 160.2	4 mg/L	20 %RPD	4 mg/L	20 %RPD	NA	NA	NA
Total dissolved solids	EPA 160.1	10 mg/L	20 %RPD	10 mg/L	20 %RPD	NA	NA	NA
Total organic carbon	NA	NA	NA	NA	NA	Agronomy No. 9	0.2 %	20 %RPD
Alkalinity	Std. Methods 2320 B ²	20 mg/L	20 %RPD	20 mg/L	20 %RPD	NA	NA	NA
Hardness	Std. Methods 2340 B ³	35 mg/L	20 %RPD	20 mg/L	20 %RPD	NA	NA	NA
Turbidity	EPA 180.1	0 NTU	20 %RPD	0 NTU	20 %RPD	NA	NA	NA
Chemical Oxygen Demand	EPA 410.4	NA	NA	5 mg/L	20 %RPD	NA	NA	NA
% Organic Matter	NA	NA	NA	NA	NA	Calculated ⁴	0.2 %	20 %RPD
Particle Size Distribution ⁵	NA	NA	NA	NA	NA	ASTM D422-63 or Plumb Method AD/A103 788, May 1981	NA	30 %RPD
Cation Exchange Capacity and Exchangeable Bases	NA	NA	NA	NA	NA	Modified SW-846 9081	0.01 meq/g ⁷	30 % RPD

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1. PRQL: Project Required Quantitation Limit. The laboratory lower limit of detection must be less than the PRQL.
2. Alkalinity due to carbonate, bicarbonate and hydroxide will be reported.
3. Hardness will be calculated by the laboratory from major cation results.
4. %Organic matter will be calculated from the total organic carbon results using the following equation:
$$\% \text{Organic matter} = (\text{TOC} + 0.4) / 0.458 \quad (\text{Ball, Journal Soil Science 15:84-92, 1964})$$
5. Precision will be calculated for laboratory/method duplicates. Particle sizes larger than 75 μm determined by sieving or laser; particle sizes smaller than 75 μm determined by sedimentation using a hydrometer or laser. The results of this test method are presented in the form of a graph, with the diameters of the particles plotted on a logarithmic scale as the abscissa and the percentages smaller than the corresponding diameters plotted on an arithmetic scale as the ordinate. For use as an acceptance criterion, an RPD will be calculated for each point on the graph. For the portion smaller than 75 μm , it may be necessary to extrapolate the percent passing for a given particle diameter in order to calculate an RPD.
6. Listed precision limits are for laboratory duplicates and MS/MSD analyses as applicable; field duplicate precision limits are discussed in Section D.1.3.
7. PRQL of 0.01 meq/g is for both the cation exchange capacity and all measured exchangeable bases (e.g., Mg, Ca, Na, K).

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**Table B.4.4-2h-P2
RADON FLUX, AIRBORNE RADON, AND RADON EMANATION FRACTION – QC ACCEPTANCE CRITERIA**

Parameter	Analytical Method	Lower Limit of Detection (LLD)	Precision ¹
Radon Flux	Modified EPA 115 (4)	0.8 pCi/m ² s	30 %RPD
Airborne Radon	Alpha Track	0.2 pCi/l (2)	± 30 %D (3)
Radon Emanation Fraction	Gamma Spectrometry	0.1 pCi/g	DER <2 (5)

- Listed precision limits pertain to lab duplicates and field duplicates as applicable.
- LLD would yield 6 pCi/l over a 30-day collection period (exposure).
- Precision is count and exposure dependent; the listed criterion assumes an approximate outdoor radon concentration of 0.5 pCi/l and a 30-day exposure.
- Method EPA 115 modification is that that laboratory/canister vendor uses a sampler in which the charcoal is sealed in the canister eliminating the need for the charcoal to be poured to and from the canister as stated in Method EPA 115. Methodology comparability studies have been completed and found to be acceptable by the U.S. Nuclear Regulatory Commission.
- Duplicate Error Ratio (DER) discussed in Section D.3.1.

Definitions for Tables B.4.4-2a-P2 – B.4.4-2h-P2:

- PRDL: Project Required Detection Limit to Meet Applicable and Appropriate Levels of Concern
PRQL: Project Required Quantitation Limit to Meet Applicable and Appropriate Levels of Concern
OLC02.0: USEPA CLP Program, Statement of Work for Organics Analysis, Low Concentration Water, Document # OLC02.0
OLM03.0: USEPA CLP Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Document# OLM03.0
ILM04.0: USEPA CLP Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Document # ILM04.0
Agronomy: American Society of Agronomy, Method of Soil Analysis, 2nd Edition, 1982
ASTM: Annual Book of American Society for Testing and Materials Standards, 2000
SW846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update III, December 1996.
EPA: USEPA Office of Research and Development, Environmental Monitoring and Support Laboratory, Methods for Chemical Analyses of Water and Wastes, March 1983
Std. Methods: Standard Methods for the Examination of Water and Wastewater, 17th Edition, 1989
HASL: USDOE Environmental Measurements Laboratory Procedures Manual, 27th Edition, Revised February 1992
NAREL: USEPA National Air and Radiation Environmental Laboratory
- LLD: Lower Limit of Detection
%R: Percent Recovery
%RPD: Percent Relative Percent Difference

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µg/l:	micrograms per liter
µg/kg:	micrograms per kilogram
meq/g:	milliequivalents per gram
mg/kg:	milligrams per kilogram
mg/l:	milligrams per liter
pCi/l:	picocuries per liter
pCi/g:	picocuries per gram
µS/cm:	microsiemens per centimeter
µm:	micrometer
mV:	millivolts
NTU:	Nephelometric turbidity units
DER:	Duplicate Error Ratio
QC:	Quality Control
VOC:	Volatile Organic Compounds
SVOC:	Semivolatile Organic Compounds
TPH:	Total Petroleum Hydrocarbons
TVPH:	Total Volatile Petroleum Hydrocarbons
TEPH:	Total Extractable Petroleum Hydrocarbons
Eh:	Oxidation reduction potential
NA:	Not Applicable
LCS:	Laboratory Control Spike
MS:	Matrix Spike
ICP-AES:	Inductively Coupled Plasma-Atomic Emission Spectrometer
ICP-MS:	Inductively Coupled Plasma-Mass Spectrometer
GFAA:	Graphite Furnace Atomic Absorption
CVAA:	Cold Vapor Atomic Absorption

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**Table B.4.4-3a-P2
THORIUM 232
DECAY SERIES ANALYSES**

Th-232 Series Aqueous	Half Life	Method ¹	Lower Limit of Detection ² (pCi/l)	Counting Error Goal (pCi/l)	Precision (DER) ³
Th232	1.4 E10y	NAREL U/Th-01	0.2	1.5	2
Ra228	6.7 y	NAREL Ra-05	3	1.5	2
Ac228	6.13 hr	Not Meaningful	----	----	----
Th228	1.91 y	NAREL U/Th-01	0.2	1.5	2
Ra224	3.64 d	Not Meaningful	----	----	----
Rn220	55 s	Not Meaningful	----	----	----
Po216	.15 s	Not Meaningful	----	----	----
Pb212	10.64 hr	Not Meaningful	----	----	----
Bi212	60.6 m	Not Meaningful	----	----	----
Po212	3E-7 s	Not Meaningful	----	----	----
Tl208	3.1 m	Not Meaningful	----	----	----
Non-Aqueous			(pCi/g)	(pCi/g)	
Th232	1.4 E10y	NAREL U/Th-01	0.2	0.2	2
Ra228	6.7 y	NAREL Ra-01, Ra-05	0.5	1.5	2
Ac228	6.13 hr	Not Meaningful	----	----	----
Th228	1.91 y	NAREL U/Th-01	0.2	0.2	2
Ra224	3.64 d	Not Meaningful	----	----	----
Rn220	55 s	Not Meaningful	----	----	----
Po216	.15 s	Not Meaningful	----	----	----
Pb212	10.64 hr	Not Meaningful	----	----	----
Bi212	60.6 m	Not Meaningful	----	----	----
Po212	3E-7 s	Not Meaningful	----	----	----
Tl208	3.1 m	Not Meaningful	----	----	----

1. Those Isotopes listed as not meaningful have relatively short half-lives (and/or low dose factors) and will not be directly measured; however, relative concentrations can be calculated from other isotopes in the decay series. Proposed/equivalent analytical methods may be used pending EPA approval.
2. Lower Limits of Detection Listed may be affected by sample Total Dissolved Solids Content. Laboratory Lower Limit of Detection (LLD) must be ≤ the QAPP-listed LLD. The laboratory must report down to their LLD.
3. Precision Duplicate Error Ratio (DER) is discussed in Section D.3.1
Other applicable means of calculating and evaluating precision thresholds (DER or RER) exist and will be considered as necessary and appropriate.

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Table B.4.4-3b-P2
URANIUM 235
DECAY SERIES ANALYSES

U235 Series Aqueous	Half Life	Method ¹	Lower Limit of Detection ² (pCi/l)	Counting Error Goal (pCi/l)	Precision (DER) ³
U235	7.1E+8 y	NAREL U/Th-01	0.2	1.5	2
Th231	25.5 h	Not Meaningful	----	----	----
Pa231	3.25E+4 y	Not Meaningful	----	----	----
Ac227	21.6 y	Not Meaningful	----	----	----
Th227	18.2 d	NAREL U/Th-01	2	2	2
Fr223	22 m	Not Meaningful	----	----	----
Ra223	11.43 d	Not Meaningful	----	----	----
Rn219	4.0 s	Not Meaningful	----	----	----
Po215	1.77E-3 s	Not Meaningful	----	----	----
Pb211	36.1 m	Not Meaningful	----	----	----
Bi211	2.16 m	Not Meaningful	----	----	----
Po211	0.52 s	Not Meaningful	----	----	----
Tl207	4.79 m	Not Meaningful	----	----	----
Non-Aqueous			(pCi/g)	(pCi/g)	
U235	7.1E+8 y	NAREL U/Th-01	0.2	0.2	2
Th231	25.5 h	Not Meaningful	----	----	----
Pa231	3.25E+4 y	NAREL Gam-01	0.2	0.2	2
Ac227	21.6 y	Not Meaningful	----	----	----
Th227	18.2 d	NAREL U/Th-01	2	2	2
Fr223	22 m	Not Meaningful	----	----	----
Ra223	11.43 d	Not Meaningful	----	----	----
Rn219	4.0 s	Not Meaningful	----	----	----
Po215	1.77E-3 s	Not Meaningful	----	----	----
Pb211	36.1 m	Not Meaningful	----	----	----
Bi211	2.16 m	Not Meaningful	----	----	----
Po211	0.52 s	Not Meaningful	----	----	----
Tl207	4.79 m	Not Meaningful	----	----	----

1. Those Isotopes listed as not meaningful have relatively short half-lives (and/or low dose factors) and will not be directly measured; however, relative concentrations can be calculated from other isotopes in the decay series. Proposed/equivalent analytical methods may be used pending EPA approval.
2. Lower Limits of Detection Listed may be affected by sample Total Dissolved Solids Content. Laboratory Lower Limit of Detection (LLD) must be ≤ the QAPP-listed LLD. The laboratory must report down to their LLD.
3. Precision Duplicate Error Ratio (DER) is discussed in Section D.3.1
Other applicable means of calculating and evaluating precision thresholds (DER or RER) exist and will be considered as necessary and appropriate.

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Table B.4.4-3c-P2
URANIUM 238
DECAY SERIES ANALYSES

U238 Series Aqueous	Half Life	Method ¹	Lower Limit of Detection ² (pCi/l)	Counting Error Goal (pCi/l)	Precision (DER) ³
U238	4.5E+9 y	NAREL U/Th-01	0.2	1.5	2
Th234	24.1 d	Not Meaningful	----	----	----
Pa234	1.17 m	Not Meaningful	----	----	----
U234	2.46E+5 y	NAREL U/Th-01	0.2	1.5	2
Th230	8E+4y	NAREL U/Th-01	0.2	1.5	2
Ra226	1622 y	NAREL Ra-04	1	0.5	2
Rn222	3.8 d	NAREL Gam-01	100	150	2
Po218	3.05 m	Not Meaningful	----	----	----
Pb214	26.8 m	Not Meaningful	----	----	----
Bi214	19.7 m	Not Meaningful	----	----	----
Pb210	21 y	Modified HASL	5	4	2
Po210	138.4 d	Modified HASL	0.5	0.15	2
Non-Aqueous			(pCi/g)	(pCi/g)	
U238	4.5E+9 y	NAREL U/Th-01	0.2	0.2	2
Th234	24.1 d	Not Meaningful	----	----	----
Pa234	1.17 m	Not Meaningful	----	----	----
U234	2.46E+5 y	NAREL U/Th-01	0.2	0.2	2
Th230	8E+4y	NAREL U/Th-01	0.2	0.2	2
Ra226	1622 y	NAREL Ra-01, Ra-04	0.5	1.5	2
Rn222	3.8 d	Not Meaningful	----	----	----
Po218	3.05 m	Not Meaningful	----	----	----
Pb214	26.8 m	Not Meaningful	----	----	----
Bi214	19.7 m	Not Meaningful	----	----	----
Pb210	21 y	Modified HASL	3	2	2
Po210	138.4 d	Modified HASL	0.5	0.15	2

- Those Isotopes listed as not meaningful have relatively short half-lives (and/or low dose factors) and will not be directly measured; however, relative concentrations can be calculated from other isotopes in the decay series. Proposed/equivalent analytical methods may be used pending EPA approval.
- Lower Limits of Detection Listed may be affected by sample Total Dissolved Solids Content. Laboratory Lower Limit of Detection (LLD) must be ≤ the QAPP-listed LLD. The laboratory must report down to their LLD.
- Precision Duplicate Error Ratio (DER) is discussed in Section D.3.1
Other applicable means of calculating and evaluating precision thresholds (DER or RER) exist and will be considered as necessary and appropriate.

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Definitions for Tables B.4.4-3a-P2, B.4.4-3b-P2, B.4.4-3c-P2

Th	Thorium
Ra	Radium
Ac	Actinium
Rn	Radon
Po	Polonium
Pb	Lead
Bi	Bismuth
Tl	Thallium
U	Uranium
Pa	Protactinium
Fr	Francium

y	years
d	days
hr	hours
m	minutes
s	seconds

pCi/l	picocuries per liter
pCi/g	picocuries per gram

EPA USEPA Office of Research and Development, Environmental Monitoring and Support Laboratory,
Prescribed Procedures for Measurement of Radioactivity in Drinking Water, August 1980

HASL USDOE Environmental Measurements Laboratory Procedures Manual, 27th Edition, Revised February
1992

NAREL USEPA National Air and Radiation Environmental Laboratory

SECTION C

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C.1 ASSESSMENTS AND RESPONSE ACTIONS

C.1.1 Purpose/Background

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.1.2 Assessment Activities and Project Planning

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.1.2.1 Assessment of Subsidiary Organizations

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.1.2.2 Assessment of Project Activities

Surveillance. No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

Technical Systems Audit (TSA). A TSA is a thorough and systematic onsite qualitative audit where field procedures, equipment, personnel, training, and record keeping are examined for conformance to this QAPP (and supporting SAP and SOPs). Any deviations revealed during a TSA will be communicated to the URS Project Manager in an audit findings report. The audit findings report will consist of audit observations and audit findings. Audit observations include discovery of items not negatively impacting data quality and recommendations for improvements in current procedures. Audit findings consist of items which negatively impact data quality and therefore require resolution. URS's Project Manager must respond to the audit findings report and provide detailed corrective actions (Section C.1.3). The Project Manager may issue a stop work order if any finding seriously affects the data quality objectives. The Project QA Manager or his/her designee may conduct a TSA of the field procedures at any time for the duration of the project.

Performance Evaluation (PE). A PE audit may be conducted to assess the quantitative data generated by the laboratories. Blind PE samples for VOCs, SVOCs, metals, common ions and radionuclides may be included with routine sample shipments for any given sampling effort. PE samples may be spiked with a subset of analytes listed in Section B of this QAPP at levels no higher than ten times and no lower than the quantitation limit. The results of the PE samples will be assessed for bias, precision, and quantitation limits. If results from one PE audit are unacceptable, the Project QA Manager will notify the laboratory and ask the laboratory to investigate possible problems and implement corrective actions. The laboratory's QA manager should provide the URS Project QA Manager with a report of the investigation findings and any corrective actions implemented. The URS Project QA Manager may direct issue of a second PE sample to assess corrective action efficacy. If results from more than one PE audit are unacceptable, the Project QA Manager will notify the URS Project Manager, who may issue a

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stop work order until the source of the problem can be identified and appropriate corrective actions are implemented.

PE samples were sent to one URS-contracted laboratory with samples from the first sampling event of Phase 1A for some of the definitive chemical analytical methods listed in Table B.4.3-1-P2). Results for these PE samples were acceptable. As the same laboratory will be used for Phase 2A/1B and the same analytical methods generally employed, no additional PE samples are planned for Phase 2A/1B.

Audit of Data Quality (ADQ). No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

Peer Review. No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

Data Quality Assessment (DQA). No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.1.2.3 Schedule of Assessment Activities and Personnel

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.1.3 Nonconformance and Corrective Actions

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

C.2 REPORTS TO MANAGEMENT

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

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Table C.1-1-P2
TABLE OF PEER REVIEWS AND REVIEWERS

Document	Reviewer	Title
QAPP	Alan Roberts	URS Project Quality Assurance Manager
Field Sampling Plan	Alan Roberts	URS Project Quality Assurance Manager
Standard Operating Procedures	Alan Roberts	URS Project Quality Assurance Manager
Field and Sample Forms	Alan Roberts	URS Project Quality Assurance Manager
Technical Scopes of Work (SOWs)	Alan Roberts	URS Project Quality Assurance Manager
Data Validation Reports	Alan Roberts	URS Project Quality Assurance Manager

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**Table C.1-2-P2
SCHEDULE OF ASSESSMENT ACTIVITIES AND PERSONNEL**

Assessment Activity	Timing	Frequency	Responsible Personnel
MSR	Before first sample collection begins	At the discretion of the URS Project Quality Assurance Manager or URS Project Manager; once for each sub-contracted laboratory	URS Project Quality Assurance Manager
Sample Receipt Review	During sample collection	Each day samples are received	Laboratory's Project Manager
TSA	Any time during the project	At the discretion of the URS Project Quality Assurance Manager or URS Project Manager	URS Project Quality Assurance Manager
Surveillance	During sample collection	At the discretion of the URS Project Quality Assurance Manager or URS Project Manager	URS Project Quality Assurance Manager
PE	During sample collection and analyses	At the discretion of the URS Project Quality Assurance Manager or URS Project Manager	URS Project Quality Assurance Manager
Peer Review	Before a document is finalized	Once per document	Technical staff
DQA	After data are validated	Once for each sampling event	URS Project Quality Assurance Manager

SECTION D

Data Validation and Usability

D.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

D.2 VALIDATION AND VERIFICATION METHODS

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

D.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

No significant changes have been made to this section. Please refer to the Phase 1A QAPP.

D.4 ADDITIONAL DATA QUALITY ASSESSMENT

In addition to the reconciliation with data quality objectives described above, data reviewers will also assess the comparison of total and dissolved metal concentrations and the cation-anion balance for groundwater and surface water samples as discussed in Sections B.5.2.2 and B.5.2.3. Data qualifiers will not be assigned based on these criteria; instead, these QC measures will be used to evaluate the overall effectiveness of various sampling and analysis processes.

D.4.1 Comparison of Total and Dissolved Metals Concentrations

In the case of a dissolved metal concentration exceeding a total metal concentration, the relative percent difference (RPD) will be calculated as follows:

$$\text{RPD (\%)} = 100 \times \frac{|D - T|}{(D + T)/2}$$

where: D = dissolved concentration
T = total concentration

An RPD criterion of 10% will be considered when evaluating data quality.

D.4.2 Cation-Anion Balance

The cation-anion balance will be calculated using the following equation specified in Standard Methods (APHA et. al, 1989) Method 1030F for aqueous samples where the sum of the dissolved major cation concentrations and the sum of the major anion concentrations are expressed in milliequivalents per liter (meq/l).

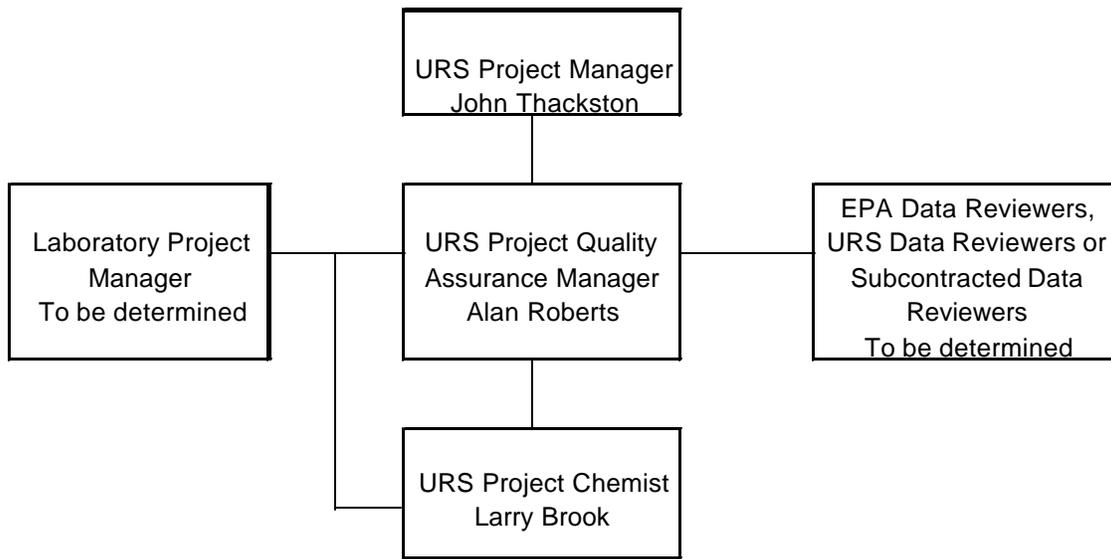
$$\% \text{ DIFFERENCE} = 100 \times \frac{\sum_{\text{cations}} - \sum_{\text{anions}}}{\sum_{\text{cations}} + \sum_{\text{anions}}}$$

A percent difference criterion of 10% will be considered when evaluating data quality.

