Midnite Mine Superfund Site
100 Percent Design

Basis of Design Report

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Prepared for:

Dawn Mining Company
PO Box 250
Ford, Washington 990413

and

Newmont USA Limited
6363 South Fiddler's Green Circle
Greenwood Village, Colorado 80111

Prepared By:

MWH Americas, Inc.
2890 E. Cottonwood Parkway, Suite 300
Salt Lake City, UT 84121

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LIST OF ACRONYMS

ABA	acid base accounting
AES	Advanced Environmental Sciences
ARD	acid rock drainage
bgs	below ground surface
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BODR	Basis of Design Report
BMP	Best Management Practice
BPA	Backfilled Pit Area
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	contaminant of concern
CQAP	Construction Quality Assurance Plan
CRSP	Colorado Rockfall Simulation Program
CSWPPP	Construction Stormwater Pollution Prevention Plan
CWA	Clean Water Act
cy	cubic yards
DMC	Dawn Mining Company, LLC
DOI	U.S. Department of the Interior
DOJ	U.S. Department of Justice
DQO	data quality objective
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESI	Expanded Site Investigation
FS	Feasibility Study
FSP	Field Sampling Plan
gpm	gallons per minute
GSR	Green and Sustainable Remediation
HASP	Health and Safety Plan
HELP	Hydrologic Evaluation of Landfill Performance
HRS	Hazard Ranking System
HSWRP	Hillside Waste Rock Pile
IX	ion exchange
MA	Mine Area or Mined Area
MAA	Mine Affected Area
MGC	Miller Geotechnical Consulting

LIST OF ACRONYMS (continued)

µg/L	micrograms per liter
µR/hr	microroentgen per hour
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
MNA	monitored natural attenuation
MWH	MWH Americas, Inc.
MSHA	Mine Safety and Health Administration
NEPA	National Environmental Policy Act
Newmont	Newmont USA Limited
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	operations and maintenance
OM&M	operations, maintenance and monitoring
OSHA	Occupational Safety and Health Administration
OSWER	EPA Office of Solid Waste and Emergency Response
pCi/L	picoCuries per liter
pCi/m^2-s	picoCuries per square meter per second
PE	Professional Engineer
PCP	Pollution Control Pond
PM	Project Manager
PMP	Performance Monitoring Plan
QA	quality assurance
QAPP	Quality Assurance Project plan
QC	quality control
RA	Remedial Action
RAC	Remedial Action Contractor
RAO	Remedial Action Objective
RAWS	Remote Automated Weather Stations
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
ROD	Record of Decision
SD	Settling Defendant
Site	Midnite Mine Superfund Site
SOP	Standard Operating Procedure
SOW	Scope of Work or Statement of Work
SMP	Site-Wide Monitoring Plan
SWCC	Soil-water characteristic curve
SWMP	Stormwater Management Plan

LIST OF ACRONYMS (continued)

SWRP	South Waste Rock Pile
Tribe	Spokane Tribe of Indians
TERO	Tribal Employment Rights Ordinance
TCLP	Toxicity Characteristic Leaching Procedure
TTDR	Treatability Testing Data Report
TTER	Treatability Testing Evaluation Report
UAO	Unilateral Administrative Order
USGS	United States Geological Survey
UTL	upper tolerance limit
WDOH	Washington Department of Health
WME	Worthington Miller Environmental
WRT	Water Remediation Technologies
WTP	Water Treatment Plant

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

This Basis of Design Report (BODR) has been prepared on behalf of Dawn Mining Company (DMC) and Newmont USA Limited (DMC/Newmont or Settling Defendants) and presents the engineering design for implementing the Selected Remedy at the Midnite Mine Superfund Site (Site). The Site is located in Stevens County on the Spokane Indian Reservation in eastern Washington State, approximately 45 air miles northwest of Spokane (see Figures 1-1 and 1-2). The Site includes an inactive open-pit uranium mine and areas and media impacted by mine-related contamination (see Figure 1-3). Contaminants at the Site include radionuclides and heavy metals mobilized as a result of mining activities and environmental processes, such as acid mine drainage, radioactive decay, and particulate transport in air, surface water, and groundwater. The Remedial Design (RD) included herein has been prepared in accordance with the *Midnite Mine Superfund Site Remedial Design Work Plan, Revision 1* (RDWP; MWH, 2012f)

This BODR is one of many work elements being performed pursuant to the remedial actions set forth in the *Midnite Mine Superfund Site Record of Decision* (ROD; United States Environmental Protection Agency [EPA], 2006a) and a RD/Remedial Action (RD/RA) Consent Decree (CD) lodged by the United States District Court on 17 January 2012 (EPA, 2011). This BODR presents the design documents that are necessary to implement the Selected Remedy identified in the ROD and the CD (including the Statement of Work [SOW] attached as Appendix B to the CD). The main components of the Selected Remedy include:

- Consolidation and containment of mine wastes in pits
- Collection and treatment of mine-affected water
- Disposal of residual water-treatment sludge
- Monitored natural attenuation of groundwater

A more detailed description of the Selected Remedy for the Midnite Mine is presented in Section 2.5.

The objectives of the Midnite Mine RD included herein are to prepare engineering plans and technical specifications that: 1) meet the RA objectives (RAOs) and Performance Standards defined in the CD and ROD, and 2) are suitable for procuring construction contractors to implement the Selected Remedy. This version of the BODR presents the 100 Percent Design, which expands on the information presented in the 90 Percent Design that was submitted to EPA on July 31, 2014.

1.2 COMPLIANCE DURING REMEDIAL DESIGN WITH REGULATORY GUIDANCE

This RD has been prepared, and the actual RA activities will be performed, in accordance with the *Superfund Remedial Design and Remedial Action Guidance* (EPA, 1986). The intent is to design the Selected Remedy such that it:

- Complies with the ROD
- Fulfills the CD SOW

EPA guidance documents will be used throughout the design process as the basis for development of work plans, sampling plans, monitoring plans, and other supporting documents. EPA guidance documents used for these purposes include:

- EPA *Superfund Remedial Design and Remedial Action Guidance* (Office of Solid Waste and Emergency Response [OSWER] Directive 9355.0-4A, June 1986) and other EPA RD/RA guidance
- EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans (EPA, 2001)
- EPA QA/G-5, EPA Guidance for Quality Assurance Project Plans (EPA, 2002)
- EPA QA/G-4HW, Data Quality Objectives Process for Hazardous Waste Site Investigations (EPA, 2000)
- Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (OSWER Directive Number 9200.4-17P) (EPA, 1999)
- Monitored Natural Attenuation of Inorganic Contaminants in Ground Water - Technical Basis for Assessment, Volumes 1-3 (EPA/600/R-07/139; EPA/600/R-07/140; and EPA/600/R-10/093) (EPA, 2007a, 2007b, 2010)

Design plans and documents are submitted for review and approval by the EPA.

1.3 PROJECT ROLES AND RESPONSIBILITIES

The overall organizational structure and key personnel for the Site RD is illustrated in Figure 1-4. The responsibility and authority of each organization is presented below.

1.3.1 Environmental Protection Agency

The EPA is the lead agency governing the remediation of the Site. The EPA issued the ROD and CD, and is responsible for approving all plans and reports related to implementing the Selected Remedy. The EPA Remedial Project Manager is Ms. Karen Keeley. The EPA has contracted CH2M Hill as their oversight contractor. The CH2M Hill point of contact is Ms. Kira Sykes.

1.3.2 Dawn Mining Company/Newmont USA Limited

As the responsible party, DMC/Newmont is implementing the Selected Remedy in accordance with the CD. DMC/Newmont has overall responsibility for procuring consultants and contractors to perform the work, budgeting and securing the necessary funds, and ensuring that the requirements of the CD are met. The DMC/Newmont Project Coordinator is Mr. Nick Cotts and the Alternate Project Coordinator is Mr. William Lyle.

1.3.3 Spokane Tribe of Indians

The Site is located on lands owned by the federal government and held in trust for the Spokane Tribe of Indians (Tribe) and individual tribal members. The Tribe has given its concurrence with the EPA ROD. Mr. Randy Connolly is the Tribe Superfund Coordinator. The Tribe has access to contract technical support from AESE, Inc. The AESE, Inc. point of contact is Dr. F. E. Kirschner.