SECTION D

Data Validation and Usability

Figure D.2-1-P2
ORGANIZATIONAL CHART FOR VERIFYING AND VALIDATING DATA



SECTION E

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Appendix A

Sampling and Analysis Plan

Appendix A

Sampling and Analysis Plan

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Appendix A

Sampling and Analysis Plan

1.0 INVESTIGATION APPROACH

The Midnite Mine Phase 2A/1B RI/FS field investigation is being conducted to collect environmental data to satisfy the data needs identified in the Phase 2A/1B Quality Assurance Project Plan (Phase 2A/1B QAPP). The data needs were identified during the data quality objective (DQO) process, which was implemented to define project objectives, decisions, and decision criteria clearly and unambiguously.

The objective of the Phase 2A/1B field investigation is to collect, to the extent practical, the necessary data for completing the Midnite Mine RI/FS, including the human health and ecological risk assessments, and the feasibility study. The field investigation consists of two RI/FS phases to be conducted concurrently in the fall of 2000. Phase 2A is designed to gather data (if necessary) to characterize all potentially contaminated environmental media within the MA, and surface materials/subsurface materials, radon, and radiation in the PIA. Phase 1B is a follow-on to Phase 1A, which was conducted in fall 1999 and spring 2000. Phase 1B is designed to provide supplementary data to complete the characterization of groundwater, surface water, and sediment in the PIA. Both phases also include background characterization activities for the relevant media.

The following activities will be performed during the Phase 2A/1B field investigation:

- Sampling of surface materials in the MA and on haul roads in the PIA.
- Sampling of surface materials/subsurface materials in areas of the PIA that are in the primary downwind directions from the MA (downwind areas), adjacent to haul roads in the PIA, and in background areas.
- Installation of groundwater monitoring wells in the MA and at a location along Blue Creek.
- Groundwater sampling at new wells in the MA and at Blue Creek, and at existing background wells.
- Sampling of surface water in the open pits, at a PIA location along the east haul road, and in background areas.
- Sampling of sediment in the open pits, at a PIA location along the east haul road, in the PIA drainages south and east of the MA, along Blue Creek, and in background areas.
- Measurement of airborne radon in the open pits, in the MA, along haul roads in the PIA, in PIA downwind areas, and in background areas.
- Measurement of radon flux in the MA and in background areas.
- Measurement of radon emanation fraction in the MA and in background areas.
- Measurement of gamma radiation in the open pits, along PIA haul roads, in PIA downwind areas, and in background areas.

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Sampling and Analysis Plan

- Measurement of hydraulic heads at all site monitoring wells.
- Measurement of hydraulic conductivity at unconsolidated wells in the PIA drainages south and east of the MA and at Blue Creek.
- Drilling of geotechnical test holes and excavation of test pits in the South Spoils and Hillside Dump waste rock piles.
- Mapping of geologic and lithologic conditions at the open pits and in the MA.
- Laboratory analysis of surface materials, groundwater, surface water, and sediment samples for a wide variety of constituents and radioactive isotopes.
- Laboratory evaluation (counting) of airborne radon measurement devices.
- Laboratory testing of geotechnical samples for a wide variety of material properties.

These activities and supporting activities are described in remaining sections of this Sampling and Analysis Plan (SAP).

2.0 FIELD ACTIVITIES

This section describes field activities that will be performed for the Midnite Mine Phase 2A/1B RI/FS field investigation. The field work involves investigation of the MA, PIA, and background areas and consists of the following activities:

- Premobilization
- Mobilization
- Surface material/subsurface material sampling
- Airborne radon measurement
- Radon flux measurement
- Gamma radiation surveying
- Monitoring well borehole drilling
- Borehole geophysical logging
- Monitoring well installation and development
- Geotechnical test hole drilling and piezometer installation
- Geotechnical test pit excavation
- Groundwater sampling
- Groundwater level measurement

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Sampling and Analysis Plan

- Surface water and sediment sampling
- Slug testing
- Decontamination
- Management of investigation derived waste (IDW)
- Surveying
- Demobilization

Instructions for performing the field activities are given in standard operating procedures (SOPs), which are included in Appendix B. Many of the SOPs were previously provided in the Phase 1A QAPP and are based on written procedures presented in the Work Plan for the Midnite Mine prepared by SMI (SMI 1998). Existing SOPs were modified and new SOPs added to satisfy the data collection needs for the Phase 2A/1B RI/FS.

A field adit during this third field sampling event is not considered necessary.

2.1 Premobilization

Prior to the start-up of field activities, the site will be visited to perform field reconnaissance of proposed sample locations. The proposed monitoring well and groundwater sample locations shown on Figures A.7-1 and A.7-4 of the Phase 2A/1B QAPP are approximate. The locations will be selected and staked during field reconnaissance based on the following information:

- Site access
- Local topography
- Availability of water and sediments (surface water and sediment sampling locations)
- Project objectives for the sample points

It may be necessary to perform earthwork to provide adequate access to sampling locations. The need for any earthwork will be identified during the premobilization activities so that the URS Field Manager can coordinate the work with other field activities.

The URS Project Manager will be informed if no suitable location for a proposed sampling point can be identified. The URS Project Manager will then be responsible for the re-evaluation of the sample point, and identifying an alternative location to meet the related data needs.

Additional premobilization activities may include identifying appropriate locations for a field trailer and decontamination facilities, and making arrangements for electric power for the field trailer and other logistic considerations.

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Sampling and Analysis Plan

Ordering of equipment and supplies will occur during the premobilization. Contracting of subcontractors and analytical laboratories will also be conducted during this period.

2.2 Mobilization

Mobilization activities will be conducted to prepare field personnel and the field activities support area for the start-up of work. Mobilization will involve the following activities:

- Set-up of the field trailer and decontamination facilities on the site
- Receipt, organization, and transport of field supplies and equipment
- Calibration and testing of field equipment
- Set-up and checking of site communications
- Kick-off meeting involving field staff, members of the technical working group, and supporting office staff
- Site health and safety briefing

2.3 Surface Material/Subsurface Material Sampling

2.3.1 Surface Material Sampling

Samples of surface materials will be collected from locations in the MA, PIA, and background areas to allow laboratory analysis for a wide variety of chemicals and radionuclides. Surface material sampling is being performed primarily to support the human health and ecological risk assessments. For this purpose, surface materials are defined as any friable material below the non-decomposed plant litter down to a depth of 5 cm below the plant litter that has the possibility of being ingested, inhaled, or coming into dermal contact with a human or organism, or that may be in contact with a plant's root system. For the purposes of this study, friable surface materials will consist of either soil, crushed rock or highly weathered rock material that is sand size or smaller.

Locations of surface material samples are shown on Figures A.7-1 and A.7-3 of the Phase 2A/1B QAPP. Section A.7 of the Phase 2A/1B QAPP discusses the rationale for the selected locations.

Surface material samples will be collected in accordance with SOP No. 15, Surface Material Sampling. In all cases, the surface material samples will be collected as five-increment composite samples with each increment being collected over a vertical interval from ground surface to 5 cm in depth so as to allow comparability of MA, PIA and background surface material samples.

Surface material samples will consist of:

- Crushed rock or highly weathered rock material on stockpiles and waste rock piles in the MA

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- Crushed/highly weathered rock or soil in disturbed ground areas in the MA
- Crushed rock material on haul roads and soil material adjacent to haul roads
- Soil material in the PIA downwind areas
- Soil or crushed/highly weathered rock material in background areas

All surface material samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be analyzed for the constituents listed on Table A-8 of this SAP. Specific analytical parameters, analytical methods, sample containers, and preservatives for each chemical group are presented in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of surface material sampling will be recorded in field logbooks and surface material sampling field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP. Decontamination of sampling equipment used in surface material sampling activities will be performed as described in SOP No. 10, Decontamination. Wash water from decontamination, and any other investigation-derived waste (IDW) will be managed as described in Section 2.17.

The locations of surface material samples will be surveyed in accordance with SOP No. 14, GPS surveying.

2.3.2 Subsurface Material Sampling

Samples of subsurface materials will be collected from locations in the PIA and background areas to allow laboratory analysis for a wide variety of chemicals and radionuclides. Subsurface material sampling is being performed primarily to support the human health and ecological risk assessments. For this purpose, subsurface materials are defined as any friable material from 5 to 20 cm below the ground surface (below the non-decomposed plant litter) that has the possibility of being ingested, inhaled, or coming into dermal contact with a human or organism, or that may be in contact with a plant's root system. For the purposes of this study, friable subsurface materials will consist of either soil or crushed or highly weathered rock material that is sand size or smaller.

Locations of subsurface material samples are shown on Figures A.7-1 and A.7-3 of the Phase 2A/1B QAPP. Section A.7 of the Phase 2A/1B QAPP discusses the rationale for the selected locations.

Subsurface material samples will be collected in accordance with SOP No. 15, Surface Material Sampling. In all cases, the subsurface material samples will be collected as five-increment composite samples with each increment being collected over a vertical interval from 5 to 20 cm in depth so as to allow comparability of investigation and background subsurface material samples.

Subsurface material samples will consist of:

- Soil material adjacent to haul roads

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- Soil material in the PIA downwind areas
- Soil or crushed/highly weathered rock material in background areas

All subsurface material samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be analyzed for the constituents listed on Table A-8 of this SAP. Specific analytical parameters, analytical methods, sample containers, and preservatives for each chemical group are presented in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of subsurface material sampling will be recorded in field logbooks and subsurface material sampling field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP. Decontamination of sampling equipment used in subsurface material sampling activities will be performed as described in SOP No. 10, Decontamination. Wash water from decontamination, and any other investigation-derived waste (IDW) will be managed as described in Section 2.17.

The locations of subsurface material samples will be surveyed in accordance with SOP No. 14, GPS surveying.

2.4 Airborne Radon Measurement

Measurements of radon in air will be conducted in a variety of locations in the MA, PIA, and background areas. Airborne radon measurement is being performed primarily to support the baseline human health and ecological risk assessments. Because substantial airborne radon is expected to occur naturally in undisturbed uranium mineralized areas, background airborne radon measurement is necessary to determine the component of radon in MA and PIA air attributable to mining activities.

Airborne radon measurement locations are shown on Figures A.7-1 and A.7-3 of the Phase 2A/1B QAPP. Section A.7 of the Phase 2A/1B QAPP discusses the rationale for the selected locations. Airborne radon measurements will be conducted in accordance with SOP No. 18, Gamma Radiation Surveys, Radon Flux Measurement, and Airborne Radon Measurement.

Airborne radon samples will be conducted by deploying long-term alpha track (AT) radon devices at each location at an approximate height of one meter or greater above ground. Airborne radon measurements will be conducted over a 3 to 8 month duration; weather and snow cover conditions permitting.

Following the test duration, the radon devices will be retrieved and submitted to the analytical laboratory for counting.

All airborne radon devices will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be analyzed for radon as shown on Table A-6 of this SAP. The analytical method for airborne radon are presented in Tables B.4.4-2h-P2 and B.4.3-1-P2 of the Phase 2A/1B QAPP.

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The details of airborne radon measurements will be recorded in field logbooks and on field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP.

The locations of airborne radon measurements will be surveyed in accordance with SOP No. 14, GPS surveying.

2.5 Radon Flux Measurement

Radon flux will be measured at a variety of locations in the MA and background areas. Radon flux measurement is being performed primarily to support the feasibility study. Radon flux is a key factor in evaluating the need for and thickness of cover material in the MA. Because substantial radon flux is expected to occur naturally in undisturbed uranium mineralized areas, background radon flux measurements are necessary to determine the component of radon flux in the MA that is attributable to mining activities.

Radon flux measurement locations are shown on Figures A.7-2 and A.7-3 of the Phase 2A/1B QAPP. Section A.7 of the Phase 2A/1B QAPP discusses the rationale for the selected locations.

Radon flux measurements will be obtained in accordance with SOP No. 18, Gamma Radiation Surveys, Radon Flux Measurements and Airborne Radon Measurements.

Large area charcoal canisters will be placed at radon flux measurement locations. Radon flux measurements will be collected over a 24-hour duration; weather and snow cover conditions permitting. Radon emanation from the ground is highly affected by rainfall or the presence of snow cover. Therefore, the test must be conducted during a rain-free period extending from 24 hours prior to the test through the 24-hour test duration. Also, snow cover cannot be present. Following the 24-hour test duration, the flux sample is retrieved and sent to the analytical laboratory for analysis.

All radon flux samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be analyzed for radon as shown on Table A-7 of this SAP. The analytical method and sample container for radon flux measurement are presented in Tables B.4.4-2h-P2 and B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of radon flux measurement will be recorded in field logbooks and on field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP.

The locations of radon flux measurement stations will be surveyed in accordance with SOP No. 14, GPS surveying.

2.6 Gamma Radiation Surveys

Gamma radiation surveys will be conducted over a variety of locations in the PIA and background areas. Gamma radiation measurements are being collected primarily to support the human health risk

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assessment. Gamma radiation surveying will be conducted along the open pit haul roads and PIA east and west haul roads, at surface material increment sample locations in the PIA downwind areas and along and adjacent to haul roads, and at background surface material increment sample locations. Gamma radiation surveys will be conducted in accordance with SOP No. 18, Gamma Radiation Surveying, Radon Flux Measurements, and Airborne Radon Measurement.

The gamma survey will be conducted using Ludlum Model 12, 2220, or 2221 survey meters with scalers, or equivalent, calibrated to Model 44-2 or equivalent NaI scintillation probes. Depending on the location, gamma radiation surveys will be conducted either in point or integrated mode, or both.

Two general types of surveys will be conducted. For the open pits and PIA haul roads, longitudinal and transverse transects will be surveyed along the haul roads. Also, radiation measurements will be obtained at specific surface material sampling locations in the pits and on the PIA haul roads. For the PIA downwind areas, PIA areas adjacent to haul roads, and background areas, radiation measurements will be made at each surface material increment sample location.

Longitudinal transect surveys will be performed along the entire lengths of both the east and west haul roads. Transverse transects will be performed across the roads at each surface material sampling location. Transverse transects will extend sufficiently far from the roads to bound the extent of elevated radioactivity due to dust from the roads. This will be accomplished by continuing the transects until radiation levels approach a static value at distance away from the road. If this cannot be determined, the transects will extend a minimum of 200 feet in either direction from the road.

The details of gamma radiation surveying will be recorded in field logbooks and on field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP. Locations of survey lines will be surveyed and gamma readings will be documented during the field surveys.

2.7 Monitoring Well Borehole Drilling

A total of 6 borings will be drilled as part of the Phase 2A/1B RI/FS field investigation for the purpose of constructing monitoring wells; 5 in the MA and 1 along Blue Creek in the PIA. As part of pre-mobilization activities (Section 2.1), each proposed boring location will be staked and marked. If the drilling crew identifies access or other problems with a marked boring location, the URS Field Manager will be contacted. The location of each boring will be documented by surveying the location after monitoring well completion.

The proposed Blue Creek monitoring well is presented in Table A-1 of this SAP. The approximate well location is shown on Figure A.7-4 of the Phase 2A/1B QAPP. The well will be installed along Blue Creek at a location immediately downstream of the confluence of Blue Creek and the Eastern Drainage.

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Proposed MA wells are listed in Table A-2 of this SAP. The approximate well locations are shown on Figure A.7-1 of the Phase 2A/1B QAPP. The table indicates the proposed well type and the approximate target depths of the wells. Two of the wells are to be completed as water table wells in the uppermost water-bearing zone within bedrock. The remaining three wells are to be completed in bedrock deep below the water table.

The bedrock borings will be drilled using casing advance reverse circulation dual tube drilling rigs. Casing will be advanced through unconsolidated material (alluvium or weathered bedrock), if present, to provide stability in the borings during drilling and well installation. Once the hole is considered to be stable, drilling will be continued below the cased portion of the boring as an open hole. The open hole section of the boring will be drilled to the target depth listed on Table A-1 or A-2, or as field conditions dictate. The open hole section of the boring will then be geophysically logged to help locate fractured zones or other water-bearing features. If a water-bearing zone is not encountered upon reaching the target depth, the boring will be drilled until an adequate water-bearing zone is encountered to a maximum depth of 100 feet deeper than the target depth. Geophysical logging is discussed in Section 2.8 and SOP No. 13, Borehole Geophysical Logging.

The alluvial well at Blue Creek will either be drilled with a hollow-stem auger drill rig or with a reverse circulation dual tube drill rig, depending on subcontractor selection and availability.

Drilling procedures are described in SOP No. 1, Drilling and Sampling of Subsurface Materials. Each of the borings will be visually logged and documented in field logbooks by a rig geologist or engineer in accordance with SOP No. 2, Borehole Logging. An example of the boring log form is provided in Appendix C of the Phase 2A/1B QAPP.

No subsurface materials will be collected from monitoring well boreholes for laboratory analysis as part of the Phase 2A/1B RI/FS field investigation.

Decontamination of downhole drilling and logging equipment will be performed in accordance with SOP No. 10, Decontamination, to prevent cross-contamination between boring locations as well as cross-contamination of subsurface units within individual borings.

Soil and liquid waste generated during drilling activities (e.g., drill cuttings and decontamination water) will be handled in accordance with procedures described in Section 2.17.

2.8 Borehole Geophysical Logging

Downhole geophysical logging will be performed to help identify screen intervals for well completion. The well screens in bedrock wells will be placed in fractured zones that are water-bearing. The types of geophysical logs to be performed include caliper, temperature, and fluid conductance. The choice of logs will be dependent on the characteristics of target zones and objectives of individual wells.

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Geophysical logging will be performed in open hole bedrock sections of the borings. The logging will be performed in accordance with pertinent procedures described in SOP No. 13, Borehole Geophysical Logging. Personnel performing the geophysical logging will have specialized training in the calibration and use of logging instruments and the analysis of log data.

For Phase 2A/1B, geophysical logging will not be performed for the purpose of identifying subsurface mineralized zones.

2.9 Monitoring Well Installation and Development

As described in Section 2.3, three types of monitoring wells will be installed as part of the Phase 2A/1B RI/FS field investigation: an alluvial water table well; bedrock water table wells; and deep below the water table bedrock wells. Well installation is discussed in Section 2.9.1. Development of monitoring wells is discussed in Section 2.9.2.

New monitoring well locations will be surveyed following well completion. The survey will include measurement of the location northing and easting coordinates in the State Plane coordinate system, as well as the ground surface and top of well casing elevations. The top of well casing will be surveyed on the north side of the well. This point will serve as the measuring point for subsequent water level measurements and will be clearly marked to facilitate consistency in depth to water measurements.

Solid and liquid waste generated during well installation and development activities will be handled in accordance with procedures described in Section 2.17.

2.9.1 Well Installation

A total of 6 new monitoring wells are planned for the Phase 2A/1B RI/FS field investigation. The monitoring wells will be constructed in accordance with procedures described in SOP No. 3, Monitoring Well Installation. The new monitoring wells will be constructed of 4-inch outer diameter polyvinyl chloride (PVC) well casing. Well construction information will be documented in field logbooks and on well construction logs. An example well construction log is provided in Appendix C.

The target zones for each proposed well are specified in Tables A-1 and A-2 of this SAP. The criteria for selecting screen intervals and total well depths vary depending on the type and purpose of individual wells. Rationale for each of the wells is presented in Tables A.7-3, A.7-4, and A.7-8 of the Phase 2A/1B QAPP. Information for the three well types is presented in the following subsections.

2.9.1.1 Alluvial Water Table Well

One alluvial water table monitoring well (MWBC-01) is proposed for the Phase 2A/1B RI/FS field program. The purpose of the alluvial water table well is to monitor groundwater quality in saturated alluvium. The alluvial well will be drilled through alluvium to the top of bedrock. The well is proposed

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to be completed using a 15-foot long screen interval, if sufficient alluvium is present. The well screen will be placed so that the top of the screen is approximately 5 feet above the static water level. The length of screen above the water table will allow for water level rise due to natural seasonal fluctuations. The 10-foot length of screen below the water table allows water level measurements even if the water level drops significantly in response to seasonal fluctuations. The alluvial well will be constructed of Schedule 40 PVC. Additional well construction details are presented in SOP No. 3, Monitoring Well Installation.