1.3.4 Worthington Miller Environmental

Mr. Lou Miller, PE, of Worthington Miller Environmental (WME) is the Supervising Contractor procured by DMC/Newmont to implement the Selected Remedy. As the Supervising Contractor, Mr. Miller will direct and supervise all aspects of the RD/RA in accordance with the CD. He also is responsible for coordinating with the necessary agencies and authorities to identify any permit requirements associated with implementation of the remedy.

1.3.5 MWH Americas, Inc.

MWH Americas, Inc. (MWH) is the RD Engineer, and reports to the Supervising Contractor. MWH prepared the bulk of the information included in this BODR. The specific individuals involved and their respective roles are as follows:

Project Manager. Mr. Vance Drain is the MWH Project Manager (PM) and main point of contact for the Supervising Contractor. He is responsible for the contractual commitments and for ensuring that the necessary resources are dedicated to the project. As MWH Project

Manager, he defines and clarifies the scope of work and objectives for each major activity, and then ensures the technical, budget, and schedule requirements are met.

Mr. Drain is a professional geologist with a bachelor's degree in geology and a master's degree in earth sciences. Mr. Drain has over 28 years of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) experience and has managed several complex, interdisciplinary remediation projects for CERCLA and RCRA sites throughout the western United States, including EPA Region 10.

Engineering Manager. Mr. Clint Strachan is the MWH Engineering Manager and the primary design interface to the MWH Project Manager. He is responsible for coordinating the necessary resources to accomplish the design of the various elements and to complete the RD phase on schedule. He ensures that the various plans and design submittals meet the requirements of the CD and the SOW in Appendix B of the CD.

Mr. Strachan is a registered professional (civil) engineer (registered PE in Washington) with a technical specialty in geotechnical engineering. Mr. Strachan has over 32 years of experience with the development, design, permitting, construction, operation, and reclamation of mine facilities. Project experience has included tailings impoundments, heap leach facilities, water storage dams, sedimentation dams, and storage ponds. Mr. Strachan's work experience includes site selection, site evaluation and investigation, analysis and design, waste material characterization, project permitting, construction QA/QC, and expert witness work. Mr. Strachan has a bachelor's degree in agricultural engineering and a master's degree in civil engineering.

Water Treatment Lead Engineer. Mr. Dan Dupon is the lead engineer for the water treatment component of the Selected Remedy. Mr. Dupon is experienced with the treatment of mining-impacted waters, their inherent chemical complexity, and the broadening field of advanced treatment technologies. Mr. Dupon offers a unique ability to define solutions for a vast array of water-quality challenges. During his 22 years of experience in the industry, he has been dedicated to developing and implementing treatment investigations that range from conceptual process development and bench-scale tests to full-scale design and operation. The range of technologies that Mr. Dupon has direct experience with is extensive, including membrane separation, lime softening, enhanced coagulation, ion exchange (IX), and biological reduction. His primary focus has been the evaluation and recommendation of treatment processes for mine wastewaters, as part of reclamation planning and water management. In addition, many of these projects have involved assessing the technical feasibility of passive and innovative technologies, with the objective of developing costs to support the selection of appropriate long-term, remediation alternatives.

Project Reviewers. Mr. Michael Gronseth and Mr. Ed Cryer are the earthwork and water treatment Project Reviewers, respectively. Mr. Gronseth and Mr. Cryer oversee all QA/QC related to the RD of the Site. Mr. Gronseth has over 27 years of experience with environmental remediation and served as a QA/QC manager for the MWH for 10 years. In this capacity, Mr. Gronseth has been involved with the development of Corporate QA/QC policies and is responsible for the implementation of contract and corporate QA/QC programs. Mr. Cryer has over 42 years of experience in water quality and environmental studies, municipal, water resources, aquaculture and industrial water and wastewater planning, and engineering projects. His experience includes the preparation of planning studies, contract documents, and designs for municipal and industrial water and wastewater systems and industrial, water resources and mining processing and pollution control facilities.

1.4 REPORT ORGANIZATION AND SUMMARY OF CONTENTS

The remainder of this BODR is comprised of the following sections:

- Section 2.0 describes the site background, site characteristics, nature and extent of contamination, a summary of the remedial actions completed to date, and a summary of the ROD and Selected Remedy.
- Section 3.0 summarizes the results of the design investigations.
- Section 4.0 summarizes the remedy Performance Standards as defined in the CD SOW. Section 4.0 also presents the Remedial Design Components that define how the Selected Remedy will be implemented at the Site, and where the associated design details and/or supporting documentation can be found within this BODR.
- Section 5.0 presents the references used in this BODR.

In accordance with the CD SOW (i.e., specifically Sections 3.9.1, 3.9.2, and 3.9.3) and the RDWP, this design submittal includes the following (at a 100-percent level of detail). For reference, the location of this information is included after each bullet (in parentheses).

- Summary of data and references used in the design, including results of design investigations (Section 3.0, and engineering design Appendices A through J and Appendix AA).

- 100-percent-level design calculations and sketches (engineering design Appendices A through J and Appendix AA).
- 100-percent-level design of rockfall protection systems, including documentation of the evaluation of rockfall mitigation measures for shallow, intermediate, and deep instability (Appendix D – Mine Waste Excavation and Containment).
- Water balance analyses (Appendix E – Water Management Ponds).
- Material Balance Analysis/construction scheduling (Appendix D – Mine Waste Excavation and Containment).
- Grading Plans based upon Material Balance Analysis (Appendix D – Mine Waste Excavation and Containment).
- Dewatering system design calculations (pipe and pump sizing, etc.), configuration, sub-drain and slope drain material requirements (permeability, material, and filter compatibility requirements), load calculations on sub-drain piping, for Pits 3 and 4 (Appendix D – Mine Waste Excavation and Containment).
- Pit liner – material requirements, survivability vs. load, anticipated strain, etc. (Appendix D – Mine Waste Excavation and Containment)
- Settlement and deformation analyses – backfilled pits (Appendix D – Mine Waste Excavation and Containment).
- Cap/Cover Design (material requirements, compatibility with settlement/strain estimates, veneer stability) (Appendix D – Mine Waste Excavation and Containment).
- Surface Water Management (hydrology and design of controls for intermediate construction and final reclamation phases) (Appendix F – Surface Water and Sediment Controls).
- Storage Ponds (configuration, construction material balance analyses, hydrology, stability) (Appendix E – Water Management Ponds).
- 100-percent-level calculations for design of groundwater collection system(s) (Appendix D – Mine Waste Excavation and Containment; Appendix G – Groundwater Controls).
- Backfilled Pit Area (BPA) – Waste containment design (material balance analyses; design calculations for dewatering systems, pipe, pump capacities, etc.) (Appendix D – Mine Waste Excavation and Containment).

- Water Treatment Plant calculations (Appendix I). (Note that the Water Treatment Plant design is held at the 60% level pending re-issue of the NPDES Permit. As such, Appendix I is not included in this 100% Design Submittal, and where mentioned below please refer to the 60% BODR (MWH, 2013f))
- Design assumptions and parameters, including waste material volume estimates, borrow material estimates, materials management strategies, pit capacity estimates, compaction requirements, surface and groundwater volume estimates, cover design parameters, liner design parameters, water treatment facility parameters (including a process flow diagram and process instrumentation diagram), sludge-disposal facility parameters, treatment outfall parameters, haul and access road improvements, erosion and surface water controls, pit drainage and extraction systems, and pit backfill parameters (Appendix D – Mine Waste Excavation and Containment; Appendix I – Water Treatment Plant; Appendix J – Influent/Effluent Pipeline Design).
- Design criteria for covers and liners, including permeability, porosity, re-vegetation, soil amendments, moisture, radiation and radon flux attenuation, material specifications, and thickness (Appendix D – Mine Waste Excavation and Containment).
- Demonstration that the design will attain the Performance Standards through supporting technical documentation, justification and quality control procedures (Section 4 and engineering design appendices A through J.).
- Expected long-term monitoring and operation requirements (Appendix Q – Site-Wide Monitoring Plan [SMP] and Appendix P Operations Maintenance and Monitoring Plan [OM&M Plan]).
- Stormwater Management Plan (SWMP) including a Best Management Practice (BMP) catalog (Appendix O).
- Substantive environmental compliance documentation, including a biological assessment, Endangered Species Act (ESA) consultation, and Clean Water Act (CWA) requirements (Appendix M).
- Blue Creek and Delta Assessment Work Plan (Appendix Y).
- 100-percent-level design drawings and schematics. The drawings in this submittal include an overall site plan, anticipated limits of excavations, soil stockpiling and laydown areas, surface water management facilities, decontamination facilities, and a

preliminary grading plan. (Volume II – Design Drawings and associated schematics are provided in appendices A through J and Appendix AA).