2.9.1.2 Bedrock Water Table Wells

Two bedrock water table wells (MWP3-01 and MWHD-01) are proposed for the Phase 2A/1B RI/FS field program. Bedrock water table wells are intended to monitor the uppermost saturated zone in bedrock (i.e., in areas where saturated unconsolidated material is not present). This is the expected condition at both of the proposed well locations. It is unknown whether water will be encountered in weathered bedrock or in fractured unweathered rock. If water table conditions are encountered in weathered bedrock, the static water level should be observable and indicative of the approximate potentiometric surface. If the bedrock is relatively impermeable and flow is controlled by rock fractures, it may be necessary to drill beyond the potentiometric surface (i.e., the depth to which water will rise in the completed well) to encounter the water-bearing fracture. As a result, it may be necessary to drill up to 100 feet below target zones to encounter the uppermost water-bearing zones. This has been observed previously in locations on the mine site, such as the Northwest Ridge.

The bedrock water table well boreholes will initially be drilled to the target depths (Table A-2) or shallower if water is encountered. If water is encountered, drilling will be stopped and, if necessary, borehole geophysical logging will be performed (Section 2.8) to help identify the interval that is producing the water. The well screen will be placed across the first interval in the target zone that produces sufficient quantities of water for sampling. If a significant quantity of water is not encountered, the rig geologist may direct the drillers to discontinue drilling and allow the borehole to stand over night to allow water to enter the boring. Wells may be drilled up to 100 feet below the target depth to find water. Additional borehole geophysical logging may be performed to help identify water-bearing zones, in the event that water is encountered. More detail regarding the identification of screen intervals is provided in SOP No. 3, Monitoring Well Installation and SOP No. 13, Borehole Geophysical Logging.

The bedrock water table wells will be completed with 20-foot long factory slotted PVC well screens. The screens will be placed across water-bearing intervals. Bedrock water table wells will be constructed of Schedule 40 PVC. Additional well construction details are presented in SOP No. 3, Monitoring Well Installation.

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2.9.1.3 Bedrock Wells Deep Below the Water Table

Three deep bedrock wells (MWP3-02, MWP4-02, and MWDB-01) are proposed for the Phase 2A/1B RI/FS field program. Deep bedrock wells will be installed to provide information related to: (1) vertical hydraulic gradients within bedrock and; (2) groundwater quality in deep bedrock flow paths. These wells will be initially drilled to the target depths identified in Table A-2 of this SAP. Water may be encountered in a boring before a target zone is reached. Because a column of water from fractures shallower than the target zone may be present in the boring, it may not be possible to identify deeper water-bearing zones based on observations of water inflow to the borehole. Therefore, borehole geophysical logging (Section 2.8) will be performed to aid in identification of deeper bedrock water-bearing zones. If no discernable fractures or other evidence of deep water-bearing zones are observed, the boring will be drilled deeper, to a maximum depth of 100 feet greater than the target depth. Additional borehole geophysical logging will then be performed to attempt to identify water-bearing zones. More detail regarding the identification of screen intervals is provided in SOP No. 3, Monitoring Well Installation and SOP No. 13, Borehole Geophysical Logging.

The deep bedrock wells will be completed with 20-foot long factory slotted PVC well screens. The screens will be placed across water-bearing intervals. The deep bedrock wells will be constructed of Schedule 80 PVC. Additional well construction details are presented in SOP No. 3, Monitoring Well Installation.

2.9.2 Well Development

Following installation of monitoring wells, the new wells will be developed to remove any potable water introduced to the well during construction and to allow future collection of groundwater samples that are representative of the screened water-bearing zone. Well development will be conducted in accordance with SOP No. 4, Monitoring Well Development. Prior to initiating the development process, a grab sample of the water in the well will be collected and tested for field parameters as described in SOP No. 7, Field Parameter Measurements. Additional grab samples will be collected throughout well development and field parameter measurements will be made until the well has been successfully developed. The well will be considered successfully developed when they meet the criteria for consistency described in SOP No. 4.

The well development process will be documented in field logbooks and on the well development log. An example log is provided in Appendix C.

Any downhole equipment used during the well development process will be decontaminated as described in SOP No. 10, Decontamination. Purge water and other IDW generated during well development will be containerized and managed as described in Section 2.17.

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2.10 Geotechnical Test Hole Drilling and Piezometer Installation

Nine geotechnical test holes will be drilled in the MA; 6 in the South Spoils and 3 in the Hillside Dump. The South Spoils and Hillside Dump slopes may become unstable over time, particularly under the weight of cover material if a cover is constructed. Therefore, an assessment of waste rock pile stability is necessary for the FS. The purpose of the geotechnical test holes and piezometers is to allow collection of subsurface material samples for geotechnical testing, and to allow measurement of phreatic surface levels within the stockpiles.

Locations of geotechnical test holes are shown on Figure A.7-5 of the Phase 2A/1B QAPP. The target depths of the test holes are shown on Table A-2 of this SAP. The test holes will be drilled in accordance with SOP No. 17, Geotechnical Investigation.

The test holes will be drilled using a Becker hammer drill rig or equivalent. Samples of subsurface material will be submitted to a geotechnical laboratory for testing by standard ASTM methods.

Drilling procedures are described in SOP No. 1, Drilling and Sampling of Subsurface materials and SOP No. 17, Geotechnical Investigation. Each of the borings will be visually logged and documented in field logbooks by a rig geologist or engineer in accordance with SOP No. 2, Borehole Logging. An example of the boring log form is provided in Appendix C of the Phase 2A/1B QAPP.

Following drilling and sample collection, each test hole will be completed as a piezometer for water level measurement. The piezometers will consist of 1-inch Schedule 40 PVC, with 15 to 20-foot screen intervals. The piezometers will be constructed in accordance with SOP No. 17, Geotechnical Investigation.

Piezometer construction information will be documented in field logbooks and on well construction logs. Piezometer locations and elevations will be surveyed. The survey will include measurement of the location northing and easting coordinates in the State Plane coordinate system, as well as the ground surface and top of piezometer casing elevations. The top of the piezometer casing will be surveyed on the north side of the well. This point will serve as the measuring point for subsequent water level measurements and will be clearly marked to facilitate consistency in depth to water measurements.

Following piezometer installation, water level measurements will be recorded for each piezometer. Water levels will be measured in accordance with SOP No. 5, Monitoring Well Water-Level Measurement.

All geotechnical samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be tested by the geotechnical test methods shown on Table A-10 of this SAP. The geotechnical test methods and sample containers are presented in Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of test hole drilling and geotechnical sample collection will be recorded in field logbooks.

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2.11 Geotechnical Test Pit Excavation

Nine geotechnical test pits will be excavated; 6 in the South Spoils and 3 in the Hillside Dump at locations adjacent to the geotechnical test holes. The purpose of the geotechnical test pits is support the assessment of stockpile stability by allowing observation of stockpile materials and collection of subsurface material samples for geotechnical testing.

The test pits will be excavated at the approximate locations shown on Figure A.7-5 of the Phase 2A/1B QAPP. The test holes will be excavated in accordance with SOP No. 17, Geotechnical Investigation.

The test pits will be excavated using a tracked backhoe or dozer. Bulk subsurface material samples will be collected using a shovel. Samples will either be collected at discrete depths or as composite samples over a vertical interval. Bulk samples will be tested for a suite of geotechnical tests (Table A-10). Field tests (inplace density measurement, i.e., sand cone density) will also be performed.

Following excavation and sample collection, the test pits will be backfilled with the excavated material.

All geotechnical samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be tested by the geotechnical test methods shown on Table A-10 of this SAP. The geotechnical test methods and sample containers are presented in Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of test pit excavation and geotechnical sample collection will be recorded in field logbooks. The locations and ground surface elevations of test pits will be surveyed in accordance with SOP No. 14, GPS surveying.

2.12 Groundwater Sampling

As part of the Phase 2A/1B RI/FS field investigation, groundwater samples will be collected from the 6 new monitoring wells and from 19 existing background monitoring wells. Sampling locations and analytical parameters for groundwater samples are listed on Table A-3 of this SAP. Groundwater sampling locations are presented in Figures A.7-1, A.7-3, and A.7-4 of the Phase 2A/1B QAPP.

As described in Section 2.13 and SOP No. 5, Monitoring Well Water-Level Measurement, the static water level in monitoring wells will be measured prior to sampling or other activities that could potentially affect the water level. Purging of well water will then be conducted to remove well bore storage so that groundwater samples are representative of the screened formation. Procedures for well purging are described in SOP No. 6, Groundwater Sampling.

Well purging will be performed using a stainless steel/Teflon submersible pump capable of low and higher flow rates or a bailer. An in-line multi-parameter measurement device will be installed in the tubing connected to the pump. Field parameter measurements will be taken during the purging process (SOP No. 7, Field Parameter Measurements). Well purging will be attempted at a low flow rate (0.5

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liters/minute). Water level measurements will be taken during the purging process to observe any water level changes that occur. If the water level does not drop significantly (i.e., more than 0.1 meters [0.3 feet]) due to low-flow purging, purging of the well will continue at the low flow rate until field parameter (pH, specific conductance, turbidity, and temperature) stabilization is achieved (per SOP No. 7). If the water level drops significantly from the initial static level at the 0.5 l/minute flow rate, the pump rate should be reduced, but no lower than 0.1 l/minute (EPA, 1996). If the stress (drawdown) on the well continues, low flow well purging will be discontinued and the well will be purged at a higher pumping rate or using the bailing method. Pumping at the higher flow rate may result in pumping the well dry. If this occurs, the well should be sampled when the well has recharged sufficiently to collect the sample. Otherwise, the well should be purged until field parameter stabilization is achieved.

Following well purging, field parameters representative of the groundwater sample to be collected will be measured and recorded. Certain field parameters (Eh, pH, specific conductance, dissolved oxygen, and temperature, as applicable) will be measured using the in-line multi-parameter device. The remaining field parameters (ferrous iron, turbidity, as applicable) will be measured in a grab sample.

Groundwater samples will then be collected in accordance with SOP No. 6 Groundwater Sampling. The samples will be collected using low flow pumps constructed of stainless steel and teflon or a bailer. Filtered and unfiltered samples will be collected.

Samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and submitted to an analytical laboratory for analysis. Analytical requirements, listed by chemical group, for groundwater samples are presented in Table A-3 of this SAP. It should be noted that the groundwater samples collected from the MA wells and Blue Creek well will be analyzed for an abbreviated suite of indicator parameters indicative of site-related contamination.

Specific analytical parameters, analytical methods, sample containers, and preservatives for each chemical group are presented in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Table B.4.3-1-P2 of the Phase 2A/1B QAPP. The details of each groundwater sampling event will be recorded in field logbooks and groundwater sample field data sheets. An example field data sheet is provided in Appendix C.

Decontamination of any non-dedicated sampling equipment will be performed as described in SOP No. 10, Decontamination. To the degree possible, dedicated sampling equipment (e.g., tubing) will be used to minimize the need for equipment decontamination and potential for cross-contamination of wells. Wash water from decontamination, purge water, and any other waste water will be managed as described in Section 2.17.

2.13 Groundwater Level Measurement

Depth to water will be measured in borings during drilling, and in all monitoring wells as part of each groundwater sampling event and during site-wide rounds of groundwater level measurements. During

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groundwater sampling events, depth to water measurements shall be made prior to any well purging or sampling activities that may affect the static water level.

The water levels will be measured at all new and existing monitoring well locations in the MA, PIA and background areas. Water level measurements should be completed within a period of no more than one week. The water level data will be used to evaluate hydraulic gradients and for development of potentiometric surface maps. The water level measurements will be recorded in field logbooks and on water level measurement forms. An example form is included in Appendix C of the QAPP.

Water level measurements will be taken and recorded in accordance with SOP No. 5, Monitoring Well Water-Level Measurements. The recorded depth to water values will be subtracted from surveyed measuring point elevations to calculate the groundwater elevations. The depth to water values will be recorded in field logbooks, boring logs, and groundwater sampling field sheets, as applicable.

During measurement of the new Blue Creek monitoring well (MWBC-01), a field measurement of the creek level relative to the groundwater level will be recorded. To facilitate this, the creek bank will be surveyed for elevation when the well is surveyed.

It is important for measured water levels to be representative of static conditions in the monitoring wells. Sufficient time should be given to allow water levels in new monitoring wells to stabilize following development or other activities.

2.14 Surface Water and Sediment Sampling

Surface water (if present) and sediment will be collected from Pit 3 and Pit 4, one location down stream of the east haul road, and in background areas. Sediment will also be collected in the PIA to verify Phase 1A results where contamination was detected, and to supplement the PIA sediment sampling program by collecting additional riparian area sediment samples.

2.14.1 Open Pit Surface Water and Sediment Sampling

Samples of surface water (if present) and sediment will be collected from each of Pits 3 and 4. The purpose of the sampling is to support the human health and ecological risk assessments. Locations of the open pit surface water and sediment samples are shown on Figure A.7-1 of the Phase 2A/1B QAPP. Section A.7 of the Phase 2A/1B QAPP discusses the rationale for the selected locations. Samples will be collected from near the bottom of the open pits (if water is absent), or from near the point where the pit haul roads enter the pit lakes (if water is present).

Open pit surface water and sediment samples will be collected in accordance with SOP No. 8, Surface Water Sampling and SOP No. 9, Sediment Sampling, as revised for this Phase 2A/1B QAPP. The open pit surface water samples (SWP3-01 and SWP3-02) will be collected as grab samples. The sediment samples (SDP3-01 and SDP4-01) will be collected as multi-increment composite samples

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with each increment being collected over a vertical interval from the top of the sediment to 20 cm in depth so as to ensure comparability of investigation and background sediment samples.

2.14.2 East Haul Road Surface Water and Sediment Sampling

Samples of surface water (if present) and sediment will be collected from a drainage south and west of the east haul road (Figure A.7-3 of the Phase 2A/1B QAPP). This portion of the drainage may have been affected by runoff of mine materials used to cover the haul road. The purpose of the sampling is to support the human health and ecological risk assessments.

The surface water (SWEHR-01) and sediment (SDEHR-01) samples will be collected in accordance with SOP No. 8, Surface Water Sampling and SOP No. 9, Sediment Sampling, as revised for this Phase 2A/1B QAPP. The surface water sample will be collected as a grab sample if water is present. The sediment sample will be collected as a six-increment composite sample with each increment being collected over a vertical interval from the top of the sediment to 20 cm in depth so as to ensure comparability with background sediment samples.

All surface water and sediment samples will be handled as described Section 3.0 and SOP No. 11, Sampling Handling, Shipping, and Documentation, and will be analyzed for the constituents listed on Tables A-4 and A-5 of this SAP, respectively. Filtered and unfiltered surface water samples will be collected. Measurements of surface water field parameters will be performed in accordance with SOP No. 7, Field Parameter Measurements. If flowing water is present, discharge measurements will be made in accordance with SOP No. 12, Surface Water Discharge in Streams and Seeps. Specific analytical parameters, analytical methods, sample containers and preservatives for each chemical group are presented in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

2.14.3 Background Surface Water and Sediment Sampling

Based on statistical comparison, the Phase 1A background surface water results for Rounds 1 (fall 1999) and 2 (spring 2000) appear to represent significantly different statistical populations. Therefore, Phase 1B collection of additional surface water samples in the fall of 2000 is necessary to better characterize background concentration limits.

All background surface water stations (SWBK-01 through SWBK-24 and SWNW-01 through SWNW-03) where water is present will be sampled. The sampling stations are shown on Figure A.7-3 of the Phase 2A/1B QAPP. Surface water samples will be collected in accordance with SOP No. 8, Surface Water Sampling. The surface water samples will be collected as grab samples.

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Four new background sediment stations (SDBK-17 through SDBK-19 and SDBK-23) will be sampled to supplement the existing background sediment populations with additional riparian area samples. The sampling stations are shown on Figure A.7-3 of the Phase 2A/1B QAPP.

The sediment samples will be collected in accordance with SOP No. 9, Sediment Sampling, as revised for this Phase 2A/1B QAPP. Both composite and grab samples will be collected at each of these new background sediment sample locations. The composite sediment samples will be collected as six-increment composite samples with each increment being collected over a vertical interval from the top of the sediment to 20 cm in depth so as to ensure comparability with investigation sediment samples. The grab samples will be collected over a vertical interval of 0 to 10 cm in depth.

2.14.4 PIA Sediment Samples

Per the Phase 1A QAPP, selected sediment stations where PCOCs were detected in Phase 1A samples will be resampled to verify the detected PCOC concentrations. A total of 7 PIA sediment stations sampled in Phase 1A (SDND-01; SDNE-01 and SDNE-02; SDED-02, SDED-03, and SDED-06; and SDSW-01) will be resampled in Phase 1B. The locations of the Phase 1B verification samples are shown on Figure A.7-4 of the Phase 2A/1B QAPP.

To support the human health and ecological risk assessments, additional sediment samples will be collected in PIA riparian areas. These additional samples (RSWD-01 through RSWD-03, RSCD-01 and RSCD-02, RSED-01 through RSED-03, and RSBC-01 through RSBC-05) are necessary to more fully represent fine-grained riparian sediments in the sediment population used for risk assessment. The locations of the Phase 1B riparian area samples are shown on Figure A.7-4 of the Phase 2A/1B QAPP. Ten of the PIA riparian sediment sampling locations were randomly selected from grid patterns superimposed on Blue Creek and the PIA drainages south of the MA. Three other locations were selected to be at groundwater discharge areas.

The PIA sediment samples will be collected in accordance with SOP No. 9, Sediment Sampling, as revised for this Phase 2A/1B QAPP. The sediment samples will be collected as six-increment composite samples with each increment being collected over a vertical interval from the top of the sediment to 20 cm in depth so as to ensure comparability with background sediment samples.

All surface water and sediment samples will be handled as described in Section 3.0 and SOP No. 11, Sample Handling, Shipping, and Documentation, and will be analyzed for the constituents listed on Tables A-4 and A-5 of this SAP, respectively. Filtered and unfiltered surface water samples will be collected. Measurements of surface water field parameters (pH, specific conductance, turbidity, Eh, ferrous iron, temperature, and dissolved oxygen) will be performed in accordance with SOP No. 7, Field Parameter Measurements. If flowing water is present, discharge measurements will be made in accordance with SOP No. 12, Surface Water Discharge in Streams and Seeps. Specific analytical parameters, analytical methods, sample containers and preservatives for each chemical group are

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presented in Tables B.4.4-2a-P2 through B.4.4-2h-P2 and Table B.4.3-1-P2 of the Phase 2A/1B QAPP.

The details of surface water and sediment sampling will be recorded in field logbooks and surface water/sediment sampling field data sheets. Example field data sheets are provided in Appendix C of this Phase 2A/1B QAPP.

Decontamination of sampling equipment used in surface water or sediment sampling activities will be performed as described in SOP No. 10, Decontamination.

Wash water from decontamination, and any other IDW will be managed as described in Section 2.17.

The approximate locations of new surface water and sediment sampling stations will be surveyed in accordance with SOP No. 14, GPS surveying.

2.15 Slug Testing

It is anticipated that the FS will consider remedial action alternatives for the existing groundwater contamination in the PIA south of the MA. Groundwater modeling to predict contaminant movement and changes in contaminant concentrations over time in the shallow groundwater system south of the MA is expected to be necessary. The hydraulic conductivity of the alluvium along the drainages is a key parameter in developing a credible model of contaminant movement.

To estimate alluvial aquifer hydraulic conductivity, slug testing will be performed in ten alluvial monitoring wells located in the Western, Central, and Eastern Drainages south and east of the MA and the new Blue Creek alluvial well. The proposed slug testing locations are shown on Figures A.7-4 and A.7-5 of the Phase 2A/1B QAPP. Slug testing and data analysis will be performed in accordance with SOP No. 16, Slug Testing.

2.16 Decontamination

Decontamination of personnel, sampling equipment, and heavy equipment will be performed during data collection activities for the following purposes:

- Personnel health and safety
- Minimization of cross-contamination of samples and environmental media
- Minimization of migration of contamination to off-site areas

A personnel decontamination facility will be constructed at the site. Personnel will follow procedures for individual decontamination described in SOP No. 10, Decontamination. Use of personal protective equipment (PPE) is described in the Health and Safety Plan. Disposal of used PPE is described in Section 2.17.

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Sampling equipment and downhole equipment (e.g., augers, bailers, pumps) will require decontamination between sample locations. If multiple water samples are collected at individual sample locations, sampling equipment will be decontaminated between samples. Procedures for equipment decontamination are presented in SOP No. 10, Decontamination.

Vehicles and heavy equipment, such as drilling rigs, will be decontaminated at the decontamination facility. Procedures for heavy equipment decontamination are presented in SOP No. 10, Decontamination.

The effectiveness of decontamination procedures will be checked by frisking personnel, sampling equipment, and heavy equipment with a thin window Geiger-Muller detector. Procedures for use of the detector are described in the Health and Safety Plan. The decontamination and frisking procedures will be documented in field logbooks.

2.17 Management of Investigation Derived Waste

IDW generated during the field investigation is expected to include:

- Used PPE and other non-soil solid wastes
- Wash and rinse water from decontamination activities
- Soil cuttings and other soil wastes generated during sampling
- Well development and purged water

The plan for managing used PPE and other non-soil solid waste generated during field activities (e.g., sample handling) is to collect it in plastic trash bags, transport the waste from the Midnite Mine, and dispose of it at the Spokane Waste Energy Plant.

Waste water IDW that is generated and containerized at sample locations will be transported to Pit 3 and disposed of in the pit lake. Disposal of IDW waste water into the pit lake will occur after collection of the surface water sample from the lake (Section 2.14.1). To address concerns raised by Dawn Mining Company (DMC) during the Phase 1 field work regarding soapy IDW water entering the water treatment plant intake, URS and DMC agreed that IDW waste water will be disposed immediately south of the pit lake into a drainage leading to the pit.