- Technical Specifications (Appendix K).
- 100-percent-level RA confirmation sampling and verification plan to demonstrate achievement of RAOs, and/or cleanup levels for components of the RA (Appendix S).
- Siting, easements or rights of way, documentation related to the reissued NPDES permit for the WTP, and other regulatory and administrative requirements for access, remedy construction, and operations and maintenance (O&M) (Appendix M and Appendix N).
- Construction Quality Assurance Plan (CQAP) that describes the site-specific components of the quality assurance program such that the completed project meets or exceeds all design criteria, plans, and specifications (Appendix U).
- 100-percent-level construction schedule, including construction sequencing and a description and schedule for all associated siting and discharge permit requirements (Appendix X).
- Procurement Plan describing the contracting strategy, including contracting terms and conditions, certifications, qualifications and training requirements, health and safety training, contract submittals, and requirements for compliance with applicable laws, including Tribal Employment Rights Ordinance (TERO) (Appendix V).
- Estimate of remedy implementation cost including long-term operation, maintenance, and monitoring. This 100-percent design cost estimate has an accuracy of +20 percent to -10 percent of the actual known implementation costs (Appendix W).
- Detailed plans for re-vegetation, including technical and performance specifications, for re-vegetation of disturbed areas following construction (Appendix D – Mine Waste Excavation and Containment).
- A Well Decommissioning Plan describing how monitoring wells and piezometers (other than those retained for ongoing monitoring) will be abandoned during the RA (Appendix Z).
- A Green and Sustainable Remediation (GSR) evaluation of each core elements as recommended by the EPA (engineering design appendices B through J):
    - Total energy use and renewable energy use

- Air and atmospheric pollutants and greenhouse gas emissions
- Water use and impacts to water resources
- Materials management and waste reduction
- Land management and ecosystem services

2.0 PROJECT DESCRIPTION

This section provides an overview of the Site and a summary of information assembled during the Site Remedial Investigation/ Feasibility Study (RI/FS). The section includes descriptions of the conceptual site model, physical setting, and RI sampling results, including background levels of contamination. Unless otherwise noted (or updated where appropriate to reflect current conditions), the information in this section was taken from the following documents:

- *Midnite Mine Remedial Investigation Report* (EPA, 2005a)
- *Midnite Mine Feasibility Study Report* (EPA, 2005c)
- *Midnite Mine Superfund Site Record of Decision* (ROD; EPA, 2006)

The above documents (which are in the Administrative Record) should be referenced for more detailed information.

2.1 SITE HISTORY AND ENFORCEMENT ACTIVITIES

In 1954, Tribe members and prospectors Jim and John LeBret found uranium in an area of the Spokane Reservation. The LeBret brothers and several other Tribe members formed Midnite Mines, Inc. and secured mining leases at the Site. The Dawn Mining Company was subsequently formed, with Newmont Mining Company as the 51 percent shareholder and Midnite Mines, Inc. owning 49 percent. Newmont USA Limited is the corporate successor of Newmont Mining Company. This document refers to Newmont Mining Company and its successors collectively, as Newmont or Newmont USA Limited.

Midnite Mine was initially operated from 1954 until 1965, providing uranium under contracts with the United States Atomic Energy Commission. Following four years of inactivity, mining resumed in 1969, providing uranium under contracts with the energy industry. Mining activities were suspended in 1981, when the price of uranium dropped steeply, and were never resumed. Mine operations were overseen by a series of United States Department of the Interior agencies, including U.S. Geological Survey, U.S. Bureau of Mines, and U.S. Bureau of Land Management (BLM) Minerals Management Service. The Bureau of Indian Affairs (BIA) represented the Tribe and individual tribal allotment owners in matters related to leases and royalties.

Approximately 5.3 million tons of ore and proto-ore and 33 million tons of waste rock were removed from nine open pits between 1955 and 1981. About 2.4 million tons of ore and proto-ore were stockpiled on site. Waste rock was used to backfill a series of previously mined pits, construct roads, and grade the Site, or was placed in one of several waste rock piles. Pit 3 and Pit 4, the two pits mined last, were not backfilled and remain open.

Ore from Midnite Mine was processed at the Dawn Mill established adjacent to the reservation in the town of Ford, Washington. Approximately 2.9 million tons of ore were transported off Site and processed at the mill, producing approximately 11 million pounds of "yellowcake" (milled uranium oxide [U_3O_8]). The Dawn Mill is being closed under Washington Department of Health (WDOH) oversight, pursuant to the Uranium Mill Tailings Radiation Control Act.

In the late 1970s, contaminated seeps were observed at the toe of the largest Midnite Mine waste rock piles. Pursuant to a BLM order, DMC constructed an impoundment (the Pollution Control Pond, or PCP) in 1979 to capture the seeps for evaporation. Following the suspension of mining in 1981, DMC began pumping water from the PCP to the now inactive Pit 3 in response to growing quantities of water in the PCP and newly identified seeps at the base of the largest waste rock pile.

In 1980, DMC performed partial reclamation of the side slopes of the South Waste Rock Pile (SWRP) with approximately eight inches of stockpiled topsoil, which was seeded with a mixture of grasses and planted with trees. DMC performed certain stabilization and security measures at the Site required by BLM, including construction of and periodic improvements to the seep collection system; construction of a sedimentation basin at the toe of a steeply sloped waste rock pile located to the east of Pit 4; and installation of surface water controls such as a diversion trench, pipes, and channels. Data collection also was required and included monitoring of surface water quality and flow and groundwater quality in Site wells. In the mid-1980s, BIA installed a barbed wire fence along the mine lease perimeter and in the drainage area to prevent cattle from entering contaminated areas.

In 1987, DMC and EPA entered into a Compliance Order under the CWA that required DMC to eliminate discharges of pollutants to waters of the United States. In response, DMC constructed a seep collection and pumpback system to collect water from the Western Drainage and Central Drainage and to pump that water to the PCP and Pit 3. The system incorporated seep collection that had been ongoing at the East Seep since 1978. Seeps appearing in the Central Drainage down gradient of the unlined PCP also were collected.

In 1988, DMC constructed a WTP to treat the growing quantities of water in the open pits. A 1991 BLM order required DMC to dewater the pits in compliance with a NPDES permit issued by EPA in 1986 (Permit No. WA-002572-1). In 1992, the WTP began treating water using barium chloride and hydrated lime to precipitate radium, heavy metals and uranium, and final clarification to reduce suspended solids. Treated water is discharged to the East Drainage at the Site pursuant to the NPDES permit.

The water treatment process concentrated uranium and produced sludge with uranium concentrations of regulatory significance. Consequently, the Atomic Energy Act license requirements applied. WDOH, under the authority of the Nuclear Regulatory Commission Agreement State Program, issued the license (Radioactive Materials License WN-I0390-1) in 1992.

The BIA terminated the mining lease held by DMC in 1991, but did not terminate the site management and reclamation obligations of the lease.

In 1991, DMC submitted a mine reclamation plan. This plan was not accepted by BLM. BLM initiated scoping of the studies for an Environmental Impact Statement (EIS) in 1995 for mine reclamation under the National Environmental Policy Act (NEPA). In 1996, DMC produced a revised Reclamation Plan. BLM considered the revised plan sufficient for inclusion as one of several reclamation options to be evaluated under NEPA following additional site studies.

In 1997, the Federal Government entered negotiations with DMC and Newmont for study and cleanup of the Site in compliance with CERCLA and NEPA requirements. In 1998, negotiations involving the U. S. Department of the Interior (DOI), EPA, and the U.S. Department of Justice (DOJ) led to an interim agreement between DOJ, DOI, DMC, and Newmont. The 1998 Interim Agreement called for data collection at the Site and temporary dewatering of the backfilled pits. Negotiations for an overall site settlement continued.

In 1998, EPA performed an Expanded Site Investigation (ESI) and scored the Site using the Hazard Ranking System (HRS) to determine the eligibility of the Site for inclusion on the National Priorities List (NPL).

DMC and Newmont fulfilled the requirements of the 1998 Interim Agreement, including data collection and temporary dewatering of backfilled pits at the mine. The field work was conducted in 1999 and 2000, followed by reporting in 2000 and 2001.