Waste soil cuttings and chips generated during drilling operations and other field activities will be drummed or contained in other suitable containers. The waste soil drums will be transported from drilling locations, and emptied on the edge of selected existing waste rock or ore stockpiles. The wastes will be dumped in locations where storm runoff flows toward open pit lakes or other locations that will control flow. The wastes will not be dumped in locations from which runoff and suspended sediment can migrate off-site. The suitable location(s) for disposal of soil and rock cuttings will be specified by the URS Field Manager.

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2.18 Surveying

Global positioning system (GPS) surveying and conventional land surveying methods will be used to survey monitoring well and sampling locations. One or more base stations may be set up to improve the accuracy of GPS survey measurements due to the remoteness of some locations to be surveyed. The GPS surveying will be performed in accordance with SOP No. 14, GPS Surveying. The SOP is a general discussion of methods and surveying criteria. It is anticipated that the surveying will be performed by an experienced contractor that is knowledgeable of specific GPS surveying techniques. The contractor will be a licensed surveyor in the State of Washington. It is anticipated that the surveying method selection will be based on conditions encountered in the field and accuracy requirements.

Northing and easting coordinates will be reported in the Washington State Plane North Zone NAD27 Coordinate System. Elevations will be reported in the NAVD88 system (using Geoid 96 derived elevations for GPS surveying).

2.19 Demobilization

Demobilization will involve the following:

- Dismantling and removal of temporary structures (e.g., field trailer) and associated utilities (electrical power)
- Completion of field documentation
- Final shipping of samples
- Decontamination of site-dedicated vehicles and other equipment to be removed from the site
- Return of equipment and supplies
- Clean-up of any areas that may be disturbed by field investigation activities
- Departure from the site

3.0 SAMPLE MANAGEMENT

Investigation and background samples will be collected and submitted to analytical laboratories as part of the Phase 2A/1B RI/FS field investigation. Analytical methods, sample containers and preservatives are listed in Table B.4.3-1-P2 in the Phase 2A/1B QAPP. Procedures for handling, shipping, and documentation of samples are described in SOP No. 11, Sample Handling, Shipping, and Documentation. The SOP describes chain-of-custody, sample labeling, and sample cooler packing and labeling procedures. Example chain-of-custody forms, sample labels, and sample cooler labels are provided in Appendix C of the QAPP.

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Following sample collection, sample containers will be radiologically screened and decontaminated, if necessary, prior to preparing the sample for shipment. The radiological screening process is described in the project Health and Safety Plan. The decontamination process is described in SOP No. 10, Decontamination.

Each sample will be assigned a unique field sample number so that no ambiguity exists in associating sample locations and dates to field measurements and laboratory sample results. The field sample number is the single designation to which laboratory sample analysis results are related. Field crews will be provided with field sample numbers for their planned sampling activities (on pre-printed labels, if possible). QA/QC samples will also be assigned unique field sample numbers.

Field data and investigation activities, including field sample numbers, field parameter measurements, and numerous other types of information will be documented as described in the following section.

4.0 FIELD DOCUMENTATION

Field documentation will be performed for the following purposes:

- To track samples
- To associate sample location ID numbers with locations, dates and other sampling event data
- To track the status and completeness of field tasks
- To maintain complete records of sample events and measurements
- To facilitate electronic data entry of field data
- To document the reliability of field instruments
- To provide a written record that can be used to reconstruct field events
- To provide a written record of sample collection, shipment, and custody

Field documentation will include the recording of field events and data in project logbooks, field forms, and completion of chain-of-custody records. Sample locations may be further documented by taking photographs. The procedure for logging photographs to assure that the photographs are recorded properly is described in SOP No. 11, Sample Handling, Shipping, and Documentation.

The documentation of field data will be used as the primary source of information for the creation of the project database. The field data will be combined with analytical results from laboratories to complete data records. The field data will be the source of information that links the analytical records to the sampling locations and events. Field documents are also the original records of measurements and events. Therefore, it is critical that the field events are recorded accurately and completely.

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Field personnel will document all aspects of the investigation activities in project logbooks. The logbook documentation will be the key record of field activities. Complete and accurate descriptions of the field activities are critical to the success of the project. Project logbooks should include the following information:

- Date
- Time
- Location
- Weather conditions
- Task
- Level of personal protection
- Personnel present including work crew members and visitors
- Record of events, procedures, and measurements
- Deviations from SOPs (Refer to requirements described in the Phase 1A or Phase 2A/1B QAPP)

Field forms will also be used to record field events. Various field forms and their use were introduced in Section 2.0 of this SAP. The purpose of the field forms described in Section 2.0 is to give guidance to field personnel in collection of field data and to create a complete record of the sampling and field measurement events. A list of these forms is provided below:

- Daily quality control report
- Field audit form
- Boring log
- Well construction log
- Well development log
- Monitoring well low-flow purging and sampling form
- Record of external gamma radiation survey
- Record of deployment and retrieval of radon flux samples
- Record of deployment and retrieval of airborne radon samples
- Groundwater field data sheet
- Surface material field data sheet
- Surface water field data sheet

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- Sediment sample collection form
- Water level measurement form
- Slug testing form

The daily quality control report form is used to summarize field events, and will be filled out daily and submitted to the URS Field Manager. The boring log form will be used as a guide for creating boring logs in project logbooks. The well construction log and well development log will be completed for each well. The low-flow purging and sampling log may be filled out at the URS Field Manager's discretion. The groundwater sampling, and surface water and sediment field data sheets should be used as checklists to ensure that all relevant data are recorded in logbooks. These forms may be filled out at the URS Field Manager's discretion. All water level measurements from wells will be recorded on the water level measurement form.

5.0 REFERENCES

EPA. 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures. EPA/540/S-95/504.

Shepherd Miller, Inc. (SMI). 1998. Work Plan for the Midnite Mine. Prepared for Dawn Mining Company. September 28.

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Table A-1

PHASE 2A/1B RI/FS PIA WELL INSTALLATION LOCATIONS

Location Cross-Reference	Site ID	Target Total Depth (ft-bgs)	Target Zone
MWBC-01	Blue Creek	50	Water Table

Table A-2

PHASE 2A RI/FS MA WELL AND PIEZOMETER INSTALLATION LOCATIONS

Location Cross-Reference	Site ID	Target Total Depth (ft-bgs)	Target Zone
Monitor Wells			
MWP3-01	Pit 3	150	Water Table (Bedrock)
MWP3-02	Pit 3	300	Deep Bedrock
MWP4-02	Pit 4	300	Deep Bedrock
MWHD-01	Hillside Dump	150	Water Table (Bedrock)
MWDB-01	South Spoils	300	Deep Bedrock
Geotechnical Test Hole Piezometers			
THSS-01	South Spoils	150	Water Table (Stockpile)
THSS-02	South Spoils	150	Water Table (Stockpile)
THSS-03	South Spoils	150	Water Table (Stockpile)
THSS-04	South Spoils	150	Water Table (Stockpile)
THSS-05	South Spoils	150	Water Table (Stockpile)
THSS-06	South Spoils	150	Water Table (Stockpile)
THHD-01	Hillside Dump	150	Water Table (Stockpile)
THHD-02	Hillside Dump	150	Water Table (Stockpile)
THHD-03	Hillside Dump	150	Water Table (Stockpile)

**Table A-3
PHASE 2A/1B GROUNDWATER SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type																					
		Total Metals	Dissolved Metals	Anions	pH (field)	Temperature	Specific conductance (field)	Eh (field)	Turbidity (field)	Dissolved Oxygen (field)	Ferrous Iron (field)	COD	Isotopic Uranium (U234, U235, U238)	Rn222	Phosphorus	Ammonia	TSS	TDS	Alkalinity	Hardness		
MWNW-06	BK GW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MWBC-01	PIA GW		X	X	X	X	X		X				X	X					X			
MWP3-01	MA GW		X	X	X	X	X		X				X	X					X			
MWP3-02	MA GW		X	X	X	X	X		X				X	X					X			
MWP4-02	MA GW		X	X	X	X	X		X				X	X					X			
MWHD-01	MA GW		X	X	X	X	X		X				X	X					X			
MWDB-01	MA GW		X	X	X	X	X		X				X	X					X			

**Table A-5
PHASE 2A/1B SEDIMENT SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type																				
		Metals	Mercury	Anions	Carbonate/Bicarbonate	Paste pH	TOC	Grain Size Distribution	U234, U235, U238	Th227, Th228, Th230, Th232	Ra226	Ra228	Po210	Po210	Ammonia	Total Phosphorus	Ortho-Phosphate	Cation Exchange Capacity	Gravimetric Clay Content	Exchangeable Bases	Soluble/Exchangeable Phosphorous
SDBK-17	BK SED (GRAB)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDBK-17	BK SED (COMP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDBK-18	BK SED (GRAB)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDBK-18	BK SED (COMP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDBK-19	BK SED (COMP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SDBK-19	BK SED (GRAB)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SDBK-23	BK SED (GRAB)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDBK-23	BK SED (COMP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDP3-01	MA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDP4-01	MA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDND-01	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDNE-01	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDNE-02	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDED-02	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDED-03	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
SDED-06	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				

**Table A-5
PHASE 2A/1B SEDIMENT SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Metals	Mercury	Anions	Carbonate/Bicarbonate	Paste pH	TOC	Grain Size Distribution	U234, U235, U238	Th227, Th228, Th230, Th232	Ra226	Ra228	Pa231	Pb210	Po210	Ammonia	Total Phosphorus	Ortho-Phosphorus	Cation Exchange Capacity	Gravimetric Clay Content	Exchangeable Bases	Soluble/Exchangeable Grain Size Dist.	Exchangeable Phosphorous	Metals	
RSBC-04	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
RSBC-05	PIA SED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								

Note: Composite samples will be collected unless otherwise indicated. PIA sediment samples will be submitted to the analytical laboratory for the full radionuclide decay series. Based on a comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210, and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanometry), and Ra228 may be cancelled (see Section A.7.2.2.4 of the Phase 2A/1B QAPP). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231. One grab sample and one composite sample will be collected and analyzed at background sediment sample locations SDBK-17, -18, -19 and -23.

**Table A-6
AIRBORNE RADON MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Radon Track Count
ARP3-01	MA AIRBORNE RADON	X
ARP4-01	MA AIRBORNE RADON	X
ARMA-01	MA AIRBORNE RADON	X
ARMA-02	MA AIRBORNE RADON	X
ARMA-03	MA AIRBORNE RADON	X
ARMA-04	MA AIRBORNE RADON	X
ARMA-05	MA AIRBORNE RADON	X
ARMA-06	MA AIRBORNE RADON	X
ARMA-07	MA AIRBORNE RADON	X
ARMA-08	MA AIRBORNE RADON	X
ARMA-09	MA AIRBORNE RADON	X
ARMA-10	MA AIRBORNE RADON	X
ARMA-11	MA AIRBORNE RADON	X
ARMA-12	MA AIRBORNE RADON	X
ARMA-13	MA AIRBORNE RADON	X
ARMA-14	MA AIRBORNE RADON	X
ARMA-15	MA AIRBORNE RADON	X
ARMA-16	MA AIRBORNE RADON	X

Table A-6
AIRBORNE RADON MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS

Location Cross Reference	Sample Type	Radon Track Count
AREHR-01	PIA AIRBORNE RADON	X
ARWHR-01	PIA AIRBORNE RADON	X
ARDWSW-01	PIA AIRBORNE RADON	X
ARDWNE-01	PIA AIRBORNE RADON	X
ARBKMIN-01	BK AIRBORNE RADON	X
ARBKMIN-02	BK AIRBORNE RADON	X
ARBKMIN-03	BK AIRBORNE RADON	X
ARBKMIN-04	BK AIRBORNE RADON	X
ARBKMIN-05	BK AIRBORNE RADON	X
ARBKMIN-06	BK AIRBORNE RADON	X
ARBKMIN-07	BK AIRBORNE RADON	X
ARBKMIN-08	BK AIRBORNE RADON	X
ARBKMIN-09	BK AIRBORNE RADON	X
ARBKNON-01	BK AIRBORNE RADON	X
ARBKNON-02	BK AIRBORNE RADON	X
ARBKNON-03	BK AIRBORNE RADON	X
ARBKNON-04	BK AIRBORNE RADON	X
ARBKNON-05	BK AIRBORNE RADON	X

Table A-6
AIRBORNE RADON MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS

Location Cross Reference	Sample Type	<i>Radon Track Count</i>
ARBKNON-06	BK AIRBORNE RADON	X
ARBKNON-07	BK AIRBORNE RADON	X
ARBKNON-08	BK AIRBORNE RADON	X
ARBKNON-09	BK AIRBORNE RADON	X

**Table A-7
RADON FLUX MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Radon Indicator Parameters
RFSP-01	MA RADON FLUX	X
RFSP-02	MA RADON FLUX	X
RFSP-03	MA RADON FLUX	X
RFSP-04	MA RADON FLUX	X
RFSP-05	MA RADON FLUX	X
RFSP-06	MA RADON FLUX	X
RFSP-07	MA RADON FLUX	X
RFSP-08	MA RADON FLUX	X
RFSP-09	MA RADON FLUX	X
RFSP-10	MA RADON FLUX	X
RFSP-11	MA RADON FLUX	X
RFSP-12	MA RADON FLUX	X
RFSP-13	MA RADON FLUX	X
RFSP-14	MA RADON FLUX	X
RFSP-15	MA RADON FLUX	X
RFSP-16	MA RADON FLUX	X
RFSP-17	MA RADON FLUX	X
RFSP-18	MA RADON FLUX	X
RFWR-01	MA RADON FLUX	X
RFWR-02	MA RADON FLUX	X

Table A-7
RADON FLUX MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS

Location Cross Reference	Sample Type	Radon Indicator Parameters
RFWR-03	MA RADON FLUX	X
RFWR-04	MA RADON FLUX	X
RFWR-05	MA RADON FLUX	X
RFWR-06	MA RADON FLUX	X
RFWR-07	MA RADON FLUX	X
RFWR-08	MA RADON FLUX	X
RFWR-09	MA RADON FLUX	X
RFWR-10	MA RADON FLUX	X
RFWR-11	MA RADON FLUX	X
RFWR-12	MA RADON FLUX	X
RFWR-13	MA RADON FLUX	X
RFWR-14	MA RADON FLUX	X
RFWR-15	MA RADON FLUX	X
RFWR-16	MA RADON FLUX	X
RFWR-17	MA RADON FLUX	X
RFWR-18	MA RADON FLUX	X
RFDG-01	MA RADON FLUX	X
RFDG-02	MA RADON FLUX	X
RFDG-03	MA RADON FLUX	X
RFDG-04	MA RADON FLUX	X

Table A-7
RADON FLUX MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS

Location Cross Reference	Sample Type	Radon Indicator Parameters
RFDG-05	MA RADON FLUX	X
RFDG-06	MA RADON FLUX	X
RFDG-07	MA RADON FLUX	X
RFDG-08	MA RADON FLUX	X
RFDG-09	MA RADON FLUX	X
RFDG-10	MA RADON FLUX	X
RFDG-11	MA RADON FLUX	X
RFDG-12	MA RADON FLUX	X
RFDG-13	MA RADON FLUX	X
RFDG-14	MA RADON FLUX	X
RFDG-15	MA RADON FLUX	X
RFDG-16	MA RADON FLUX	X
RFDG-17	MA RADON FLUX	X
RFDG-18	MA RADON FLUX	X
RFBKMIN-01	BK RADON FLUX	X
RFBKMIN-02	BK RADON FLUX	X
RFBKMIN-03	BK RADON FLUX	X
RFBKMIN-04	BK RADON FLUX	X
RFBKMIN-05	BK RADON FLUX	X
RFBKMIN-06	BK RADON FLUX	X

Table A-7
RADON FLUX MEASUREMENT LOCATIONS
AND ANALYTICAL PARAMETERS

Location Cross Reference	Sample Type	Radon Indicator Parameters
RFBKMIN-07	BK RADON FLUX	X
RFBKMIN-08	BK RADON FLUX	X
RFBKMIN-09	BK RADON FLUX	X
RFBKNON-01	BK RADON FLUX	X
RFBKNON-02	BK RADON FLUX	X
RFBKNON-03	BK RADON FLUX	X
RFBKNON-04	BK RADON FLUX	X
RFBKNON-05	BK RADON FLUX	X
RFBKNON-06	BK RADON FLUX	X
RFBKNON-07	BK RADON FLUX	X
RFBKNON-08	BK RADON FLUX	X
RFBKNON-09	BK RADON FLUX	X

**Table A-8
 PHASE 2A/1B SURFACE MATERIAL SAMPLING LOCATIONS
 AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type
	Metals
	Mercury
	Anions
	Carbonate/Bicarbonate
	Paste pH
	TOC
	Grain Size Distribution
	U234, U235, U238
	Th227, Th228, Th230, Th232
	Ra226
	Ra228
	Pa231
	Pb210
	Po210
	Ammonia
	Total Phosphorous
	Ortho-Phosphate
	Radon Emanation Fraction

Note: PIA surface material samples will be submitted to the analytical laboratory for the full radionuclide decay series. Based on a comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210, and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanation), and Ra228 may be cancelled (see Section A.7.2.2.4 of the Phase 2A/1B QAPP). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231.

**Table A-9
PHASE 2A/1B SUBSURFACE MATERIAL SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Metals*	Moisture	Paste pH	TOC	U234, U235, U238*	Th227, Th228, Th230, Th232*	Ra226*	Ra228*	Pa231*	Pb210*	Po210*	Cation Exchange Capacity	Gravimetric Clay Content	Exchangeable Bases	Soluble/Exchangeable Phosphorous	Soluble/Exchangeable Metals
SSEHR-01	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSEHR-02	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-03	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-04	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-06	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-07	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-08	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSEHR-09	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSEHR-11	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSEHR-12	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSWHR-02	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSWHR-03	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSWHR-04	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSDWSW-01	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSDWSW-02	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSDWSW-03	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSDWSW-04	PIA Subsurface Material	X	X	X	X	X	X	X	X	X	X						

**Table A-9
PHASE 2A/1B SUBSURFACE MATERIAL SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Metals*	Moisture	Paste pH	TOC	U234, U235, U238*	Th227, Th228, Th230, Th232*	Ra226*	Ra228*	Po210*	Po210*	Cation Exchange Capacity	Gravimetric Clay Content	Exchangeable Bases	Soluble/Exchangeable Phosphorous	Soluble/Exchangeable Metals
SSBKMIN-07	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-08	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-09	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-10	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-11	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKMIN-12	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-13	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-14	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-15	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-16	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKMIN-17	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-18	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-19	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKMIN-20	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKNON-01	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKNON-02	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					
SSBKNON-03	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X					

**Table A-9
PHASE 2A/1B SUBSURFACE MATERIAL SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type	Metals*	Moisture	Paste pH	TOC	U234, U235, U238*	Th227, Th228, Th230, Th232*	Ra226*	Ra228*	Pa231*	Pb210*	Po210*	Cation Exchange Capacity	Gravimetric Clay Content	Exchangeable Clay Bases	Soluble/Exchangeable Phosphorous	Soluble/Exchangeable Metals
SSBKNON-04	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-05	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-06	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKNON-07	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-08	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-09	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-10	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-11	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKNON-12	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-13	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-14	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKNON-15	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-16	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSBKNON-17	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-18	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-19	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						
SSBKNON-20	BK Subsurface Material	X	X	X	X	X	X	X	X	X	X						

**Table A-9
PHASE 2A/1B SUBSURFACE MATERIAL SAMPLING LOCATIONS
AND ANALYTICAL PARAMETERS**

Location Cross Reference	Sample Type
	Metals*
	Moisture
	Paste pH
	TOC
	U234, U235, U238*
	Th227, Th228, Th230, Th232*
	Ra226*
	Ra228*
	Pa231*
	Pb210*
	Po210*
	Cation Exchange Capacity
	Gravimetric Clay Content
	Exchangeable Clay Bases
	Soluble/Exchangeable Bases
	Soluble/Exchangeable Phosphorous
	Soluble/Exchangeable Metals
	Grain Size Dist.

Note: PIA surface material samples will be submitted to the analytical laboratory for the full radionuclide decay series. Based on a comparison of gamma spectroscopy (by NAREL Method GAM-01), isotopic uranium, Pb210, and Po210 results to background values, the analyses for Th227, Th228, Th230, Th232, Ra226 (by de-emanation), and Ra228 may be cancelled (see Section A.7.2.2.4 of the Phase 2A/1B QAPP). NAREL Method GAM-01 includes the following isotopes relevant to this study: Ra226, Bi214, Pb214, and Pa231.

* Analyses not initially performed but may be performed following evaluation of surface material sample data.

Appendix B

Standard Operating Procedures

Appendix B

Standard Operating Procedures

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SOP Number 1	Drilling and Sampling of Subsurface Materials
SOP Number 2	Borehole Logging
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SOP Number 9	Sediment Sampling
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SOP NUMBER 1

Drilling and Sampling of Subsurface Materials

SOP NUMBER 2

Borehole Logging

SOP NUMBER 3

Monitoring Well Installation

SOP NUMBER 4

Monitoring Well Development

SOP NUMBER 5

Monitoring Well Water-Level Measurement

SOP NUMBER 6

Groundwater Sampling

SOP NUMBER 6

Groundwater Sampling

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SOP NUMBER 6

Groundwater Sampling

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to conduct groundwater sampling during the Remedial Investigation/Feasibility Study (RI/FS) at the Midnite Mine Site, Spokane Indian Reservation, Washington.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager has the overall responsibility for implementing this SOP. The Project Manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel.

All personnel performing these procedures are required to have appropriate health and safety training. In addition, all personnel are required to have complete understanding of the procedures described within this SOP and receive specified training regarding these procedures, if necessary.

3.0 RELATED STANDARD OPERATING PROCEDURES

This procedure is intended to be used with the following SOPs:

SOP No. 3	Monitoring Well Installation
SOP No. 5	Monitoring Well Water-Level Measurement
SOP No. 7	Field Parameter Measurements
SOP No. 10	Decontamination
SOP No. 11	Sample Handling, Shipping, and Documentation

4.0 EQUIPMENT NECESSARY FOR GROUNDWATER SAMPLING

The following items may be required to properly sample groundwater monitoring wells:

- Well completion logs
- Groundwater sampling forms (see Appendix C of the Quality Assurance Project Plan [QAPP])
- Well keys
- Sample collection supplies (e.g., appropriate laboratory-supplied sample containers, sample labels, cooler for sample storage, ice, etc.)
- Sample filtering supplies (e.g., hand or peristaltic pump, Tygon or silicon tubing, disposable 0.45-micron filters)

SOP NUMBER 6

Groundwater Sampling

- Stainless steel, adjustable rate, submersible pump, controller, and power source (generator or battery)
- Teflon or Teflon-lined polyethylene tubing
- Water quality meters for temperature, conductivity, pH and turbidity
- Plastic sheeting
- Decontamination equipment and supplies (see SOP No. 10 Decontamination)
- Personal protective equipment (PPE) as outlined in the Project Health and Safety Plan (HSP)
- Organic vapor detector (on wells scheduled for volatile organics analysis)
- Graduated cylinder and bucket for measuring flow rate and volumes
- Drums or other large container for capturing and storing purge water
- Water-level probe
- Weighted tape measure
- pH testing paper

5.0 GROUNDWATER SAMPLING PROCEDURES

This section gives procedures for well purging and collecting water samples using a submersible pump. Observations made during sample collection will be recorded in the field notebook and groundwater sample field data sheet. Groundwater samples will be collected for the laboratory chemical analyses described in the QAPP. The type and frequency of QA/QC samples is also specified in the QAPP.

All non-dedicated purging and sampling equipment coming in contact with well water will be decontaminated in accordance with SOP No. 10 Decontamination, before each well is sampled. If dedicated equipment is used, it should be rinsed with distilled or de-ionized water. Sampling equipment will be protected from the ground surface with clear plastic sheeting.

Before sampling any well for volatile organic compound (VOC) analysis, the headspace in the well will be measured using an organic vapor detector as described in the HSP.

Electronic equipment used during sampling includes pH, conductivity, and turbidity meters, and an electronic water-level indicator. Before going into the field, the sampler shall verify that all of these are operating properly and are properly calibrated before each day's use. Operation and calibration of field meters is discussed in SOP No. 7 Field Parameter Measurements.

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Groundwater Sampling

5.1 PURGING

The purpose of well, or borehole, purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled. Wells will be purged using the following low stress (low flow) purging procedure:

- Before starting purging activities, check well for security damage or evidence of tampering, record pertinent observations.
- Lay out sheet of clean polyethylene for monitoring and sampling equipment.
- Remove well cap and immediately measure VOCs at the rim of the well with a photo-ionization detector (PID) or flame-ionization detector (FID) instrument as described in the HSP.
- Measure the static water level. Measurement of the well depth should be performed 24 hours prior to purging and sampling activities in order to allow disturbed sediments to settle. If not measured the day before, well depth should be measured after sampling of the well is complete.
- Determine the appropriate depth for the submersible pump based on screen interval and measure required length of tubing. Teflon or Teflon-lined tubing should be used for wells where samples for semi-volatile compounds analysis will be performed. Tygon or silicon tubing can be used at other wells. Purging and sampling depth will be at the center of the screened interval in the well, or at the depth of greatest hydraulic conductivity within the screened interval and at least 2 feet above the bottom of the well. The depth of greatest hydraulic conductivity may be determined during drilling, from geophysical logging and well development logs.
- Slowly lower the pump, safety cable, tubing, and electrical lines into the well to the appropriate depth taking care not to disturb settled sediments.
- Before starting the pump, measure and record the water level.
- Start the pump at its lowest speed setting and slowly increase the speed until a steady discharge of 0.5 liters per minute (l/min) is achieved. This flow rate should be confirmed every three to five minutes at the time field parameters are measured.
- Determine water-level drawdown. If drawdown exceeds 0.1 meters (0.3 feet) at the 0.5 l/min flow rate, follow the instructions given in the final bullet of this section. If drawdown remains stable at the 0.5 l/min pumping rate, follow the succeeding steps and continue purging until indicator field parameters stabilize.
- Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate).
- During well purging, monitor field parameters pH, conductivity, temperature, and turbidity every three to five minutes. Refer to SOP No. 7 Field Parameter Measurements for operation and calibration procedures.

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Groundwater Sampling

- Purging is considered complete and sampling may begin when all the above field indicator parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three to five minute intervals, are within the following limits:
 - pH: +/- 0.2 units
 - Conductivity: +/- 10%
 - Temperature: +/- 10%
 - Turbidity: +/- 10% or less than 5 NTUs
- The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.
- If drawdown exceeds 0.1 meters at the 0.5 l/min pumping rate, purge water may not represent recharging formation water; instead, purge water may just represent dewatering of the stagnant borehole water. In this case, reduce the flow rate, but no lower than 0.1 l/min, to try and stabilize the water level. If the water level does not stabilize, purge the well dry either by pumping at a higher flow rate or with a bailer and sample as soon as the water level has recovered sufficiently to collect the required volume.

5.2 SAMPLING

Collect groundwater samples for chemical analyses immediately after or within two hours of purging. For slow recovering wells that are purged dry, the sample shall be collected immediately after sufficient volume is available.

Water samples that are not required to be field filtered can be collected by directly filling pre-preserved sample containers from the pump tubing discharge or teflon bailer. Alternatively, water samples can be collected into clean unpreserved sample containers which are then preserved. The tubing should be free of any air bubbles. VOC sample containers will be filled first. Fill sample containers by allowing the pump or bailer discharge to flow gently down the inside of the container with minimal turbulence. VOC sample containers should be filled completely so that water forms a convex meniscus at the top then capped such that no air space exists in the container. Fill sample bottles for parameters other than volatile organics to almost full and cap quickly.

Samples that require field filtering will be initially collected into clean, unpreserved sample containers. Samples will be filtered with a hand or peristaltic pump and 0.45 µm filter. The filter and filter unit will be rinsed with approximately 25 – 50 ml of sample before collection for chemical analysis. Filtered samples will be immediately preserved.

Check the pH of all samples (except those for VOC analyses) with pH testing paper. To test the pH, insert a decontaminated glass rod into the sample and remove it, then test the pH of the liquid drops that cling to the glass rod with pH paper.

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Groundwater Sampling

Measure field parameters specified in the SAP in accordance with procedures described in SOP No. 7, Field Parameter Measurements and record results.

If a flow-through-cell was used to measure field indicator parameters, water samples for laboratory analysis must be collected before water has passed through the cell. This may require disconnecting the flow-through cell before sampling.

Complete and attach sample labels and immediately place all samples in a cooler with ice. Samples for radiological analysis do not require ice. After collection of the samples, the pump tubing or bailer may either be dedicated to the well for resampling (by hanging the tubing or bailer inside the well or storing in labeled, clean plastic bags), decontaminated, or properly discarded.

Secure the well when sampling activities are complete.

6.0 DOCUMENTATION

The following groundwater sampling information will be recorded in field logbooks and on the Groundwater Sampling Form found in Appendix C of the QAPP.

- Well ID and location
- Sample ID number
- Depth of well (determined after sampling event)
- Depth to top and bottom of well screen
- Depth of pump intake
- Field personnel
- Purging device (pump type/model number)
- Clock time
- Water depth
- Pump dial setting
- Purge rate
- Cumulative volume purged
- pH, conductivity, temperature, and turbidity
- Any additional comments or observations

In addition, the Sample Collection Information log and Monitoring/Sample Location Information log (Appendix C) will be filled in by the samplers.

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Field Parameter Measurements

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Surface Water Sampling

1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) describes sampling equipment, sampling procedures, and documentation for collecting surface water samples from streams and seeps at and in the vicinity of the Midnite Mine Site. More than one sampling method may be required due to variable flow conditions at surface water collection locations. In consideration of these varied conditions, this SOP describes methods that are to be used based on site-specific flow conditions.

This SOP addresses the collection of ambient water quality samples. Sampling locations, sampling frequencies, and a list of analytes are specified in the Sampling and Analysis Plan (SAP).

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager has the overall responsibility for implementing this SOP. The Project Manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel.

All personnel performing these procedures are required to have the appropriate health and safety training. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP and receive specific training regarding these procedures, if necessary.

All project staff are responsible for reporting deviations from this SOP to the Project Manager.

3.0 RELATED STANDARD OPERATING PROCEDURES

Related SOPs cross-referenced by this SOP are as follows:

- SOP No. 10 Decontamination
- SOP No. 11 Sample Handling, Shipping, and Documentation.
- SOP No. 12 Surface Water Discharge in Streams and Seeps

4.0 EQUIPMENT NECESSARY FOR COLLECTING SURFACE WATER SAMPLES

4.1 GENERAL EQUIPMENT REQUIREMENTS

General equipment used for collecting surface water samples includes:

- Laboratory-provided sample containers
- Sample transfer devices
- Field logbook

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- Surface water data field sheets (Appendix C of QAPP)
- Stopwatch
- Plastic flagging
- Disposable latex gloves
- Appropriate health and safety equipment

Additional equipment for collecting filtered surface water samples includes:

- Beakers of assorted sizes
- Peristaltic pump and battery
- Tygon® or silicone tubing
- Disposable 0.45-micron filters

Equipment for sample handling and documentation includes:

- Sample labels
- Appropriate preservatives
- pH testing paper
- Chain-of-custody forms
- Clear plastic tape
- Fiber tape
- Custody seals
- Large (30 gallon) trash bag
- 1 Gallon Ziploc® freezer bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Shipping documentation

4.1.1 Laboratory-Provided Sample Containers

Wherever possible, laboratory-provided sample containers will be used to collect water quality samples. Alternatively, the containers may be purchased from a supplier who certifies that bottles have been pre-cleaned to EPA specifications. Records of container certification will be kept for these containers.

4.1.2 Sample Transfer Devices

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Beakers or dippers, composed of Teflon®, stainless steel or glass, may be used if site conditions or the use of pre-preserved sample containers prevent sampling by sample container immersion. The selected type of transfer device, the composition of this device, and the volume of the device will be recorded in the field notes.

5.0 SURFACE WATER COLLECTION METHODS

Surface water flow conditions vary geographically and seasonally. Therefore, the following list may be used as a guideline in identifying techniques of sampling which will correspond to the sample site flow conditions.

The flow conditions which have been most frequently encountered at the site, and sections of this SOP containing methods to be used at these sites, are:

1. Flowing, channelized streams:

Samples are to be collected by container immersion in accordance with Section 5.2, Stream Surface Water Sampling.

2. Spring and Seep Areas:

Samples are to be collected in accordance with Section 5.3, Sampling of Seeps or other Low Flow Conditions.

3. Low Flow Conditions:

Samples will be obtained in accordance with Section 5.3, Sampling of Seeps or other Low Flow Conditions.

4. Pits:

Samples will be obtained in accordance with Section 5.4, Pit Water Sampling Procedures.

Surface water samples are to be collected as grab samples. Grab samples characterize a medium at a particular point in space and time. Grab water samples are collected by sample container immersion or by using a transfer device, such as a beaker or dipper.

5.1 PROCEDURES

Samples will be collected from the same cross-section of the stream as that used for the discharge measurement (See SOP No. 12 Surface Water Discharge in Streams and Seeps). Always collect samples prior to making discharge measurements. Sediment samples will also be collected in the vicinity of some surface water sampling locations. Surface water sampling should also precede sediment sampling.

5.1.1 Sample Collected by Container Immersion

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Empty sample bottles that contain no preservatives may be used to collect surface water samples by container immersion. To collect samples by container immersion, submerge the sample bottle below the water surface with the opening pointed upstream at the midpoint of the stream flow. Minimize the disturbance of bottom materials and fill the container to the desired volume. Preserve the sample, if necessary (as specified in the QAPP), cap the container and decontaminate the container's outside surface. Check the pH of preserved samples.

The sample pH will be checked by removing the sample lid, inserting a decontaminated glass rod into the sample and removing it, and testing the liquid drops that cling to the glass rod with pH paper. Do not perform this check on samples for VOC analyses.

5.1.2 Sample Collected by Sample Transfer Device or Peristaltic Pump

If sample bottles are pre-preserved or site conditions prevent sample collection by container immersion, sample transfer devices or peristaltic pumps may be used for sample collection. The device is placed with the opening upstream at the midpoint of the stream flow. The sample will be poured directly from the beaker or dipper into the sample container. Alternatively, if a pump is used the water should be pumped directly into sample containers. The sampler will attempt to minimize the disturbance of bottom materials. Check the pH as described above.

5.2 STREAM AND HIGH-FLOW SEEP SAMPLING PROCEDURES

The following section describes procedures for collecting samples from surface water streams and high-flow seeps. Seeps will be considered high-flow if samples can easily be collected without significant disturbance of sediment and other material at the sample point. Low-flow seeps will be sampled as described in Section 5.3.

If surface water flow will subsequently be measured (see SOP No. 12 Surface Water Discharge in Streams and Seeps), collect samples at the cross-section of the stream that will be used to measure discharge. Always collect the samples for chemical analysis before measuring discharge.

Collect surface water samples as follows:

1. Obtain all necessary sample collection and filtering equipment.
2. Decontaminate non-disposable sampling equipment as specified in SOP No. 10 Decontamination.
3. Make sure that the sample labels have been filled out for the sampling location (if labels used).
4. Obtain bottles for filling.
5. Place labels on the sample bottles and secure the labels with clear plastic tape, or write required information directly on bottles.
6. Wear clean, disposable latex gloves at all times when collecting samples.

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7. Make sure that no activities are occurring or have recently occurred immediately upstream that would affect the integrity of the sample. Wade, if necessary, to the sample collection point (i.e., midpoint of the stream cross section) from a downstream location. To avoid disturbing stream sediments or otherwise contaminating samples, stand downstream of the location from which you collect. When collecting samples at successive locations, always proceed from downstream to upstream locations.
8. The open end of the sample bottle, sample transfer device, or pump tubing shall face upstream during stream sample collection.
9. Triple rinse the water collection device (e.g., beaker or dipper) with sample water, or pump 100 to 200 mL of sample water through tubing/filter to rinse. If not enough sample water is available to perform the triple rinse, then at a minimum, a single rinse will be performed and will be recorded in the field logbook and/or data sheet.
10. Directly fill sample bottles for unfiltered samples by container immersion, sample transfer, or pumping, as necessary. Fill filtered sample bottles with a peristaltic pump, tubing, and filter through a 0.45 micron filter by pumping directly from the stream or seep or from an intermediate container (i.e., a decontaminated beaker or intermediate sample bottle). At sites not readily accessible, both unfiltered sample bottles and intermediate sample bottles shall be filled at the sample site, transported back to the vehicle, and filtered from the intermediate bottles into new sample bottles. Sample bottles used as intermediate containers shall not be reused, but shall be discarded.
11. Measure field parameters described in the SAP using an in situ probe or by testing a separate aliquot of the unfiltered sample in accordance with SOP No. 7 Field Parameter Measurements.
12. Preserve the samples as specified in SOP No. 11 Sample Handling, Shipping, and Documentation. Check the sample pH by inserting a decontaminated glass rod into the sample and removing it, and testing the liquid drops that cling to the glass rod with pH paper.
13. Wipe clean the outside surface of all sample containers.
14. Place the samples in plastic bags.
15. Place the samples on ice in a cooler. Samples for radiological analysis do not require ice.
16. Record the date and time of sampling.
17. Complete field documentation and chain-of-custody form(s).

5.3 SAMPLING OF SEEPS OR OTHER LOW-FLOW CONDITIONS

Flow conditions at surface water sampling sites vary seasonally. Some of the sites may have low discharges with depth of flow being less than 0.5 inch. Field personnel will attempt to obtain samples of water at these sites by use of a transfer device. Field personnel will attempt to minimize the disturbance of bottom materials.

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Sample containers will be filled as long as it is possible to dip water from the small stream into a beaker without disturbing bed materials. If flow is so low that all sample bottles cannot be filled, collect as many samples as possible and record the site flow conditions. Surface water sites with a flow depth less than 0.5 inch and no defined channel (i.e., seeps), are known to exist. Field crews may attempt to obtain water samples at such sites as follows:

1. Dig a small depression in the soil within the path of flow.
2. Place a stainless steel bowl in this depression, with the rim of the bowl below the water surface.
3. Allow the bowl to become full of water, to overflow, and to continue to overflow for several minutes until the water is no longer turbid.
4. Obtain samples from the bowl by container immersion or by the dip and transfer method.
5. Repeat steps 2 through 4 until adequate sample volume is obtained.
6. When collecting unfiltered samples, triple rinse and fill the unfiltered sample bottles directly by immersion in the stream or seep flow if possible. If not enough sample water is available to perform the triple rinse, then at a minimum, a single rinse will be performed and will be recorded in the field logbook and/or data sheet. If unfiltered bottles cannot be filled due to low water depth, use the peristaltic pump and tubing to pump sample water into sample bottles or use a beaker to fill the unfiltered sample bottles, being careful to minimize sediment. Fill filtered sample bottles with a peristaltic pump, tubing, and filter through a 0.45 micron filter by pumping directly from the stream or seep or from an intermediate container (i.e., a decontaminated beaker or intermediate sample bottle). At sites not readily accessible, both unfiltered sample bottles and intermediate sample bottles shall be filled at the sample site, transported back to the vehicle, and filtered from the intermediate bottles into new sample bottles. Sample bottles used as intermediate containers shall not be reused, but shall be discarded.
7. Wear clean, disposable latex gloves at all times when collecting samples.
8. Measure field parameters described in the SAP using an in situ probe or by testing a separate aliquot of the unfiltered sample in accordance with SOP No. 7 Field Parameter Measurement.
9. Preserve the samples as specified in SOP No. 11 Sample Handling, Shipping, and Documentation. Check the sample pH by inserting a decontaminated glass rod into the sample and removing it, and testing the liquid drops that cling to the glass rod with pH paper.
10. Decontaminate the outside surface of all sample containers.
11. Place the samples in plastic bags.
12. Place the samples on ice in a cooler. Samples for radiological analysis do not require ice.
13. Record the date and time of sampling.
14. Complete field documentation and chain-of-custody form(s).

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5.4 PIT WATER SAMPLING PROCEDURES

Samples may be collected by direct submersion of the sample bottle in the pit water if the sample bottles supplied by the laboratory do not contain preservatives. If the bottles contain preservatives, a transfer container must be used to initially collect the sample of the pit water and then transfer the water to the bottle.

1. Wear clean, disposable latex or nitrile gloves at all items when collecting samples.
2. Rinse laboratory-supplied sample bottle or transfer device three times with pit water before collecting the sample (discard rinse water well away from sample location).
3. Submerge the laboratory-supplied sample bottle or decontaminated transfer container below the water surface taking care to minimize disturbance of bottom materials. If possible, the sample should be collected from at least six inches below the water surface.
4. Directly fill the laboratory-supplied sample bottles for unfiltered analyses to the required volume (either by submersion or from the transfer container).
5. Fill sample bottles for filtered analyses by using a peristaltic pump and new tubing to pump water through a 0.45 micron filter into the sample containers. Water may be pumped directly from the pit or from an intermediate container (i.e., a decontaminated beaker or unpreserved sample bottle). Sample bottles used as intermediate containers shall not be reused.
6. Measure field parameters described in the SAP using an in situ probe or by testing a separate aliquot of the unfiltered sample in accordance with SOP No. 7, Field Parameter Measurements.
7. Preserve the samples as specified in SOP No. 11, Sample Handling, Shipping, and Documentation. Check the sample pH by inserting a decontaminated glass rod into the sample and removing it, and testing the liquid drops that cling to the glass rod with pH paper.
8. Decontaminate the outside surface of all sample containers.
9. Place the samples in plastic bags.
10. Place the samples on ice in a cooler.
11. Complete field documentation and chain-of-custody forms.

6.0 DOCUMENTATION

6.1 SURFACE WATER SAMPLING DOCUMENTATION

Complete a surface water data sheet (Appendix C of the QAPP) for surface water samples at each sampling location. Be sure to completely fill in the data sheet. If items on the sheet do not apply to a

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Surface Water Sampling

specific location, label the item as not applicable (NA). The information on the data sheet includes the following:

- Sampling location
- Date and time of sampling
- Weather conditions
- Person(s) performing sampling
- Field parameter measurements, date and time
- Field meters used and calibration information
- Sample identification number(s)
- QA/QC samples taken at the location
- Method of sample collection (e.g., poly dipper).

In addition to the field sheets, samplers will record sampling information on the Monitoring/ Sampling Location Information log and Sample Collection Information log (Appendix C).