In late 1998, EPA determined that negotiations for an overall site settlement were unsuccessful and, with Tribe support, proposed the Site for the NPL in February 1999. Negotiations with DMC in 1999 to conduct a RI/FS were unsuccessful, leading to an RI/FS conducted and funded by EPA. EPA performed the RI/FS from 1999 to 2006. The Final Rule for the inclusion of the

Midnite Mine Site on the NPL was issued in May 2000. In 2005, the United States filed a claim against Newmont and DMC for response costs incurred at the Site.

The *Midnite Mine Superfund Site Record of Decision* (ROD) was signed by the Director of the Environmental Cleanup Office of the EPA, Region 10 on September 29, 2006. The ROD presents the final remedy for the Site as selected by the EPA, with concurrence by the Tribe. A summary of the ROD and Selected Remedy is presented below in Section 2.5.

On November 7, 2008, following a court ruling on the cost claim, EPA Region 10 issued to DMC and Newmont a Unilateral Administrative Order (UAO) for Phase I Remedial Design and Remedial Action, EPA Docket No. CERCLA-10-2009-0026, with an attached Statement of Work (SOW) (EPA, 2008a). In accordance with the UAO, DMC and Newmont performed certain RD and RA tasks, including ongoing water treatment and residuals management, site fencing, interim measures to reduce contaminant loading to Blue Creek, and a number of pre-design investigations (summarized in Section 3.0). A complete list of project-related documents dating back to issuance of the UAO is included in Appendix D of the RDWP (MWH, 2012f).

A CD for remedy implementation was negotiated among the parties and became effective upon entry into US District Court on January 17, 2012. The CD and attached SOW define the specific actions that DMC and Newmont will undertake to design and implement the Selected Remedy at the Site in accordance with the ROD and the SOW contained in the CD. This BODR is a requirement of the CD, and has been prepared in accordance with the CD SOW and *Superfund Remedial Design and Remedial Action Guidance* (EPA, 1986).

2.2 CONCEPTUAL SITE MODEL

Open pit mining at Midnite Mine involved blasting bedrock and managing the resulting materials as uranium ore, rock with uranium marginally below ore grade (known as “proto-ore” or “protore”), or waste rock of no economic importance. Most ore was hauled by truck to the mill, but ore that was not hauled off site was stockpiled, as was proto-ore. Some ore and proto-ore stockpiles were incorporated into growing waste rock piles over time. Waste rock was used to fill previously mined open pits, placed in waste rock piles, or used for site grading and road construction.

Mining accelerates the process of physical, biological, and geochemical weathering of rock. Exposed rock surfaces oxidize, and, in the presence of certain sulfide minerals, a process called “acid rock drainage” (ARD) causes water contacting exposed rock surfaces to become acidic. The acidified water dissolves minerals (including metals and radionuclides) in the rock, mobilizing the minerals into groundwater and surface water. Exposure to affected media can reach levels that pose a threat to humans and the environment. ARD and the movement of fine particles into and along surface water drainages may also cause contamination of sediments.

At Midnite Mine, mining activities such as blasting, excavation, and disposal of rock have exposed the rock surfaces and enhanced the oxidation process. Uranium-bearing rock is exposed in open-pit walls and in ore, proto-ore, and waste rock stockpiles on the ground surface and in previously mined open pits, leading to elevated levels of radioactive decay products (such as radon gas) and ionizing radiation. Humans, plants, and animals may be exposed to elevated concentrations of metals and radionuclides in surface water, groundwater, soil, and sediments, as well as increased levels of radon in air and direct radiation exposure.

The primary sources of contamination at the Site are related to exposed uranium-bearing rock, with the primary release mechanisms being oxidation, ARD, and radioactive decay. Contaminant migration pathways include surface-water flow, groundwater flow, wind erosion and deposition, and sediment transport. Potential receptors include people who visit the Site for recreational, commercial, or subsistence purposes, as well as potential future residents of the Site. Potential ecological receptors include plants growing in contaminated media and animals living on or using the Site.

2.3 SITE PHYSICAL CHARACTERISTICS

2.3.1 Surface Features

Midnite Mine was developed on the south slope of a ridge that separates Blue Creek and Sand Creek, streams that flow to the southwest across portions of the Spokane Indian Reservation (see Figure 1-2). The Site encompasses areas where physical disturbances caused by mining are apparent (the Mined Area; MA) and areas where media are affected by contaminant transport (the Mine Affected Area; MAA).

As shown on Figure 1-3, key site features include the following:

- Open pit mines, Pit 3 and Pit 4 (both partially filled with water).
- An area of interconnected open pits filled with waste rock (the BPA).
- Waste rock fill and waste rock piles (SWRP, Hillside Waste Rock Pile, and others).
- Seven or more piles of rock stockpiled as ore or “proto-ore” (near ore grade).
- A seep collection and pumpback system and WTP.

- Mine roads and buildings, including sheds where rock cores are stored.
- Surface water conveyances and impoundments (such as the PCP).
- Natural drainages that receive surface water from the MA.
- Blue Creek, which receives water from the mine drainages.

Waste rock from the mining process was deposited on the Site in waste rock piles; backfilled into an area of older, interconnected open pits (the BPA); and used to contour the Site and to construct roads. The largest waste rock pile is the South Waste Rock Pile, located downhill from the open pits (Pit 3 and Pit 4). Contaminated seeps occur at three primary locations at the toe of the South Waste Rock Pile, where previous surface water drainages emerge from the waste rock fill. The quality of water in the BPA is poor and is believed to contribute to the seeps near the PCP. West of Pit 4 is the more recent Hillside Dump, and south and east of Pit 4 are areas of waste rock fill.

Ore-grade or near ore-grade (protore) rocks were stockpiled during the course of mining, including ore-grade rocks that were too high in calc-silicate minerals to mill cost-effectively (Lime Protore). Seven discrete stockpiles are located at the surface, and pockets of similar material are reportedly buried in waste rock, including the BPA.

Two gravel haul roads lead from the MA to the paved BIA road (Operable Unit 2) used to transport ore to the mill at Ford, Washington. The gravel haul roads are reportedly surfaced with crushed waste rock from the mine.

Three drainages (Eastern, Western, and Central) carry surface water from the MA to Blue Creek. Blue Creek originates at Turtle Lake southeast of Midnite Mine and flows to the Spokane River Arm (Spokane Arm) of Franklin D. Roosevelt Reservoir (Lake Roosevelt), the reservoir formed by the Grand Coulee dam. There is a distance of approximately 3.5 miles from the point where the combined flow of the mine drainages enters Blue Creek to the Spokane Arm (see Figure 2-1).

2.3.2 Topography

Midnite Mine is located in a mountainous region with approximately 2,500 feet of relief in the general vicinity of the Site (see Figure 2-1). The area disturbed by mining is approximately 350 acres and falls largely within a single watershed that drains to the south. Adjacent Spokane Mountain is approximately 3,870 feet above mean sea level. Elevations in the watershed range from 3,400 feet at the ridge top to about 2,100 feet where the primary surface drainages join

Blue Creek. From this point, Blue Creek flows 3.5 miles to the Spokane Arm of Lake Roosevelt, dropping over 600 feet in elevation.

2.3.3 Meteorology

The climate is characterized by warm, dry summers and moderately moist, cold winters. Between 1992 and 2013 the mean annual temperature at the nearby Midnite Mine RAWS station was approximately 49 degrees F, with monthly average temperatures ranging from 28.2 degrees F in December to 71.9 degrees F in July.

Average annual precipitation at Midnite Mine between 1992 and 2013 was about 16.5 inches, and monthly average precipitation ranges from about 0.3 inch in August to 2.1 inches in December. Of the total annual precipitation, 36 percent falls in April through September.

Monthly day and night wind speed and direction data indicate that the wind direction appears to be influenced by local topography, diurnal cycles and seasonal temperature changes. Daytime wind directions in the spring and summer months tend to be from the southwest while night winds tend to be from the west and northeast. This likely reflects the rising of warm air up the valley during the day (anabatic wind) and the sinking of cooler air in the evening (katabatic wind). In autumn and winter months, daytime winds tend to include a northeasterly component. Average wind speeds are typically below 13 mile per hour (mph). The Midnite Mine RAWS station data indicate that the area is calm (< 1.2 mph) for more than 30 percent of the record.