6.2 FIELD NOTES

All surface water sampling information will also be recorded in a bound field logbook. Record the following information using waterproof ink:

- Names of sampling personnel
- Weather conditions
- Date and time of sampling
- Sampling location
- Decontamination information
- Calibration information, sample methods used, or reference to the appropriate SOP
- Field parameter measurements
- Sample identification number(s)
- Method of sample collection
- Any other pertinent information that may have a bearing on sample quality.

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Sediment Sampling

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Sediment Sampling

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Sediment Sampling

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes composite and point sampling procedures to be used in the collection of surface and near surface sediment samples at and in the vicinity of the Midnite Mine Site. Sampling locations, sampling frequencies, and a list of analytes are specified in the Quality Assurance Project Plan (QAPP).

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager has the overall responsibility for implementing this SOP. The Project Manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel.

All personnel performing these procedures are required to have the appropriate health and safety training. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP and receive specific training regarding these procedures, if necessary.

All project staff are responsible for reporting deviations from this SOP to the Project Manager.

3.0 RELATED STANDARD OPERATING PROCEDURES

Related SOPs cross-referenced by this SOP are as follows:

- SOP No. 10 Decontamination
- SOP No. 11 Sample Handling, Shipping, and Documentation.

4.0 EQUIPMENT NECESSARY FOR COLLECTING SEDIMENT SAMPLES

General equipment used for collecting sediment samples includes:

- Laboratory provided sample containers (see SOP No. 11 Sampling Handling, Shipping, and Documentation)
- Bound field logbook
- Sample data sheets (Appendix C of the QAPP)
- Plastic flagging
- Stainless steel soil coring tool, 1 or 2-inch diameter
- Stainless steel No. 10 sieve
- Shovel (if sampling rocky areas)
- Stainless steel mixing bowl and spoon

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- Small sealable plastic bags
- Appropriate health and safety equipment.
- Appropriate decontamination equipment (see SOP No. 10 Decontamination)

Equipment for sample labeling, packing, documentation, and performing chain-of-custody procedures includes:

- Sample labels
- Chain-of-custody forms
- Clear plastic tape
- Fiber tape
- Custody seals
- Large (30 gallon) trash bag
- Gallon sealable bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Shipping documentation

5.0 SEDIMENT SAMPLING PROCEDURES

The SAP (Appendix A of the QAPP) identifies proposed sediment sampling locations on tables and figures. The proposed sample locations are approximate and will be finalized during the field investigation. Either composite, or both composite and grab samples will be collected at sample locations as indicated in the SAP. Section 5.1 describes the procedures for sample collection, and compositing of samples. Section 5.2 describes procedures for collecting grab samples. Section 5.3 and 5.4 discuss the collection of composite samples from riparian areas and in the open pits, respectively.

5.1 COMPOSITE SEDIMENT SAMPLING

Each composite sediment sample will be comprised of six subsamples collected from two stream channel cross-sections along identified stream reaches. The stream reaches will be identified based on proposed sample locations presented in the SAP, and should be located in the same relative positions to stream features (e.g., confluences, tributaries) as the mapped proposed sample points. For example, if on the sampling location map, a proposed sample point is shown just downstream of the confluence between a tributary and the main stem of a stream, the reach of the stream where the composite sample is collected should also be located just downstream of the confluence. In this case, no part of the

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stream reach to be sampled should extend upstream of the confluence. Also, no part of the stream reach should extend downstream of a major tributary entering the main stem.

Each composite sediment sample stream reach will be approximately 120 meters long and will include areas of sediment deposition. The stream reach and cross-sections of the stream where subsamples of the composite will be collected will be delineated during a reconnaissance of the sample site using the following procedure:

- Find the approximate location of the proposed sample point as shown in the SAP.
- Visually observe the streambed from approximately 60 meters downstream of the proposed sample point to approximately 60 meters upstream of the point.
- Identify two cross-sections of the stream within the 120-meter long reach where fine-grained sediments are visible and can be sampled.

Once identified, the cross-sections of the stream should be marked for sample collection and surveying.

Three subsamples of the fine-grained sediments will be collected within each of the two identified cross-sections. If possible, one subsample should be collected near each of the two stream banks, and one sample should be collected near the center of the channel. It may be necessary to adjust the subsample locations due to the availability of fine-grained sediments. The subsamples will be collected from the interval between the surface and 20 cm below the surface. The subsamples will be collected and composited as described below:

1. Decontaminate all sediment sampling equipment prior to sample collection and between sampling sites in accordance with SOP No. 10 Decontamination.
2. Locate the subsample location within the stream cross-section.
3. Using a stainless steel coring tool or spoon, collect at least 200 grams of sediment from the 0 to 20 cm depth interval.
4. Sieve the sediment subsample using the No. 10 mesh sieve to remove any cobbles, large pebbles, pieces of vegetation, or other material.
5. Place a pre-determined equal volume of the sieved sediment subsample into a stainless steel bowl.
6. Repeat steps 2-5 for each subsample in the stream cross-section.
7. Repeat steps 2-6 for the second stream cross-section.
8. Scrape the sediment from the sides, corners, and bottom of the stainless steel mixing bowl with a stainless steel spoon and roll the sediment to the center of the bowl.
9. Thoroughly mix the sediment sample and continue until the mixture is as homogeneous as possible.

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Note: If water is present in the sample mixture that is obtained by use of a sludge or core sampler, then an attempt will be made to preserve the water-to-solid ratio by including the water as part of the sample.

10. Use the stainless steel scoop to place homogenous sample/water mixture into each sample container.
11. Remix the sample/water mixture remaining in the mixing bowl after each scoop of material is placed in a sample container.
12. Partially fill each sample container (approximately in thirds), then add additional sample to each container. See the SAP for sample analysis and container requirements. Continue in this manner until all containers have been filled. This approach is used to evenly distribute the liquid into the various sample containers, while endeavoring to maintain the solid-to-liquid ratio present in the samples collected in the core sampler.
13. If the mixture is high in liquid content, pour the mixture into a stainless steel beaker to more efficiently transfer the mixture into sample containers. Continue mixing with a spoon to maintain homogeneity of the sample mixture during filling of sample containers.
14. Decontaminate the outside surface of all sample containers.
15. Place the sample containers in sealable bags.
16. Place the sealable bags in a garbage bag.
17. Place the samples on ice in a cooler. Samples for radiological analysis do not require ice.
18. Record the date and time of sampling.
19. Complete field documentation and chain-of-custody form(s).
20. Decontaminate sampling equipment in accordance with SOP No. 10 Decontamination.

5.2 GRAB SEDIMENT SAMPLING

Grab sediment samples will be collected in addition to composite samples at sampling locations indicated in the SAP. The grab samples will be collected from points within the stream reaches delineated for composite sampling. In most cases, the sediment sample locations will also be co-located with surface water sample locations. When this occurs, the grab sediment sample location should also be suitable for surface water sampling and discharge measurement, if possible. Once identified, the grab sample point should be marked for sample collection and surveying.

The grab sediment sample will be collected from the interval between the surface and 10 cm below the surface following these procedures:

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1. Decontaminate all sediment sampling equipment prior to sample collection and between samples in accordance with SOP No. 10 Decontamination.
2. Collect representative sediments from the 0 to 10 cm interval from the stream bed using a stainless steel spoon and transfer into the stainless steel mixing bowl. Collect sufficient sample to fill an 8 ounce glass jar. Note that if sediments are to be sampled at locations where surface water samples are to be collected, the surface water sample should be collected first to avoid disturbance of the streambed.
3. Sieve sediment samples using the No. 10 mesh sieve to remove any cobbles, large pebbles, pieces of vegetation, or other material.
4. Scrape the sediment from the sides, corners, and bottom of the stainless steel mixing bowl with a stainless steel spoon and roll the sediment to the center of the bowl.
5. Thoroughly mix the sediment sample until the mixture is as homogeneous as possible.

Note: If water is present in the sample mixture that is obtained by use of a stainless steel spoon, then an attempt will be made to preserve the water-to-solid ratio by including the water as part of the sample.

6. Use the stainless steel spoon to place the homogenous sample/water mixture into each sample container.
7. Remix the sample/water mixture remaining in the mixing bowl after each scoop of material is placed in a sample container. This approach is used to evenly distribute the liquid into the sample container, while endeavoring to maintain the solid-to-liquid ratio present in the sample collected.
8. If the mixture is high in liquid content, pour the mixture into a stainless steel beaker to more efficiently transfer the mixture into sample containers. Continue mixing with a spoon to maintain homogeneity of the sample mixture during filling of sample containers.
9. Decontaminate the outside surface of all sample containers.
10. Place the samples in sealable freezer bags.
11. Place the sealable bags in a garbage bag.
12. Place the samples on ice in a cooler. Samples for radiological analysis do not require ice.
13. Record the date and time of sampling.
14. Complete field documentation and chain-of-custody form(s).
15. Decontaminate sampling equipment in accordance with SOP No. 10 Decontamination.

5.3 RIPARIAN SEDIMENT SAMPLING

SOP NUMBER 9

Sediment Sampling

Composite sediment samples will be collected from riparian areas at locations identified in the SAP. Each riparian sample will be composed of six subsamples collected from a grid cell measuring 30 x 333' centered on the drainage channel. The locations of the subsamples will be delineated during a reconnaissance of the sampling site grid using the following procedure:

- Identify the upstream and downstream boundaries of the sampling grid by locating the center of the grid from the maps provided in the SAP and measuring 167 feet in both directions from the center.
- Visually observe the area within the grid to locate the six subsample points. The subsample points should be located in areas where fine-grained sediments have been deposited beyond the active channel during high water periods, and/or in saturated soils in seep areas adjacent to the stream channel.
- As much as possible, the subsamples should be distributed along the length of the grid cell while meeting the criteria for subsample placement described above.

Sample collection, handling, and documentation procedures will be as described in Section 5.1 for composite sediment sampling.

5.4 PIT SEDIMENT SAMPLING

Composite sediment samples will be collected from Pits 3 and 4. Each pit sediment sample will be composed of six subsamples collected from a grid cell with an area of 10,000 square feet. The locations of the subsamples will be delineated during a reconnaissance of the sampling area using the following procedures:

- Measure the length of beach sediments exposed along the edge of the pit lake that can be accessed easily.
- Calculate the width necessary to make the grid cell approximately 10,000 square feet in area.
- Select subsample locations at the four corners and two center locations. The two center locations should be set apart (along the long axis of the cell) by the same distance as the distance from each center point to the nearest two corners of the grid cell.
- If the pit currently contains more water than would allow access for compositing sub-samples as described above, then a composite sample will be obtained by collecting subsamples from six locations, equally spaced along the length of exposed sediment on the south side of the pit perimeter.

Sample collection, handling, and documentation procedures will be as described in Section 5.1 for composite sediment sampling.

6.0 DOCUMENTATION

SOP NUMBER 9

Sediment Sampling

All information pertaining to sediment sampling shall be recorded in a bound field logbook with consecutively numbered pages. Corrections shall be made by line-out deletions that are initialed and dated. Sediment collection information will be recorded on the sediment sampling data sheet (Appendix C of the QAPP). The information recorded shall include the following, as appropriate:

- Name(s) of field personnel
- Date and time of entry, and physical/environmental conditions during field activity
- Location description, and log of photographs (if taken)
- Sampling equipment and method used
- Information concerning sampling decisions
- Samples collected, intervals, types, and identification number
- Field observations
- Summary of daily tasks and information concerning sampling changes and scheduling modifications
- Sample preparation procedure
- Signature and date by personnel responsible for procedures.

SOP NUMBER 10

Decontamination

SOP NUMBER 11

Sample Handling, Shipping, And Documentation

SOP NUMBER 11 Sample Handling, Shipping, And Documentation

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Sample Handling, Shipping, And Documentation

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to handle, ship and document samples collected during the Remedial Investigation/Feasibility Study (RI/FS) at the Midnite Mine Site, Spokane Indian Reservation, Washington.

This SOP is intended to accommodate shipping samples to privately contracted laboratories. If samples are collected for shipment to laboratories procured through the Environmental Protection Agency (EPA) Contract Labs Program (CLP), then see EPA document EPA/540/R-96/032 *Sampler's Guide to the Contract Laboratory Program* for additional handling and shipping information.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager has the overall responsibility for implementing this SOP. The Project Manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel.

All personnel performing these procedures are required to have the appropriate health and safety training. U.S. Department of Transportation and International Air Transport Association regulations require that employees involved with transporting hazardous materials complete specific training requirements. Site personnel will be trained regarding hazardous materials transportation prior to shipment of any hazardous materials. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP and receive specific training regarding these procedures, if necessary.

All project staff are responsible for reporting deviations from this SOP to the Project Manager.

3.0 RELATED STANDARD OPERATING PROCEDURES

Related SOPs cross-referenced by this SOP include:

- SOP No. 10 Decontamination

4.0 EQUIPMENT NECESSARY FOR SAMPLE HANDLING, SHIPPING, AND DOCUMENTATION

The following equipment will be used for sample labeling, packing, documentation, and Chain-of-Custody procedures:

- Personal protective equipment (PPE) as outlined in the Health and Safety Plan (HSP)
- Radiological monitoring equipment (Ludlum Model 19 Micro R Meter or equivalent)
- Decontamination equipment and supplies (see SOP No. 10 Decontamination)

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Sample Handling, Shipping, And Documentation

- Clean sample containers (e.g., glass polyethylene, etc.) with preservatives, if required, as specified in the Quality Assurance Project Plan (QAPP), Section 2.4
- Shipping coolers
- Ziplock or equivalent plastic bags
- Self-adhesive sample labels
- Shipping forms (provided by shipping courier)
- Shipping labels (e.g. Fragile, This Side Up, etc.)
- Sample labels (see Appendix C of the QAPP)
- Chain-of-Custody forms (see Appendix C of the QAPP)
- Custody seals (see Appendix C of the QAPP)
- Bubble wrap or equivalent packing material
- Tape (clear tape and packing tape)
- Ice
- Paper towels
- Large trash bags

5.0 SAMPLE HANDLING, SHIPPING, AND DOCUMENTATION PROCEDURES

5.1 SAMPLE IDENTIFICATION

Samples collected during site activities will have unique sample identification (ID) numbers. These numbers are necessary to identify and track each sample collected for analysis during the project. In addition, the sample ID numbers will be used in the database to identify and retrieve the analytical results received from the laboratory. The sample ID plan is presented in Section 3 of the Sampling and Analysis Plan (SAP [Appendix A of the QAPP]).

5.2 SAMPLE LABELING

Sample labels will be filled out partially before field sampling activities begin. An example of sample labels is presented in Appendix C of the QAPP. The date, time, sample depth, and sampler's initials or signature should not be completed until the time of sample collection. Sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Site location

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- Sample ID number
- Sample type
- Date and time of sample collection
- Analyses required
- Method of preservation (if any)
- Sample matrix
- Sampler initials

After the label is completed and attached to the sample container, clear plastic tape will be placed over the label to protect and secure it to the container. Care must be taken during labeling and taping to preclude the possibility of sample contact with label or tape adhesive.

5.3 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and handling and shipping procedures. Much of the information in this section is also presented in the QAPP. Table 1 summarizes sample analyses, containers, and preservation.

5.3.1 Sample Containers

As available, certified, commercially clean sample containers will be obtained from a subcontracted analytical laboratory or vendor. Required preservatives may be prepared and placed in the bottles at the laboratory before shipment to the site. Alternatively, sample preservatives will be added at the site prior to shipment of samples to the laboratories. Appropriate sample containers are discussed in the QAPP and summarized in Table 1 of this SOP.

5.3.2 Sample Preservation

All samples requiring refrigeration as a means of preservation will be stored on ice in an insulated cooler to maintain a temperature of 4°C immediately following sample collection. Soil samples do not require additional preservation. Samples for radiological analysis do not require ice. As noted above, sample containers for aqueous samples will either be obtained from the laboratory containing the appropriate preservatives or the appropriate preservatives will be added to the bottles at the site.

5.3.3 Radiological Screening

Each sample container must be decontaminated per the requirements of SOP No. 10 Decontamination, prior to transport of samples to support zones or off-site.

Following decontamination, each sample container will be frisked using a thin window Geiger-Muller detector, or equivalent, on the surface of the sample container. If elevated readings (i.e., 1000 or more

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disintegrations per minute above background) are detected, the container will be decontaminated again. If elevated readings are not indicated, and no other hazardous characteristics are identified, no additional container decontamination is required and the material may be shipped per the requirements of Section 5.3.4 of this SOP.

If elevated readings are detected from the sample container after it has been decontaminated again, the container will be placed in a Ziploc™ bag, labeled “radioactive”, and the highest radiation reading placed on the bag in waterproof ink. After the cooler is packed, meter readings must be taken across all external surfaces of the closed sample cooler. If the readings do not exceed 0.5 millirem per hour, include the following statement on a regular airbill:

“Radioactive material, excepted package – limited quantity of material”

Additionally, the following notice must be placed in the cooler:

“This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, exempted package – limited quantity of material – UN2910”

The package is exempted from additional requirements and the samples may now be shipped per the requirements of Section 5.3.4 of this SOP.

If readings greater than 0.5 millirem per hour are detected on any external surface of the cooler, attempt to separate or shield samples so that readings of less than 0.5 millirem per hour may be achieved. When packaging the samples, be sure to eliminate the potential for shifting during transport which could result in readings outside the package exceeding 0.5 millirem per hour. If readings of less than 0.5 millirem per hour cannot be achieved, the samples must be shipped per the requirements of section 5.3.4.1.

5.3.4 Sample Packaging and Shipping

Samples and sample containers will be packaged properly to prevent breakage of containers and leakage of contents. Samples that pass the radiological screening (i.e., frisking) criteria described in Section 5.3.3 will follow the packaging and shipping procedure presented below. Samples that do not pass the radiological screening criteria will follow procedures presented in Section 5.3.4.1.

- If the sample container is glass, wrap individual sample containers with bubble wrap.
- For Marinelli beakers used to collect samples for radon analysis, the lids shall be sealed to the containers using electrical tape. Specifically, place electrical tape around the area where the lid meets the container by winding around the circumference three to four times.
- Place sample containers in recloseable plastic bags.
- Place sufficient amounts of bubble wrap in the bottom and sides of the shipping cooler to prevent movement of contents.

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- Line the inside of the cooler with a plastic trash bag, add enough ice (in double bags) to the cooler to maintain the required temperature of 4°C. Line the bottom, sides, and top of cooler to ensure proper shipment temperature. Using at least 3-4 one gallon bags of ice per 48-quart cooler is recommended. Samples for radiological analysis do not require ice. These samples will be placed in a plastic bag inside a cooler. Vermiculite will be added to fill the space surrounding the radiological sample containers to absorb any liquids within the cooler. The sample teams will avoid breathing the dust generated by handling the vermiculite.
- A bottle containing tap water and identified as a temperature blank will be included with each cooler containing samples cooled to 4°C. Upon receipt of the samples at the laboratory, the temperature blank will be used to determine the cooler temperature. The temperature blank will not be assigned a sample identification number and will not appear as a line item on the chain-of-custody form.
- Place samples and temperature blank inside the bag in an upright position. Tie shut the trash bag holding the samples and ice.
- Fill excess space in the cooler with packing material (e.g., bubble wrap) to prevent movement of sample containers.
- Place the original and yellow copy of the chain-of-custody (COC) form inside a plastic bag, and tape the bag inside the cooler lid.
- Close the cooler lid, and seal the cooler and the cooler spout with appropriate packaging tape.
- Place two custody seals (tampering seals) on the cooler in separate areas over (across) the seal between the lid and the cooler base. Tape the custody seals to the cooler to ensure that custody seal is adequately affixed.

A shipping bill should be completed for the shipper and taped to the top of the cooler using the envelope provided by the shipper. The following markings will also be placed on the top of the cooler:

- This End Up
- Fragile
- Laboratory delivery address
- Sender's return address

The pink copy of the shipping bill will be retained by the Sample Manager for attachment to the corresponding COC form. Samples will be hand delivered or shipped by express courier for delivery to the analytical laboratory. The Sample Manager is responsible for verifying that samples collected by the field team have been properly packed in coolers and for verifying the accuracy and completeness of sample labels and COC forms.

The following is a summary of steps to be followed to check that sample management and paperwork is complete:

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- Verify sample labels.
- Check or complete the COC form.
- Pack samples in cooler and verify COC form accuracy.
- Verify that labels and forms meet shipping requirements.
- Photocopy the COC form and retain two copies for the project files.
- Send original and yellow copy of the COC form to the laboratory.
- Obtain pink copy of the shipping bill and staple it to the corresponding COC copy.

No samples will be shipped for Sunday delivery. Saturday delivery to the laboratory will require laboratory approval before shipment.

5.3.4.1 Shipping Samples Above Radiological Screening Criteria

Refer to the classification, identification, packing, labeling, documentation and shipping requirements specified in the current versions of the International Air Transport Association “Dangerous Goods Regulations” and U.S. Department of Transportation “Hazardous Materials Regulations” as applicable.

Copies of these regulations will be available in the on-site project file; additional guidance can be obtained by contacting the Project Health and Safety Officer.

5.3.5 Sample Container Tampering

If, at any time after samples have been secured, custody seals on the cooler are identified as having been tampered with, the following procedures will be conducted:

- Check with personnel having access to sample coolers to evaluate whether inadvertent tampering can be documented.
- Document findings of the incident in a logbook.

If it cannot be documented that inadvertent breaking of the custody seal that did not affect the integrity of samples has occurred, the samples will be re-collected and the Project Manager and QA Officer will be notified.

5.3.6 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis or extraction, based on the analyte of interest, stability factors, and preservative (if any) used. The sample analyses and corresponding holding times are summarized in QAPP Section B.

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Sample Handling, Shipping, And Documentation

6.0 DOCUMENTATION

This section describes documentation required in the field notes and sample COC requirements.

6.1 FIELD NOTES

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded on field sampling data sheets, and, in a permanently bound weatherproof field notebook with consecutively numbered pages. The information on field sampling data sheets or in the field notebook will include the following as a minimum. Additional information is included in the specific SOPs regarding the appropriate data sheets.

- Project name
- Location of sample
- Sampler's signature
- Date and time of sample collection
- Sample identification numbers and sample depth (if applicable)
- Description of samples (matrix sampled), composite or grab sample
- Analysis to be performed
- Number and volume of samples
- Description of QA/QC samples (if collected)
- Sample methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for samples
- Field observations
- Results of any field measurements, such as depth to water, pH, temperature, and conductivity
- Decontamination information
- Calibration information
- Personnel present

Changes or deletions in the field notebook should be lined out with a single strike mark, initialed and dated by person making change, and remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the collector's memory.

Each page of the field notebook will be signed by the person making the entry. Anyone making entries in another person's field book will sign and date those entries.

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6.2 CHAIN-OF-CUSTODY PROCEDURES

The custody of all samples shall be documented on the COC forms. The COC forms document possession of the sample from collection through laboratory receipt. A sample COC form is shown in Appendix C of the QAPP.

Follow appropriate sample custody and documentation procedures precisely to preserve sample integrity and to ensure the validity of field and laboratory data. As a result, all sample data will be traceable from the time and location of sample collection through chemical analyses and to the time when data are used. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form.

The following minimum information will be recorded on the COC form:

- Sample ID
- Sampling date and time
- Required analysis
- Number of containers
- Sampler signature

The objective of the custody identification and control system for the samples is to ensure, to the extent practicable, that the following occur:

- All samples scheduled for collection are uniquely identified.
- The correct samples are analyzed and are traceable to their records.
- Important sample characteristics are preserved.
- Samples are protected from loss or damage.
- Any alteration of samples (e.g., filtration, preservation, and dilution) is documented.
- A record of sample integrity is established.
- Legally traceable custody and possession records are maintained.

For this project, a sample is defined as being in an individual's custody if the following conditions occur:

- The sample is in that individual's actual physical possession.
- The sample is in that individual's view after being in their physical possession.
- The sample is in that individual's physical possession and then locked or otherwise sealed so that tampering would be evident.
- The sample is maintained in a secure area that is restricted to authorized personnel only.

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Sample Handling, Shipping, And Documentation

General field custody procedures include the following:

- As few people as possible should handle samples.
- The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred.
- When transferring the samples, the individuals relinquishing and receiving the samples will document the transfer by signing, dating, and writing the time of transfer on the COC form.
- The person responsible for delivering the samples to the laboratory or to the shipping carrier will sign the COC form, retain the third copy of the form, document the method of shipment, and send the original and the second copy of the form with the samples.
- Custody seals shall be attached so that it is necessary to break the seal to open the shipping container. The person affixing the custody seal will sign and date the seal.

Observe general documentation rules, including the use of black ink. Make any changes to the COC form by drawing a single line through the incorrect material and initialing the markout. Put a line through and initial blank lines on the COC form.

Upon receiving the samples, the laboratory's representative shall do the following:

- Sign and keep copies of shipping documents.
- Sign the COC form and return the second copy to the Project Manager (may be included with the analysis results)
- Measure and document the temperature of the samples using temperature blank.
- Document the condition of the custody seals and of the samples.
- Notify the project manager if any breakage or improper preservation has occurred or if there is a discrepancy between the COC form, sample labels, and requested analyses.
- Provide copies of the above documentation to the project manager with the final laboratory data package.
- At the laboratory, custody of all samples will be in accordance with the laboratory QAP and SOP (QAPP, Appendix E) from sample receipt through sample residual disposal.

6.3 PHOTOGRAPHS

When photographs, slides, or movies are taken for visual documentation of a site or procedure, they are numbered to correspond to the field logbook entries. If possible, a reference point (building, sign, etc.) is included in the photograph to assist in verifying the location of the photograph and provide an approximate scale. The name of the photographer, date, time, site location, direction viewed, and site description is entered sequentially in the logbook as photos are taken.

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Sample Handling, Shipping, And Documentation

7.0 REFERENCES

International Air Transport Association. 1999. "Dangerous Goods Regulations," 40th Edition. Effective 1 January 1999.

U.S. Department of Transportation. 1999. 49 CFR Parts 172 and 173, "Hazardous Materials Regulations"

ASTM D-4840-88, Standard Practice for Sampling Chain-of-Custody Procedures, 1995 Annual Book of ASTM Standards, Vol. 04.08.

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Sample Handling, Shipping, And Documentation

Table 1
SAMPLE ANALYSES, CONTAINERS AND PRESERVATION

Analytical Parameter (a)	Sample Matrix	Preservation	Number/Minimum Volume of Container(s)
Total Metals	Groundwater	pH < 2 with HNO ₃	1 1-liter poly (b)
Dissolved Metals	Groundwater	Filtration through a 0.45 micron filter followed by pH < 2 with HNO ₃	1 1-liter poly (b)
Anions, TSS, TDS, Alkalinity, Total Phosphorus, Phosphate	Groundwater	Cool to 4 °C	1 1-liter poly (b)
Ammonia, COD	Groundwater	pH < 2 with H ₂ SO ₄ and cool to 4 °C	1 1-liter poly (b)
U234, U235, U238	Groundwater	pH < 2 with HNO ₃	1 1-liter poly (c)
Rn222	Groundwater	pH < 2 with HNO ₃	1 1-liter marinelli (d)
Total Metals	Surface Water	pH < 2 with HNO ₃	1 1-liter poly (b)
Dissolved Metals	Surface Water	Filtration through a 0.45 µm filter followed by pH < 2 with HNO ₃	1 1-liter poly (b)
Anions, TSS, TDS, Alkalinity, Total Phosphorus, Phosphate	Surface Water	Cool to 4 °C	1 1-liter poly (b)
Ammonia, COD	Surface Water	pH < 2 with H ₂ SO ₄ and cool to 4 °C	1 1-liter poly (b)
U234, U235, U238	Surface Water	pH < 2 with HNO ₃	1 1-liter poly (c)
U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, gross alpha, gross beta	Surface Water	pH < 2 with HNO ₃	2 1-gallon poly (c)
Rn222	Surface Water	pH < 2 with HNO ₃	1 1-liter marinelli (d)
Pb210	Surface Water	pH < 2 with HNO ₃	1 1-liter poly (b)
Po210	Surface Water	pH < 2 with HNO ₃	1 1-liter poly (b)
Metals, Mercury, Anions, Ammonia, Total Phosphorus, Orthophosphate, Carbonate, Bicarbonate, pH, TOC	Sediment (e)	Cool to 4 °C	2 8-oz glass or poly (b)
Particle Size Distribution	Sediment (e)	None	1 8-oz glass or poly (c)
U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231	Sediment (e)	None	1 1-liter poly (c)

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Analytical Parameter (a)	Sample Matrix	Preservation	Number/Minimum Volume of Container(s)
Pb210, Po210	Sediment (e)	None	1 4-oz poly (d)
Cation Exchange Capacity (CEC) including exchangeable bases, Soluble Exchangeable Metals (SEM)/Phosphorus, Gravimetric Clay Content plus Particle Size Distribution	Sediment (e)	Cool to 4 °C (necessary for CEC and SEM)	1 8-oz glass or poly (b)
Metals, Mercury, Anions, Ammonia, Total Phosphorus, Orthophosphate, Carbonate, Bicarbonate, pH, TOC	Surface Material (e)	Cool to 4 °C	2 8-oz glass or poly (b)
Particle Size Distribution	Surface Material (e)	None	1 8-oz glass or poly (c)
U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231	Surface Material (e)	None	1 1-liter poly (c)
Pb210, Po210	Surface Material (e)	None	1 4-oz poly (d)
Radon Emanation Fraction	Surface Material (e)	None	1 16-oz glass or poly
pH, TOC, % Moisture, Metals (f)	Subsurface Material (e)	Cool to 4 °C	1 8-oz glass or poly (b)
U234, U235, U238, Th227, Th228, Th230, Th232, Ra226, Ra228, Pa231 (f)	Subsurface Material (e)	None	1 1-liter poly (c)
Cation Exchange Capacity (CEC) including exchangeable bases, Soluble Exchangeable Metals (SEM)/Phosphorus, Gravimetric Clay Content Plus Particle Size Distribution	Subsurface Material (e)	Cool to 4°C (necessary for CEC and SEM)	1 8-oz glass or poly (b)

Table 1 Footnotes:

- (a) All definitive methods and some screening methods will be conducted at an analytical laboratory. The following screening methods will be performed in the field at the time of sampling: pH (water only), temperature, specific conductance, Eh, turbidity, dissolved oxygen and ferrous iron.
- (b) One in twenty samples require triple volume for laboratory QC. Field QC to be collected at the QAPP-specified frequency.
- (c) One in ten samples require double volume for laboratory QC. Field QC to be collected at the QAPP-specified frequency.
- (d) One in twenty samples require double volume for laboratory QC. Field QC to be collected at the QAPP-specified frequency.
- (e) All sediment, surface material, and subsurface material will be sieved through a No. 10 mesh prior to collecting the sample in the specified container. Completely fill all specified containers.
- (f) Metals and radiological analysis on subsurface material will not be performed initially. Rather, these samples will be held by the laboratory (for potential future metals analysis excluding mercury) until an evaluation of the surface material sample data is completed.

SOP NUMBER 12

Surface Water Discharge In Streams And Seeps

SOP NUMBER 13

Borehole Geophysical Logging

SOP NUMBER 14

GPS Surveying

SOP NUMBER 14

GPS Surveying

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SOP NUMBER 14

GPS Surveying

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to define the procedure for conducting Global Positioning System (GPS) surveying at the Midnite Mine Site. GPS will be used to survey surface water and sediment sampling locations, surface water discharge measurement locations, and locations and top of casing elevations of groundwater monitoring wells.

This SOP only provides general procedures for GPS surveying and is not intended to provide detailed technical information about GPS surveying. This SOP is intended to be used in conjunction with the surveying instrument manufacturer's recommendations and procedures, as well as accepted industry practices.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager has the overall responsibility for implementing this SOP. The surveying will be performed by a surveyor licensed in the State of Washington. The surveyor will be responsible for meeting the specifications described in this SOP and documentation of the survey data.

All personnel performing these procedures are required to have the appropriate health and safety training.

3.0 RELATED STANDARD OPERATING PROCEDURES

This SOP is intended to be used with the following SOPs:

- SOP No. 3 Monitoring Well Installation
- SOP No. 8 Surface Water Sampling
- SOP No. 9 Sediment Sampling
- SOP No. 12 Surface Water Discharge in Streams and Seeps

4.0 EQUIPMENT NECESSARY FOR GPS SURVEYING

The following is a list of equipment that may be needed for conducting GPS surveying for this project:

- Monitoring and personal protective equipment (PPE) as outlined in the Health and Safety Plan (HSP)
- Real-time kinematic (RTK) GPS system (including GPS receiver, antenna, data logger)
- GPS base station

SOP NUMBER 14

GPS Surveying

- Measuring tape (marked in increments of tenths of a foot)
- Survey logbook

5.0 SURVEYING PROCEDURES

This section provides a general summary of GPS surveying procedures and specific procedures for surveying monitoring well and surface water/sediment sampling locations. However, these procedures should be supplemented by the specific survey instrument manufacturer's recommendations and generally accepted surveying practices.

- GPS Coordinates and elevations will be determined based on the NAD27 horizontal datum and Geoid 96 derived elevations to the NAVD88 vertical datum.
- Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (e.g., benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.
- A base station will be established within an appropriate distance from the furthest survey point, as determined by the instrument manufacturer's specifications.
- At each survey location, the location identifier and coordinates will be measured and stored in the data logger. As a backup, the same information will be recorded in the survey logbook.
- Data stored in the data logger will be downloaded at the end of each day of surveying and checked to determine if the data is reliable and to verify that coordinates have been collected for each survey location.
- Known benchmarks will be used to establish control points
- If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

The following procedure will be followed specifically for surveying monitoring well locations and top of casing elevations:

- Enter the monitor well identification in the GPS data logger and also in the survey logbook for backup purposes.
- Measure the location in state plane coordinates (northing and easting) and elevation of the concrete pad adjacent to the monitoring well protective casing and store the coordinates and elevation in the data logger and record data in the survey logbook.

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GPS Surveying

- Remove the monitoring well cap and measure the elevation of the top of the inner well casing (not the protective casing) on the north side of the well. Remove all visible debris from the tip of the survey rod before placing the rod on the top of the open well. Measure the top of casing elevation and store the elevation data in the data logger and in the survey logbook.

The following procedure will be followed specifically for surveying surface water and sediment sampling locations:

- Enter the survey location identification in the GPS data logger and also in the survey logbook.
- Place the survey rod at the stream bank adjacent to the sample location and measure the location (northing and easting) in state plane coordinates and the elevation. Store the information in the data logger and record it in the survey logbook.

6.0 DOCUMENTATION

The survey location identifier (i.e., sample location designation or monitoring well designation) and corresponding coordinates and elevation will be recorded in the data logger. As a backup, this information will also be recorded in the survey logbook. Surveying activities and field observations will also be recorded in the survey logbook. Information that will be documented in the logbook include:

- Project name and number
- Surveying personnel
- Weather conditions
- Daily field verification information (i.e., benchmark identification and coordinates)
- Survey location identification
- Survey location coordinates (northing and easting) and elevation
- Descriptions and coordinates of alternate survey locations (offsets)
- Measured distances from alternate survey locations to original survey locations
- A description of any conditions that may affect data integrity.

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Surface Material Sampling

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Surface Material Sampling

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Surface Material Sampling

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to collect surface material and subsurface material samples for chemical analysis during the Midnite Mine Phase 2 Remedial Investigation/Feasibility Study (RI/FS) field program. This SOP will be used in conjunction with the other SOPs listed below, the Quality Assurance Project Plan (QAPP), and the Sampling and Analysis Plan (SAP).

The SOP describes procedures for collection of composite surface material and subsurface material samples (i.e., composed of multiple increment samples collected at several points within the area to be characterized). Unless otherwise specified by the SAP, the term “surface material” refers to the top five centimeters of soil following removal of surface vegetation, non-decomposed plant litter, and other debris from the sampling area and “subsurface material” refers to soil from 5 to 20 cm below ground surface.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager, Field Manager, and designated project staff are responsible for implementing this SOP. Personnel performing surface material sampling activities will have knowledge and experience in the sampling methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HSP).

3.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

SOP No. 10 Decontamination

SOP No. 11 Sample Handling, Shipping, and Documentation

4.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be necessary for surface material sampling:

- Sample containers
- Bound field logbook
- Sampling site location maps
- 300-foot and 100-foot tape measures and Brunton Compass
- Soil sample field data sheets (Attachment A)
- Surveying stakes or flags for marking of grid nodes and/or sampling locations

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Surface Material Sampling

- Monitoring equipment and personal protective equipment (PPE) as outlined in the HSP.
- Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Stainless steel hand augers, scoops or spoons, knife, pick, and mixing bowls
- Sample collection supplies (e.g., plastic recloseable plastic bags or equivalent, waterproof markers, sample labels, chain of custody [COC] forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
- No. 10 mesh sieve
- Trimble Pathfinder GPS Unit

Other materials and equipment may be needed based on field conditions.

5.0 PROCEDURES

5.1 SURFACE MATERIAL

Composite surface material samples are comprised of multiple increment samples collected at several points. All or a portion of the increment samples are mixed together to create a composite sample representative of average constituent concentrations within the area to be characterized.

Prior to sampling, it is important to calculate the volume of sample material to be collected at each increment sample location to ensure that the necessary amount of composite sample will be obtained. Required volumes of composite samples are analysis-specific and will be specified in the SAP. For a given composite sample, the volume of each increment sample must be the same, and must equal $1/n$ of the required composite sample volume, where n equals the number of increment samples making up the composite sample.

Increment sampling locations specified in the SAP will be identified and marked using surveying stakes, lath, or flags. For each survey grid containing soil sample locations (except for the on haul road locations discussed below), one or more lines will be surveyed along the edge of grid and flagged every 100 feet prior to the sampling effort. The center of the composite sample location will be located by walking on a compass bearing and measuring the distance using a tape measure from the appropriate flagged location on the zero grid line. Where the center location has been reached, a survey stake or flag will be used to mark the location. The four corner points of the composite sampling grid will be located by compass and tape traversing to each increment point from the center point. The distance from the center point to each corner point of the grid is approximately 70 feet.

For the samples collected on the haul roads, identify the 30' x 333' grid cell by measuring the distance from the beginning of the road. Within the grid cell, select five increment sample locations at the center

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of the grid and as close to the four corners of the grid cell as possible while still remaining on the road surface and mark each location with stakes or flagging. For samples collected adjacent to the haul roads, identify the 100' x 100' grid cell by measuring the distance from the beginning of the road. At each grid, mark the four corners and center increment points. Place the two corners nearest the road approximately 10 feet off the road.

Each composite surface material sample will be collected as follows:

1. At each increment sample location, clear an area approximately 12 inches in diameter of surface vegetation, non-decomposed plant litter, and debris.
2. Use a decontaminated stainless steel spoon or hand auger to collect surface material to a depth of five centimeters. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation.
3. Visually describe the material and record observations on the soil sample field data sheet. Classify any pieces of gravel found as granitic, phyllitic, or calc-silicate, if possible.
4. Sieve the increment sample through a No. 10 mesh and place into a decontaminated stainless steel mixing bowl. Mix thoroughly.
5. Repeat Steps 1 through 3 at each increment sample location for a given composite sample, adding each successive increment sample to the mixing bowl.
6. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.
7. Label and handle the containers as specified in SOP No. 11, Sample Handling, Shipping, and Documentation.
8. Sample increment locations will be surveyed using the Trimble Pathfinder GPS.

5.2 SUBSURFACE MATERIAL

Composite subsurface material samples are comprised of multiple increment samples collected at several points. All or a portion of the increment samples are mixed together to create a composite sample representative of average constituent concentrations within the area to be characterized.

Prior to sampling, it is important to calculate the volume of sample material to be collected at each increment sample location to ensure that the necessary amount of composite sample will be obtained. Required volumes of composite samples are analysis-specific and will be specified in the SAP. For a given composite sample, the volume of each increment sample must be the same, and must equal $1/n$ of

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the required composite sample volume, where n equals the number of increment samples making up the composite sample.

Increment sampling locations specified in the SAP will be identified and marked using surveying stakes, lath, or flags. For each survey grid containing sample locations, one or more lines will be surveyed along the edge of grid and flagged every 100 feet prior to the sampling effort. The center of the composite sample location will be located by walking on a compass bearing and measuring the distance using a tape measure from the appropriate flagged location on the zero grid line. Where the center location has been reached, a survey stake or flag will be used to mark the location. The four corner points of the composite sampling grid will be located by compass and tape traversing to each increment point from the center point. The distance from the center point to each corner point of the grid is approximately 70 feet.

For samples collected adjacent to the haul roads, identify the 100" x 100" grid cell by measuring the distance from the beginning of the road. At each grid, mark the four corners and center increment points. Place the two corners nearest the road approximately 10 feet off the road.

Each composite subsurface material sample will be collected as follows:

1. At each increment sample location, clear an area approximately 12 inches in diameter of surface vegetation (non-decomposed plant litter) and debris.
2. Use a decontaminated stainless steel spoon or hand auger to collect subsurface material from a depth of 5 to 20 cm below ground surface. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation.
3. Visually describe the material and record observations on the soil sample field data sheet. Classify any pieces of gravel found as granitic, phyllitic, or calc-silicate, if possible.
4. Sieve the increment sample through a No. 10 mesh and place into a decontaminated stainless steel mixing bowl. Mix thoroughly.
5. Repeat Steps 1 through 3 at each increment sample location for a given composite sample, adding each successive increment sample to the mixing bowl.
6. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.
7. Label and handle the containers as specified in SOP No. 11, Sample Handling, Shipping, and Documentation.
8. Sample increment locations will be surveyed using the Trimble Pathfinder GPS.

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Surface Material Sampling

6.0 DOCUMENTATION

Personnel collecting samples are responsible for documenting sampling activities in the field logbook and on the Surface Material Sample Field Data Sheet (Appendix C of the QAPP). Information to be recorded includes the following:

- Project name and number
- Sampling personnel
- Sample number and location (i.e., Southwest downward soils, east haul road, etc.)
- Sample collection date and time
- Description of material collected (color, grain size, staining, odors)
- Monitoring equipment readings
- Type of sample containers and preservation
- Record of QA/QC samples collected
- Any irregularities or problems that may have an impact on sample quality
- Weather conditions
- Other applicable information

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Slug Testing

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Geotechnical Investigation

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Gamma Radiation Surveying, Radon Flux Measurement, and Airborne Radon Measurement

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Gamma Radiation Surveying, Radon Flux Measurement, and Airborne Radon Measurement

1.0 PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for gamma radiation surveying, radon flux measurement, and airborne radon measurement. This SOP will be used in conjunction with the other SOPs listed below, the Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP).