2.3.4 Surface Water Hydrology

The majority of the MA footprint is within a sub-watershed contained within the larger Blue Creek Watershed (see Figure 2-2) that ultimately drains into the Spokane Arm of Lake Roosevelt. A small area in the northeast MA is in a separate sub-watershed also contained in the larger Blue Creek watershed, and a small areas in the southwest MA is part of the Far West Drainage (Whitetail Creek) watershed (the Far West Drainage also drains to lake Roosevelt; see Figure 2-2). The MA currently has eight sub-basins, based on topography and diversion structures (see Figure 2-3). Surface water runoff from three of the sub-basins flows to the PCP or to Pits 3 and 4, while the surface water from the other five sub-basins drain to Blue Creek or (in the case of the Far West Drainage) flow directly into an unnamed drainage (sometimes referred to as Whitetail Creek) located between Blue Creek and Sand Creek, and that eventually reports to the Spokane Arm. Three primary drainages (Eastern, Western, and Central) drain the majority of the MA. During water treatment plant operations, treated water is discharged to the East Drainage. Apart from this seasonal discharge, flow in the East Drainage is minimal or absent during the dry summer months and during the winter months when any available water is frozen. The highest surface flow rates occur in the spring during periods of increased rainfall and snowmelt.

Mining operations have altered local hydrology. Upper portions of the three primary drainages were excavated or filled with waste rock during mining. Site grading and compaction of haul roads and truck staging areas increased runoff in some parts of the MA. In other areas, unconsolidated, coarse-grained waste rock, ore, and proto-ore have decreased runoff and increased infiltration rates.

Several facilities were constructed for surface water management, which further modified the surface water flow. These facilities include the PCP, seep collection systems, pipes and culverts that route MA surface water to the PCP and Pit 3, and ditches that divert up-gradient surface water around the MA.

Seeps occur where the Western, Central, and Eastern drainages emerge from the South Waste Rock Pile. This water is currently captured and pumped back to the PCP and Pit 3 where it is stored prior to treatment. Starting about 1,500 feet south of the MA, groundwater discharge provides a small base flow for the lower portions of the three drainages. Several small seeps occur in these lower portions of the Central and Western drainages.

Blue Creek is perennial in a normal year, although natural flows can be very low late in the summer. Blue Creek average daily flow measured upstream of the mine drainages ranged from 0.04 to 60 cubic feet per second (cfs) between 1984 and 2002 (United States Geological Survey [USGS]). The East Drainage and Blue Creek flow during the dry season is dominated by discharge from the water treatment plant (which normally operates April through November, 4 days a week).

The 100-year floodplain is constrained by slopes on both sides of Blue Creek. The MA is above the 100-year floodplain, as is the majority of the MAA south of the mine. A gravel road along Blue Creek within the floodplain (BIA Hwy 55) runs from where the mine drainages enter Blue Creek to where the creek enters the Spokane Arm.

2.3.5 Geology

The bedrock geologic setting of the Midnite Mine and surrounding area is dominated by a granitic quartz monzonite that intruded into a metamorphosed sedimentary (meta-sedimentary) rock, known as the Togo Formation (see Figure 2-4). Much of the overlying meta-sedimentary rock has been eroded away, leaving a “roof pendant” of Togo Formation rock, which is primarily phyllite schist and calc-silicate rocks, including marble, quartzite, and hornfels.

The Togo Formation is the primary host rock for uranium mineralization at Midnite Mine. The ore bodies at the Midnite Mine were localized within the phyllite and calc-silicate hornfels of the Togo Formation, adjacent to the contact with the granitic quartz monzonite intrusion. This contact is the most important geologic feature from an ore density standpoint with the following general relationships:

1) Contact = highest metals, highest uranium
2) Distal monzonite = much lower metals than schist, but higher uranium than schist
3) Distal phyllite = much higher metals than monzonite, much lower uranium than monzonite

Mineralized zones are characterized by an increase in grain size, foliation, and abundance of iron sulfide. Bedding in the phyllite and calc-silicate rocks is oriented generally north-south to north 30 degrees east, and dips about 45 degrees to 70 degrees southeast. Mining followed the contact zone. Generally, on the west side of the MA, the bedrock is predominantly quartz monzonite, while on the eastern side of the MA, the bedrock consists mostly of Togo Formation rock.

Surficial soil deposits overlie the bedrock at the Site, with thicknesses ranging from 0 to over 20 feet. Generally, soil deposits at the Site are thinnest along ridge crests, and thickest along valley bottoms. The soils were laid down by stream and glacial activity and through weathering of bedrock. Deposits from the series of floods from glacial Lake Missoula left sand and gravel deposits in some areas. The hillsides adjacent to Blue Creek downstream of the Oyachen Creek tributary are composed largely of these sand and gravel deposits. Unconsolidated materials in the site area include surficial deposits such as alluvium, colluvium, and glacial deposits, as well as waste rock from mining activities. Weathered bedrock and fractured, more competent bedrock underlie these unconsolidated deposits.

Ore bodies mined at the Midnite Mine were localized within the phyllite and calc-silicate hornfels of the Togo Formation adjacent to the contact with the granitic quartz monzonite intrusion. Eight ore bodies were present at the mine along the intrusive contact for a distance of about 1 mile. The depth to ore was reported to vary from less than 16 feet to about 300 feet. Two ore bodies had no surface expression, and others gave little evidence of their potential at depth. Mining progressed in a northward direction to areas of higher elevation. Consequently, the later pits, Pits 3 and 4, had to be larger and deeper to expose uranium ore along the granite-Togo contact.

The 1981 National Uranium Resource Evaluation identified numerous uranium and other metal anomalies in a study of Midnite Mine and surrounding areas. Some were known ore deposits and others were considered viable as possible areas for mineral exploration. The anomalies were found to occur in both meta-sedimentary and plutonic rocks. Another uranium deposit located less than 5 miles to the southwest of Midnite Mine was developed in the 1970s by Western Nuclear. That mine and co-located mill have been closed and reclaimed.

2.3.6 Hydrogeology

Precipitation that does not leave the Site through evaporation, transpiration, or runoff enters the groundwater flow system. Outside the MA, the amount of water entering the groundwater system is estimated at 10 percent of precipitation or less. Within the MA, as much as 80 percent of precipitation enters the groundwater system because of the coarse texture, high porosity, and high hydraulic conductivity of the waste rock, as well as the relatively sparse vegetation (URS, 2002).

Following the overall topography of the Site, groundwater flow is generally to the south, from the higher elevation recharge areas toward the lower elevation discharge areas (lower portions of the drainages and Blue Creek). Within the sub-basins, groundwater similarly flows toward the drainages. Groundwater levels range from about 130 feet below ground surface (bgs) on the Northwest Ridge to a few feet bgs along the drainages south of the MA (URS, 2002). The downward gradients seen in the recharge areas and upward gradients in lower elevation areas are consistent with a topographically driven groundwater flow system. Local influences on the flow include the mine pits; Pit 3 appears to create a hydraulic sink on all sides and Pit 4 appears to create a similar hydraulic sink, except on the south side of the pit.

After major precipitation events and during spring snowmelt events, interflow moves quickly downward and tends to accumulate along the top of the bedrock. Much of this interflow flows toward the buried drainages across the bedrock or buried pre-mining surfaces and emerges as seeps where the drainages surface at the toe of the South Waste Rock Pile and the East Dump. Because this water moves quickly to surface discharge points, a relatively small portion of this water recharges the underlying fractured bedrock.

Groundwater flow within the bedrock at the Site and the surrounding area is through a continuum of interconnected fractures. Fractures are pervasive throughout the bedrock and are observed in most areas to have relatively close spacing, small apertures, and varied orientation. The weathered bedrock is more altered and thus has higher hydraulic conductivity than the unweathered bedrock. The thickness of weathered bedrock overlying un-weathered bedrock varies over the site from approximately zero to 30 feet, as interpreted from the location of practical hollow-stem auger refusal during the Storage Pond Investigation performed during 2012 (refer to section 3.13). In general, thicknesses of weathered and fractured rock were greater in valley bottoms and less near ridge tops. Increased conductivity also is likely in the contact zone between the Togo Formation and granitic quartz monzonite due to fracturing and below-surface drainage channels, which develop through gradual erosion of structural weaknesses in the rock.

Groundwater recharge to the open and backfilled pits occurs by infiltration of precipitation and snowmelt, interflow along the bedrock surface to the pit walls, and flow from fractures in the bedrock. Groundwater in the Backfilled Pit Area flows southward over the bedrock rims of the pits and along the bedrock surface where it surfaces at the toe of the South Waste Rock Pile in the Central Drainage (at the PCP).

Average annual pit recharge from groundwater is estimated at 7.9 gallons per minute (gpm) for Pit 4 and 16.5 gallons per minute for Pit 3. Average water volumes entering the pits due to direct precipitation into the open pits are estimated at 22 million gallons per year for Pit 3 and 13 million gallons per year for Pit 4 (URS, 2002). Additional empirical estimates of groundwater inflow into Pit 3 and Pit 4 were conducted after the RI as described in Section 3.7.2.

2.3.7 Ecological Setting

The ecologic gradient ranges from subalpine mixed conifer in the upland areas of the Site to semi-arid non-productive conifer/mixed grassland near the Blue Creek delta. The physically disturbed upland areas at the Site provide limited and poor quality habitat for wildlife, but largely undeveloped land surrounds the disturbed areas. Habitat types at and adjacent to the Site are shown on Figure 2-5.

Upland habitat in the area includes forested, grassland, open, and steep sub-habitats. These habitats and their associated plant diversity provide food and cover for a variety of wildlife. In the vicinity of the mine, the dominant forest cover type is Ponderosa pine and mixed Ponderosa/Douglas fir. Although small remnant stands of coniferous forest occur, the upland habitat in the MA has been physically degraded, and plant diversity in the understory is low, dominated by grasses and knapweed. Upland habitat along the mine drainages and Blue Creek is not physically disturbed by mining.

Jurisdictional wetlands occur along the banks of Blue Creek, and at the western, central, and eastern tributaries. The wetlands are "riverine" originating from springs or seeps that appear to flow most of the year. The wetlands in these tributaries range from 10 to 150 feet in width and are primarily scrub/shrub vegetation dominated by mountain alder red alder, red osier dogwood, Douglas hawthorne, redtop, and rocky mountain maple. In addition to the wetlands, riparian communities occur throughout the length of these drainages. Riparian corridors provide important habitat (i.e., food, cover, and water) for wildlife in the area and serve as migratory corridors.

There are several old beaver ponds at the confluence of the eastern and western drainages and small ponds at the upstream side of Westend-Wellpinit Road and at the upstream side of the eastern haul road.   These areas provide a valuable habitat for aquatic life and a water resource for wildlife. Other aquatic habitat that occurs in the MAs includes the open pits and other surface water impoundments; however, these areas contain highly degraded water quality.

Much of the Blue Creek basin is a designated wildlife management area, and the MA pits present an attraction to wildlife such as deer and elk for watering and consuming the salts deposited around the perimeter of the pit lakes. These areas have been fenced since 2009 to preclude large game access.

Habitat at the Site may be used by species that are listed under the Endangered Species Act. Species that have the potential to occur within Stevens County include bull trout, grizzly bear, Canada lynx, and Ute ladies' tresses orchid. Of these species, only bull trout, listed as Threatened under the Endangered Species Act, has the potential to occur at the Site. The Site occurs outside of the current known range for the remainder of the listed species and does not contain the required habitat constituents.

2.4 NATURE AND EXTENT OF CONTAMINATION

EPA initiated the RI/FS in February 1999. A number of plans, technical memoranda, and reports were prepared during the RI/FS. The *Midnite Mine Remedial Investigation Report* (EPA, 2005a) provides greater detail on subjects summarized below. The following section presents the range of concentrations for key indicator contaminants in different areas and media.

2.4.1 Background Concentrations

To provide a background data set for comparison, EPA characterized sediments and surface water in Sand Creek and its tributaries, as well as Blue Creek up stream of the mine and unaffected tributaries to Blue Creek. Sand Creek drains the watershed north of Midnite Mine and roughly parallels Blue Creek as it flows to the Spokane Arm. EPA sampled areas northeast of Midnite Mine, for soils, radon, and gamma radiation, including an area of subsurface uranium deposits. Monitoring wells were installed in alluvium and bedrock to characterize background groundwater in these areas.

The RI presents these results, as well as confirmatory comparisons to background for groups of samples (area or population comparisons). In addition, the RI presents the 95 percent upper tolerance limit (UTL) of MA background reference areas, a value used as a threshold for selection of contaminants to evaluate in the human health risk assessment.. The 95 percent UTL is the upper bound of a statistical interval calculated to include, on the average, a specified proportion of future observations from the same population. The 95 percent UTL is frequently used as a background level for purposes of site cleanup. The 95 percent UTL background concentrations developed in the RI/FS for indicator contaminants in groundwater, surface water, surface materials, and sediments are included in Tables 5-2 and 5-3 of the ROD. The 95 percent UTL background levels of radiation and radon gas are 22.3 microroentgen per hour (μR/hr) and 14 picocuries per liter (pCi/L), respectively (*Human Health Risk Assessment*; EPA, 2005b).

2.4.2 Surface Materials

The waste rock, ore, and proto-ore piles are of variable size and, particularly for the waste rock, contain a mixture of rock type. Although shallow trenching indicates that near-surface materials are oxidized, waste-rock pile seeps with low pH, high sulfates, and elevated contaminant levels indicate ongoing ARD in the MA. Uranium concentrations of up to 482 milligrams per kilogram (mg/kg) were measured in the MA, as compared to a 95 percent UTL of 43 mg/kg in background soils.

In the RI/FS, geotechnical data were used to evaluate slope stability. Overall, the analyses did not identify any large-scale instability of the waste rock piles under current conditions, although the analyses indicated the potential for shallow slope failures in limited areas (such as above the PCP), particularly following heavy rains or seismic events.

2.4.3 Sediments

Samples were taken of sediments in Pit 3, Pit 4, the PCP, and from drainages. Sediment concentrations varied, the highest concentrations of contaminants of concern in sediments were measured in the open pits, and PCP, with generally lower concentrations in the mine drainages and Blue Creek.

RI sediment data for the Blue Creek delta at the confluence with the Spokane Arm were limited to two samples. Sediment concentrations in these samples were not above background estimated in the RI. However, subsequent to the RI, Church, et al. (2008) demonstrates via core sampling that concentrations of COCs in post-mining sediments exceed those analyzed in pre-mining sediments and the concentration of these pre-mining sediments are lower than background estimated in the RI. Additional sediment characterization is proposed for Blue Creek as discussed in Section 3.12.

2.4.4 Surface Water

Site surface water quality reflects the impacts of ARD, with elevated sulfate, radionuclides, and metals concentrations. Contaminant of Concern (COC) concentrations are generally highest in the open pits and PCP, and in drainages to the south of the MA, with concentrations decreasing in Blue Creek presumably because of dilution. For example, measured concentrations of (metallic) uranium in MA surface water ranged from 1,320 to 30,000 micrograms per liter (µg/L), while Blue Creek down gradient of the mine had a range of 7 to 1,000 µg/L. This compares to a maximum background value of 17 µg/L.

Sulfate concentrations range from over 3,000 milligrams per liter (mg/L) in pit waters and 1,500 mg/L in Lower Blue Creek seeps. The maximum sulfate concentration measured in background area surface water was 30 mg/L. Concentrations of $uranium^{234}$ in surface water in the mine drainages ranged from 2.5 to 360 pCi/L as compared to the 95 percent UTL of background of 8.8 pCi/L. Concentrations of $uranium^{238}$ in surface water in the mine drainages ranged from less than 0.735 to 360 pCi/L as compared to the 95 percent UTL of background of 7.6 pCi/L.

2.4.5 Groundwater

Site groundwater quality is affected by ARD processes, as demonstrated by elevated concentrations of metals, radionuclides, and sulfate. Mining-affected groundwater generally is limited to the MA and the surface water drainage basins immediately down gradient of the MA (see Figures 5-5 and 5-6 of the ROD).

Concentrations of total uranium in alluvial groundwater ranged from 3,900 to 54,000 µg/L in the MA, and in the Western Drainage measured from 78 to 2,980 µg/L, as compared to the 95 percent UTL of background of 88 µg/L. Bedrock groundwater concentrations of total uranium (metallic) ranged from 0.14 to 419,000 µg/L. Sulfate concentrations in MA wells ranged up to 3,000 mg/L, compared to a maximum background concentration in groundwater of 187 mg/L. Concentrations of $uranium^{234}$ in alluvial groundwater in the Central and Western Drainages ranged from 28.7 to1,210 pCi/L as compared to the 95 percent UTL of background of 37 pCi/L; and concentrations of $uranium^{238}$ ranged from 25.8 to 1,016 pCi/L as compared to the 95 percent UTL of background of 35 pCi/L. $Uranium^{234}$ and $uranium^{238}$ concentrations in alluvial groundwater were less than their respective UTLs in both the Eastern and Middle Blue Creek drainages.