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The URS Project Manager, URS Field Manager, and designated project staff are responsible for implementing this SOP. All personnel performing the procedures addressed in this SOP are required to have appropriate health and safety training, health monitoring, and supporting documentation as specified in the project Health and Safety Plan (HSP). In addition, all personnel are required to have a complete understanding of the procedures described within this SOP, and will receive training in these procedures, if necessary.

3.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

SOP No. 11 Sample Handling, Shipping, and Documentation

4.0 NECESSARY EQUIPMENT

The following is a list of necessary equipment:

4.1 GAMMA RADIATION SURVEYING

- Calibrated 2.5-cm NaI scintillation probes (Ludlum Model 44-2 or equivalent) connected to survey meters with scalers (Ludlum Model 12, 2220, 2221, or equivalent). Surveys will utilize instruments calibrated and checked in accordance with manufacturer's recommendations. If multiple survey instruments are utilized at a site, the degree of consistency among the instruments will be determined from inter-comparison checks for both background and check sources.
- Laser Rangefinder, Simmons Model 800 or equivalent, calibrated for 30-meter person-to-person ranging.

4.2 RADON FLUX MEASUREMENT

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- Large-area charcoal canisters consistent with EPA Method 115 (40 CFR 61 App. B).
- Vendor deployment & retrieval instructions
- Shovel and hand trowel
- Fluorescent survey tape

4.3 AIRBORNE RADON MEASUREMENT

- Long-term (AT type) Alpha-track radon detectors with standard (30 pCi/l-day) sensitivity.
- Deployment containers for environmental/weather protection.
- Sampler supports. May utilize 1"x2" boards, metal rods, or utilize local resources, where available, such as bushes, trees, fence posts, or other means of suspending sample holders at a 1-meter or greater height from the ground surface.
- Attachment materials. Nails, staples, duct tape, string, etc.
- Fluorescent survey tape.

Other materials and equipment may be needed based on field conditions.

5.0 GAMMA RADIATION SURVEYING

Gamma radiation surveying will be performed in Mined Area (MA) open pits, along and near Potentially Impacted Area (PIA) haul roads, in PIA downwind areas, and in background areas in support of the Phase 2A/1B RI/FS.

5.1 USING AND READING RADIATION DETECTION INSTRUMENTS

5.1.1 Instrument Check

Each radiation detector (Ludlum Model 44-2 or equivalent) must be checked for proper operation twice each day that it is used (generally at the beginning and end of the working day). It is necessary to first check the condition of the batteries in the survey meter (e.g., Ludlum Model 12 or equivalent) and then to check for proper response to a radiation check source and to background. A copy of the Daily Instrument Check form (Appendix C) should be maintained for each radiation monitoring instrument to record the results of the daily instrument checks. Completed Daily Instrument Check forms should be kept on file as permanent documentation that the instrument was known to be operating properly for measurements made on any given date.

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5.1.2 Battery Check

The knob of the survey meter should be turned to the “Bat” position. If the meter needle is at or below the “Bat” test line on the meter face, replace the “D” size batteries in the meter and re-test. On the Daily Instrument Check form, enter “ok” in “Battery Test” column if batteries were ok; enter “replaced” if the batteries were changed.

5.1.3 Operational Check

Using the calibrated radiation detector / meter pair, measure its response to background radiation and to an appropriate check source by making replicate (up to ten) 1-minute measurements of each in a standard location that approximates background radiation levels. The check source to use and the meter reading that should result are given in the column headings. The instrument reading should agree within ± 20 percent or 2-sigma of the correct value for each detector probe used.

5.1.4 Checked By

Initial the “Checked By” column on the Daily Instrument Check form to record who checked the instrument in case questions arise regarding checking of the instrument.

5.1.5 Meter Scales

Different Ludlum meters have different scales on the meter face that may be labeled slightly differently. The most common meter faces are described below, and their responses can be varied with a sensitivity dial. Most of the meters also have a digital readout giving the integrated count in the scaler window. This count is the total number of counts in the period specified by the preset-time knob, regardless of the meter sensitivity dial setting.

Scales for Scintillation Probes:

The top, “kcpm” scale is for use with the 44-2 scintillation probe (1" x 1" NaI probe). The “k” on the CPM scale means 1000 and the CPM stands for counts per minute. The actual scale range is determined by the scale knob, which is a scale multiplier. The Ludlum meters generally have four meter scale multipliers: 0.1, 1.0, 10., and 100., giving the following meter ranges:

- at x0.1, the range is 0 to 240 cpm,
- at x1, the range is 0 to 2,400 cpm,
- at x10, the range is 0 to 24,000 cpm,
- at x100, the range is 0 to 240,000 cpm.

Another common meter face appearing on some Ludlum meters has a CPM scale labeled from 0 to 4k. On this version the scale multiplier knob works the same, giving four meter ranges:

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at x0.1, the range is 0 to 400 cpm,
at x1, the range is 0 to 4,000 cpm,
at x10, the range is 0 to 40,000 cpm,
at x100, the range is 0 to 400,000 cpm.

Scales for GM Probes:

The middle and bottom scales are for use with Geiger-Mueller probes (Ludlum model 44-38), which are not expected to be widely used in this project. The scales are read as described above for the different multiplier settings using the values shown on the mR/hr scales. The middle mR/hr scale is used with the x0.1, x1, and x10 multiplier settings. The bottom mR/hr scale is used with the x100 multiplier only.

5.1.6 F_S Switch

Use the survey meter with the switch in the “F” position, unless you are on the x0.1 scale, where the needle will move too much. For that scale use the “S” position to give a slower needle response. When using the “S” setting, the detector response to an increased radiation source is significantly slower, and the probe must be moved very slowly across the area being surveyed.

5.1.7 Audio On-Off

The audio responds more quickly than the instrument needle, and can be easier to use than continual visual observation of the needle. Be aware that people usually relate the characteristic clicking sound produced by the speaker with high radioactivity, even if the meter reading is low. Demonstrating the sensitivity of the instrument with a Coleman lantern mantle is useful in reducing their concerns. Ludlum Model 2220 meters have a pitch-dependent audio signal instead of the clicking sound.

5.1.8 Red RES (Reset) Button

Pushing this button brings the meter needle quickly to zero, and is useful for zeroing the meter when moving to a higher scale.

5.1.9 Scintillation Probe, Ludlum Model 44-2

- The Probe has a glass tube inside its metal housing — do not bump or drop the probe.
- Scintillation probe surveys should have the meter set on the “F,” fast response mode unless the x0.1 scale multiplier is being used.
- When surveying, hold the probe by its metal body; do not dangle it by the cable or cable damage can result.

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- When surveying, the end of the probe should be pointed at the surface being surveyed.

5.2 INSTRUMENT CALIBRATION

5.2.1 General Instructions

Radiation detection instruments require periodic calibration in addition to the daily instrument field checks described in Section 5.1.1. A sticker should be present on each instrument indicating the date of the latest calibration and the date the next calibration is due. The Federal Government and most states require calibration once a year. Regardless of the calibration due date, any instrument that fails the daily instrument check or exhibits intermittent failures should be sent in for repair and calibration.

For annual calibration, the entire instrument pair (detector probe and meter) should be returned for calibration as a unit. For example, the survey meter and its probe or probes should be considered a set, and probes should not be interchanged among different survey meters unless equivalent calibration is demonstrated.

5.2.2 Calibration Request Form

The Calibration Request Form (Appendix C), or its equivalent, should accompany the instrument being sent for calibration. Be sure to completely identify the survey meter, probes, instrument case, check sources, etc. that are sent to the calibration vendor. Be sure to specify complete addresses and telephone numbers for persons to receive the return shipment and the billing notice.

The list of calibration services on the form are those to be routinely performed each year. Add to the list any other repairs needed, or other services you are instructed to request. If an instrument is sent for repair before its calibration is due, the instrument should be calibrated after repair to ensure proper operation.

5.2.3 Documentation and Records

Keep a copy of the Calibration Request Form for your records.

When instruments are returned from the calibration vendor they will be accompanied by calibration data sheets. The sheets should be kept in a central file as documentation of the calibration. For field documentation of calibration, the sticker on the instrument is sufficient.

5.2.4 Field Calibration Comparison

The energy-response characteristics of the scintillation probes used for gamma surveys will be evaluated in at least 5 different locations by comparison to a tissue-equivalent survey meter (Model 1010, Health

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Physics Instruments), which gives similar responses to a pressurized ion chamber. The comparison of meter responses will be used to identify any trend adjustments that should be applied to the gamma-ray survey data.

5.3 MEASUREMENT PROCEDURES

5.3.1 Purpose

To determine the external gamma radiation exposure rates in pre-determined areas or along pre-determined transects for use in risk assessments.

5.3.2 Equipment

- Calibrated 2.5-cm NaI scintillation probes (Ludlum Model 44-2 or equivalent) connected to scaler-meters (Ludlum model 12 or equivalent). Surveys will utilize instruments calibrated and checked according to Sections 5.1.1 and 5.2. If multiple survey instruments are utilized at a site, the degree of consistency among the instruments will be determined from inter-comparison checks for both background and check sources.
- Simmons Laser Rangefinder, Model 800 or equivalent, calibrated for 30-meter person-to-person ranging.

5.3.3 Field Set-Up

Health and safety equipment specified in the site-specific HSP will be donned before proceeding with radiation surveying activities.

For transect surveys, identify the intended beginning, intermediate, and final transect survey locations by marking with stakes or other visible markers that have been or can be surveyed or located by GPS to the required accuracy. For road-side or road-center surveys that require only axial surveys, only the initial and final survey points require marking for positive location by Land Survey or GPS if the intermediate points can be suitably estimated by visual location from road edges and by laser-rangefinder spacing between 30-m increments.

For surface material sample location surveys, identify each sample location with stakes or other visible markers, unless already marked. Sampling locations will be surveyed with a GPS or other method as part of the surface material sampling activity.

5.3.4 Survey

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For a transect survey, the basic survey units consist of 30-meter increments along a transect. The survey of each transect will be completed on the day it is started to minimize measurement uncertainty. The gamma radiation survey is conducted at a height of 1 meter above the ground surface to approximate doses to a walking human and to minimize variations arising from ground surface features. Survey results are recorded in counts per two minutes from 2-minute integrated scaler readings for both (a) the starting point of the increment; and (b) the continuous transect survey along the 30-meter increment. The maximum count rate is also recorded from meter observations during the continuous survey.

For a surface material sample location survey, the basic survey units consist of individual surveys at sample locations, typically within some sort of grid. The gamma radiation survey is conducted at a height of 1 meter above the ground surface to approximate doses to a human and to minimize variations arising from ground surface features and at the soil surface to correlate with soil analytical results. Survey results are recorded in counts per minute from three 1-minute integrated scaler readings at both elevations.

5.3.5 Procedure

Transect surveys are conducted by two people communicating by 2-way radio: a *Surveyor* and a *Locator*. The *Locator* marks the first survey point with fluorescent road-marking paint and the *Surveyor* stands at that point for two minutes to complete the point survey. During the 2 minutes, the *Locator* walks approximately 30 meters along the transect to the vicinity of the second point. The *Locator* determines its location by positioning himself in the approximate center of the roadway or transect line, at a distance of 30 m from the *Surveyor*, using the laser range finder, and then marks his new position on the ground with fluorescent paint. Both persons remain in position until the *Surveyor* reports his point survey reading by radio and the *Locator* records it. The *Surveyor* then starts his continuous survey of the 30-meter increment by walking slowly (0.25 meter/second) in a serpentine pattern to the next point, identified initially as the point where the *Locator* is standing. The *Surveyor* watches his meter to note the maximum count rate over the increment. The *Locator* documents any observations or comments about the increment during the continuous survey, and finally records the maximum count rate (from meter observations) and integral count rate (from the scaler reading) reported by the *Surveyor*. Upon completion and recording of the continuous survey, the *Surveyor* begins the next 2-minute point survey while the *Locator* walks 30 meters to the next point to continue the same procedure.

A sampling point survey can be conducted by a single person in the same manner as the point surveys that are made along transects. The person holds the survey probe at a 1-m elevation above the sample collection point and accumulates three 1-minute counts. The results read from the scaler are recorded

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as the sampling point measurements. The person then holds the survey probe at the soil surface and records three additional 1-minute counts.

5.3.6 Documentation

Project staff are responsible for documenting radiation survey activities. The written record of the transect survey, created by the *Locator*, includes the information shown on the Record of External Gamma Radiation Survey (Appendix C) and can be recorded on that field form or in a bound field log book.

Field notes will be kept during gamma radiation survey activities. The following information will be recorded in a bound field log book using waterproof ink:

- Names of survey personnel
- Weather conditions
- Survey procedures
- Dates and times of survey activities
- Transect/location designations
- Survey equipment used
- Field instrument calibration information
- Records of visitors
- Other applicable information

6.0 RADON FLUX MEASUREMENT

Radon flux measurements will be obtained in the MA and in background areas in support of the FS.

6.1 MEASUREMENT PROCEDURES

6.1.1 Purpose

To determine radon fluxes from ground surfaces in pre-determined locations for use in feasibility studies.

6.1.2 Equipment

- Large-area charcoal canisters consistent with EPA Method 115 (40 CFR 61 App. B).
- Vendor deployment & retrieval instructions
- Shovel and hand trowel

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- Fluorescent survey tape

6.1.3 Planning

Before mobilization for deployment, check to verify that suitable weather conditions (no rainfall) existed for the preceding 24-hour period and are expected to continue for the intended 24-hour sampling period. Measurements also should not be performed if the ambient temperature is below 35°F or if the ground is frozen.

6.1.4 Deployment

Health and safety equipment specified in the site-specific HSP will be donned before proceeding with deployment or retrieval of radon flux measurement devices. At each selected measurement location, the surface material for exposure of the measurement device should be cleared of loose leaves, pine needles, and debris with a hand trowel or shovel. Flat surfaces should be chosen whenever possible. The device should be deployed by removing the device from the vendor container/packaging and preparing it for exposure following vendor directions. This may involve unsealing the device and/or loading it with a prescribed quantity of granular charcoal. The underlying surface material should not be disturbed and the device should be placed on the cleared surface without penetrating the surface with the rim of the device. Gaps around the device edge should be carefully filled with surface material from around the device. The date and time of deployment and measurement location/device number should be recorded, and survey tape or other identifying markings left to aid in re-location of the device.

6.1.5 Retrieval

The flux measurement devices are retrieved after a nominal 24-hour sampling period (generally between 20 and 28 hours). Devices are retrieved by removing them from the deployment location and immediately re-sealing and otherwise preparing them for return to the laboratory following vendor instructions at each retrieval site. The date and time of retrieval should be recorded, and all requested information furnished to the vendor. Retrieved devices, even after re-sealing, should not be stored in potentially high-radon areas (device storage, ore or pit areas, etc.) before their return to the vendor to avoid unintended contamination. Return to the vendor should occur expeditiously, generally within 24 hours, using an overnight courier to reduce effects from radon decay.

6.2 DOCUMENTATION

Project staff are responsible for documenting radon flux measurement activities. A written record should document the deployment and retrieval of each measurement device, including the information shown on the Record of Deployment and Retrieval of Radon Flux Samplers (Appendix C).

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Field notes will be kept during radon flux measurement activities. The following information will be recorded in a bound field log book using waterproof ink:

- Names of measurement personnel
- Weather conditions
- Measurement procedures
- Dates and times of measurement activities, including date/time of deployment and retrieval
- Measurement location designations
- Field equipment used
- Records of visitors
- Other applicable information

7.0 AIRBORNE RADON MEASUREMENT

Airborne radon measurement will be performed in the MA, open pits, near PIA haul roads, in PIA downwind areas, and in background areas in support of the risk assessments.

7.1 MEASUREMENT PROCEDURES

7.1.1 Equipment

- Long-term (AT type) Alpha-track radon detectors with standard (30 pCi/l-day) sensitivity.
- Deployment containers for environmental/weather protection.
- Detector support. May utilize 1"x2" boards, metal rods, or utilize local resources, where available, such as bushes, trees, fence posts, or other means of suspending detector holders at a 1-meter or greater height from the ground surface.
- Attachment materials. Nails, staples, duct tape, string, etc.
- Fluorescent survey tape.

7.1.2 Planning

Before mobilization for deployment, estimate the measurement duration. For an approximate 90-day or greater sampling duration standard sensitivity (30 pCi/l-day) analysis is sufficient ($30 \text{ pCi/l-day} \div 90 \text{ days} = 0.3 \text{ pCi/l}$ detection limit).

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7.1.3 Deployment

Health and safety equipment specified in the site-specific HSP will be donned before proceeding with deployment or retrieval of airborne radon measurement devices. At each selected location, the detectors should be deployed by removing the detector from the vendor container and preparing it for exposure following vendor directions. This may involve unsealing the detector bag and/or removing foil seals from the detector. The date and time of exposing the detector(s) at a given site should be recorded. The opened detector(s) are then placed into a permeable deployment bag, such as one made from nylon mesh, and attached to a supporting structure at a height of 1-meter or greater. The support may consist of a tree, bush, fence post, or driven rod or board. A separate piece of fluorescent survey tape should be attached to a tree, bush, or post to help locate the detector at the conclusion of the measurement period. Highly-visible locations prone to disturbance or vandalism should be avoided, but careful records should document the location to facilitate retrieval.

7.1.4 Retrieval

The detectors are retrieved after the measurement period by removing them from the deployment bag and immediately re-sealing and otherwise preparing them for return to the laboratory following vendor instructions at each retrieval site. The date and time of retrieval should be recorded, and all requested information furnished to the vendor. Retrieved detectors, even after re-sealing, should not be stored in potentially high-radon areas (sample storage, ore or pit areas, etc.) before their return to the vendor to avoid unintended contamination. Return to the vendor should be completed expeditiously to avoid further, unintended exposure.

7.2 DOCUMENTATION

Project staff are responsible for documenting airborne radon measurement activities. A written record should document the deployment and retrieval of each detector, including the information shown on the Record of Deployment and Retrieval of Airborne Radon Samplers (Appendix C).

Field notes will be kept during airborne radon measurement activities. The following information will be recorded in a bound field log book using waterproof ink:

- Names of sampling personnel
- Weather conditions
- Measurement procedures
- Dates and times of measurement activities
- Detector location and designations

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- Records of visitors
- Other applicable information

Appendix C

Field Forms

MIDNITE MINE

FIELD SAMPLING DATA SHEET FOR SURFACE MATERIAL SAMPLES

Location Identification:		Date:
Samplers' Signature:		Time:
Type of Sample:	Surface:	Subsurface:
	Composite:	Grab:
Type of Surface Cover:		
Depth Interval:		
Weather Conditions:		
Sample Identification:		
Lithologic Description (i.e., sand, silt, clay)		
USCS Abbreviation		
Color		
Staining		
Odor		
Moisture		
Rad Meter Reading		

Containers	Number	Preservatives

QA/QC Samples Collected:
Comments:

Appendix C

FieldForms

INSTRUMENT CALIBRATION REQUEST

Calibration Vendor:

Ludlum Measurements, Inc.
Attn: Calibration Laboratory
501 Oak Street
Sweetwater, TX 79556
915-235-5494

OR

Health Physics Instruments
330 D South Kellogg Ave.
Goleta, CA 93117
805-967-8422

Instruments Shipped:

Ludlum Model 3, Serial No. _____

Ludlum Model 44-38, Serial No. _____

Ludlum Model 44-2, Serial No. _____

Number of Cables: _____

Check Source (Identify): _____

Instrument Case (Identify): _____

Other: _____

Services Requested:

_____ Calibrate Model 3 and 44-38 at 900 volts.

_____ Affix calibration sticker indicating calibration date and re-calibration due in one year.

_____ Plateau check 44-2 for operation at 900 volts, modify probe if necessary.

_____ Determine 44-2 count rate at 1 mR/hr, Cs-137 _____ or Ra-226 _____

_____ Other (identify repairs needed):

Return Shipment to:

Attn: _____

Address: _____

Telephone: _____

Return Shipment by:

Fed. Exp ., UPS 2nd day Air, etc.: _____

Bill To:

Purchase Order No. _____

Attn: _____

Address: _____

Appendix C

FieldForms

RECORD OF EXTERNAL GAMMA RADIATION SURVEY

Survey Date _____

Name of Surveyor _____

Name of Locator _____

Scaler/Ratemeter Model _____ S/N _____

Next Calibration Due: _____

Daily Instrument Check Completed? Yes _____ No _____

Starting Location of Transect _____

Direction of Transect _____

Transect Point & Distance (m)	Point Survey (c/2min)	Continuous Survey (c/2min)	Maximum Rate (c/min)	Comments or Observations
1 0	_____	_____	_____	_____
2 30	_____	_____	_____	_____
3 60	_____	_____	_____	_____
4 90	_____	_____	_____	_____
5 120	_____	_____	_____	_____
6 150	_____	_____	_____	_____
7 180	_____	_____	_____	_____
8 210	_____	_____	_____	_____
9 240	_____	_____	_____	_____
10 270	_____	_____	_____	_____
... ... ^a	_____	_____	_____	_____

^a Continued at 30 m intervals until the end of the transect.

Appendix D

Laboratory Technical Scopes of Work

Laboratory Technical Scopes of Work will be available upon request after they are developed.

Appendix E Laboratory Quality Assurance Plan(s) and Standard Operating Procedures

Laboratory Quality Assurance Plans and Standard Operating Procedures may be made available upon request.