2.4.6 Gamma Radiation and Radon

Site gamma radiation and radon gas levels are elevated, as indicated by radon flux data, airborne radon measurements, and gamma survey information. Radiation surveys indicate overall elevated gamma radiation levels throughout the MA, with localized areas of significantly higher levels, primarily where ore and proto-ore is stockpiled. Radon levels are also elevated. Gamma-survey transects and samples along the haul roads and adjacent areas indicate elevated levels of radioactivity, caused by mine waste rock materials used in road construction and particulate transport from the road in dust and surface water runoff.

Gamma radiation surveys in the MA indicated a range of 13.1 to 398 µR/hr. By contrast, the highest exposure rate in the MA background reference area was 19.2 µR/hr. Radon measurements in the MA ranged from 1.3 to 372 picocuries per square meter per second (pCi/m^2-s), with a mean of 140 pCi/m^2-s at the stockpiles. By comparison, the maximum background measurement was 11.8 pCi/m^2-s.

2.4.7 Fate and Transport

Contaminant migration has been reduced due to the cessation of mining operations including drilling, blasting, waste rock stockpiling, and ore hauling activities; the re-vegetation of waste rock areas; and water management measures such as seep collection, surface water diversion, and reduced accumulation of water in the pits (EPA, 2006 and Church et al., 2008). However, contaminant transport continues through the following principal pathways:

- Migration of dissolved COCs or suspended solids from ore, proto-ore, waste rock, and other surface materials containing COCs to surface water and groundwater.

- Migration of COCs in surface water downstream in mine drainages and Blue Creek.
- Migration of COCs in groundwater flowing down gradient toward Blue Creek.
- Erosion and deposition of COCs in sediments in the mine drainages and Blue Creek.

The groundwater impacts observed in unconsolidated material are most extensive south of the mine pits. However, the only indication of ARD impacts to alluvial groundwater adjacent to Blue Creek is sulfate; other COCs are below background.

Groundwater impacts in bedrock appear less areally extensive than impacts to alluvial groundwater. Dilution and changes in pH as water moves through the system may be mitigating the impacts of ARD.

2.5 RECORD OF DECISION

The ROD (EPA, 2006) presents the final Selected Remedy for the Site. The Selected Remedy is considered protective of human health and the environment from actual or threatened releases of hazardous substances to the environment. The ROD addresses all contaminated materials at the Site, including surface materials in the MA and mining-affected groundwater, surface water, soils, and sediments.

2.5.1 Remedial Action Objectives

The RAOs for contaminated media at the Site are presented below.

Surface Material and Sediments. Surface material includes soil, ore, proto-ore, waste rock, overburden, and these materials where used in haul road construction. Sediments include sediments in open pits, surface water ponds, creeks, and drainages. RAOs for these materials are:

- Reduce exposure of humans and ecological receptor populations to COCs in and radiation from mining-affected surface materials and sediments to levels that do not result in unacceptable site-related risks.
- Reduce loadings of COCs from surface materials and sediments to surface water and groundwater so that loadings do not result in unacceptable site-related risks.
- Reduce environmental transport of mining-affected surface material from the MA to areas outside of the MA. Prevent people from removing mining-affected surface material.

Surface Water. Surface water includes seeps and water in pits, ponds, and other surface impoundments, and in creeks and drainages. RAOs for surface water include the following:

- Reduce exposure of humans and ecological receptor populations to COCs in surface water to levels that do not result in unacceptable site-related risks.
- Reduce infiltration of surface water into ARD-generating materials and reduce erosion and environmental transport of mining-affected surface materials by surface water.
- Reduce loadings of COCs from surface water to groundwater so that loadings do not result in unacceptable site-related risks.

Groundwater. Groundwater includes subsurface water in unconsolidated alluvium and in bedrock. RAOs for groundwater at the Site include:

- Reduce exposure of humans to COCs in groundwater to levels that do not result in unacceptable site-related risks.
- Reduce loadings of COCs from groundwater to surface water so that loadings do not result in unacceptable site-related risks.

Air. Air RAOs include the following:

- Reduce exposure of humans to radon-222 or its decay products by limiting the average radon-222 release rate from radioactive materials to levels that do not result in unacceptable site-related risk.

2.5.2 Selected Remedy Summary

The Selected Remedy identified in the ROD includes the following:

1) Containment of Mine Waste in Pits:

   - Excavation of above-grade mine waste. Waste to be excavated includes waste rock, ore and proto-ore, stored mine cores, road gravel, contaminated soil, and pit and drainage sediments. It does not include waste rock in the BPA.
   - Consolidation of the excavated mine waste in Pit 3 and Pit 4 to create waste containment areas with a sump, drainage layer, and liner to channel groundwater entering the pits around the waste and into the sump at the bottom.

- Contouring the waste in Pits 3 and 4 and waste in the BPA and construction of a stable vegetated cover designed to minimize surface water infiltration and meet radon and radiation cleanup levels for each waste containment area.

2) Water Collection and Treatment:

- As an interim action pending waste containment, continue collection and ex situ treatment of contaminated seeps and pit water, with on-site discharge of treated water in compliance with interim discharge limits (see Table 2-1).
- Following containment, removal of water that enters Pit 3, Pit 4, and the BPA using pumping wells. Also, collection of any remaining seeps that exceed surface water cleanup levels.
- Design and construction of a replacement water treatment plant and a conveyance for discharge of treated water to the Spokane River Arm of Lake Roosevelt.
- Long-term discharge of treated water to the Spokane River Arm under an NPDES permit.

3) Residuals Management:

- Disposal of water treatment sludge at the Dawn Mill until alternate disposal is required by mill closure (*Note: treatment sludge disposal at the DMC Millsite was discontinued as of December 31, 2013.)*
- Following mill closure, disposal of sludge at a licensed off-site facility, unless the sludge characteristics are modified to allow alternative disposal.

4) Surface Water and Sediment Management:

- Contouring, re-vegetation, and surface water management in the drainage basin to divert clean water away from waste containment areas while minimizing erosion.
- Construction of sediment controls in the mine drainages to prevent sediment transport downstream to Blue Creek.
- Monitoring of Blue Creek and delta areas to assess natural recovery and the need for active remediation.

5) Monitored Natural Attenuation of Groundwater:

- Recovery of groundwater through natural flushing following source control.

- Sampling of groundwater to verify recovery.

6) Institutional Controls and Access Restrictions:

- Permanent institutional controls in waste containment areas and at the water treatment plant to prevent groundwater use and protect the integrity of the remedy.
- Physical access restrictions such as an interim fence and a permanent boulder barrier around containment areas to prevent damage to soil covers and to reduce risk.
- Interim institutional controls to prevent extraction or use of groundwater until cleanup levels are met.
- Interim measures, such as signs, advisories, and community outreach, to minimize public uses of surface water, sediment, and affected food plants outside the waste containment area until cleanup levels are met (see Tables 4-1 thorough 4-5).

7) Long-Term Site Management:

- Long-term monitoring to assess the effectiveness of the remedy, including physical inspections, re-vegetation surveys, groundwater and surface water monitoring, radiation, and radon monitoring.
- Operation and maintenance of the water treatment system, including process monitoring, routine maintenance, and periodic replacement.
- Operation and maintenance of soil covers, wells and water conveyances, surface water controls, and all other elements of the remedy that require maintenance.
- Remedy reviews every five years to assure that the remedy is protective of human health and the environment.

8) Contingent Actions:

- Sediment cleanup in Blue Creek and Blue Creek delta if necessary.

3.0 SUMMARY OF COMPLETED, ONGOING, AND ANTICIPATED DESIGN STUDIES

This section presents a summary of completed, ongoing, and anticipated studies that have been performed, are being conducted, or that may occur in the future to support the design effort for the Selected Remedy at the Midnite Mine. The pre-design data needs initially were identified in the following documents:

- *Pre-Design Data Needs Report for the Phase I RD/RA: Interim Water Management for the Midnite Min*e (Tetra Tech, 2009a)
- *Evaluation of Supplemental RD Data Needs – Revision 2* (MWH, 2012a).

In addition, other investigations have been performed or are underway based on data needs identified after the design was initiated. Work plans were prepared and approved by EPA for the tasks that were necessary to fill the identified design data gaps. Since 2010, the Settling Defendants (SDs) have conducted field activities to complete the data collection necessary for the design elements identified in the *Midnite Mine Superfund Site Record of Decision* (EPA, 2006), the data needs reports referenced above, and other data needs identified by the design team. These studies provide data and information beyond that presented in the *Midnite Mine Remedial Investigation Report* (EPA, 2005a) and are necessary for completing the design of the Selected Remedy. The studies summarized in this section comprise the data/information required to advance the RD through successive stages of the design process (i.e., 30-, 60-, 90-percent, and final design). The data obtained from the completed investigations in most cases are considered sufficient to support the RD process. However, additional data are being collected in ongoing studies, and other data needs may be identified during the RA construction process.

The information presented in this section related to the ***completed*** design studies was obtained from the following reports and technical memoranda:

- *Survey Design Investigation Report* (Tetra Tech, 2010a) – Summarized below in Section 3.1.
- *Geologic Investigations of Pits and Assessment of Sediments Design Investigation Report – Revision 2* (MGC, 2011a) – This report was approved by EPA on April 25, 2011 and is summarized below in Section 3.2.

- *Midnite Mine Rockfall Hazard Monitoring Summary Report* (MWH, 2013b) – Summarized below in Section 3.2.2.
- *Midnite Mine Field Activity Summary Report- Pit Seep Monitoring, Pit 3 and Pit 4 (*Plumley and Associates, 2012) – Summarized below in Section 3.2.4.
- *Borrow Source Design Investigation Report – Revision 2* (MGC, 2011b) and *Technical Memorandum Rhoads Property Borrow Investigation Phase II – Revision 1* (MGC, 2011c) – These reports were approved by EPA on June 3, 2011 and July 12, 2011, respectively, and are summarized below in Section 3.3.
- *Mine Waste Investigations – Revision 1* (MGC, 2011d) and *Technical Memorandum– Mine Waste Characterization* (AES, 2011a) - Summarized below in Section 3.4.
- *Addendum to the Mine Waste Investigations Report, Midnite Mine Hillside Waste Rock* (WME, 2012) - Summarized below in Section 3.4.
- *Site Access Roads Design Investigation Report – Revision 1* (Tetra Tech, 2011a) – This report was approved by EPA on June 3, 2011 and is summarized below in Section 3.5.
- *Midnite Mine - Site Seismicity Analysis* (MGC, 2010) – This report was approved by EPA on April 6, 2010 and is summarized below in Section 3.6.
- *Midnite Mine Design Investigation Report - Groundwater Investigations – Revision 2* (MGC, 2011e) – This report was approved by EPA on June 13, 2011 and is summarized below in Section 3.7.
- *Surface Water Design Investigation Report – Revision 1* (Tetra Tech, 2011b) – This report was approved by EPA on June 14, 2011 and is summarized below in Section 3.8.
- *Midnite Mine Ion Exchange Treatability Testing Data Report – Revision 2* (TTDR; Tetra Tech, 2010b) – Summarized below in Section 3.9.
- *Ion Exchange Treatability Testing Evaluation Report – Revision 1* (TTER: Tetra Tech, 2010c) – Summarized below in Section 3.10.
- *Pilot-Scale Test Results for Uranium Removal Using Anionic Exchange Resins and Chemical Precipitation - Revision 0* (MWH, 2012h) – Summarized below in Section 3.11.
- *Storage Pond Investigation Report, Revision 0* (MWH, 2012g) – Summarized below in Section 3.13.

- *Summary of 2013 Blue Creek Geotechnical Investigation – Revision 0* (MWH, 2013e) – Discussed below in Section 3.15.
- *White Tail Creek Sediment Evaluation – Phase 1 Data Transmittal Report* (WME, 2014d) and *White Tail Creek Sediment Evaluation – Phase 2 Data Transmittal Report* (WME, 2014e) – Summarized below in Section 3.16.
- *Man Camp Water Supply Well Data Evaluation Report, Revision 1* (WME, 2015) – Summarized below in Section 3.17.
- *Backfilled Pits Area Pumping Plan - Boyd Pit and Pit 2 Final Phase 2 Data Transmittal Report, Rev 0* (WME, 2014g) – Summarized below in Section 3.18.
- *Geocomposite Interface Testing Work Plan, Revision 1* (MWH, 2013a) - EPA approved this work plan on September 26, 2013 and it is summarized below in Section 3.19.
- *Ford Borrow Material Soil-Water Characteristic Testing Results Report* (MWH, 2014a) – Summarized below in Section 3.20.
- *Well Installation at Blue Creek near the Midnite Mine* (WME, 2014f) – Summarized below in Section 3.21.
- *Alluvial Groundwater Collection System Geotechnical Investigation Work Plan, Revision 1* (MWH, 2014b). This work plan was approved by EPA on July 2, 2014 and is discussed below in Section 3.22.

The information presented in this section related to the ***ongoing*** studies was obtained from the following work plans:

- *Blue Creek and Delta Assessment Work Plan – Revision 0* (MWH, 2011b) – Discussed below in Section 3.12.
- *Data Collection for NPDES Permit Application Work Plan - Revision 3* (Rescan Consultants, Inc., 2011) – Discussed below in Section 3.14.

The summaries of the completed and ongoing design studies contained below are intended to provide the design study backgrounds and relevant results and conclusions. However, these summaries are not comprehensive and the documents listed above should be referenced if more detailed information is required.

Anticipated Studies - Additional future studies may be needed after the RA starts to support refinement or revisions to the design. For example, it is anticipated that a geotechnical investigation may be performed at the planned location of the West Pond after the thick layers of overlying mine waste have been removed from that area, but before the area is completely remediated. The resulting data may be used to refine the West Pond design based on actual field conditions before the pond is built. Other currently unanticipated studies may be deemed necessary during the RA if the performance standards are not being met or to gain construction or operational efficiencies. When these studies are identified, the SDs will coordinate these efforts with EPA and the Tribe, including preparing planning documents and developing objectives. No other data needs are anticipated at this time to complete the RD.

3.1 SURVEY DESIGN INVESTIGATION

The primary survey investigation objectives were to develop updated and refined topographic base map(s) and color orthophotography of the mine area (MA), mine-affected area, adjacent areas and the proposed borrow area(s), which can be used for RD and with other design investigation information to:

- Determine the location of existing site features (roads, fences, drainages, channels, vegetation, pipelines, buildings, and pits)
- Provide a tool to aid in determining the boundaries of waste rock piles and ore/protore stockpiles
- Determine pit capacities
- Determine waste quantities that will be consolidated
- Provide data, including information to develop cross sections, for other major design elements and site hydrologic design
- Develop topographic base map(s) of potential borrow area(s) for determination of material quantities.

Surveys were performed to provide data for the RD, including:

- Topographic survey and color orthophotography of Midnite Mine and adjacent areas (provided in both NAD27/NGVD29 and NAD83/NAVD88 coordinate systems for comparison with pre-mining data and most current survey control data).
- Topographic survey and color orthophotography of the proposed WTP outfall pipeline route along Blue Creek.

- Topographic survey and color orthophotography of the potential borrow area south of the Dawn Millsite.
- Topographic survey and color orthophotography of the other potential borrow sites at the Rhoads property and the area east of Pit 3.
- Subaqueous bathymetric survey information (x, y, z) of the ground below the water surface in Pits 3 and 4.
- Survey information (x, y, z) of all culvert crossings beneath the site access roads to support data needed for the Site Access Road Investigation.
- Survey information (x,y,z) of the existing seeps and surface water sampling locations.

The *Survey Design Investigation Report* (Tetra Tech, 2010a) includes all data listed above in electronic format.

Other Sources of Survey Data. Other sources of survey data are included in the reports documenting interim mechanisms construction and the pre-mining topography maps prepared by the US Bureau of Mines. The interim mechanisms construction reports document the locations and configurations of facilities constructed in 2010 and 2011, and are considered sufficient for design purposes (i.e., it is not anticipated that additional surveying of these features will be required). The pre-mining topography info from the U.S. Bureau of Mines will be used extensively during RD to estimate the depths and locations of mining wastes, and to aid with designing drainage patterns following waste consolidation.

3.2 GEOLOGIC INVESTIGATIONS OF PITS AND ASSESSMENT OF PIT SEDIMENTS

Geologic investigations were performed at Pit 3 and Pit 4 during 2010 focusing on three topics: 1) rockfall and pit slope failure modes, hazards, and mitigation, 2) characterization of seeps and geologic features that could be groundwater pathways, and 3) characterization of pit bottom sediment and sediment management strategies. The results of these investigations are presented in the *Geologic Investigations of Pits and Assessment of Sediments Design Investigation Report – Revision 2* (MGC, 2011a). Pertinent information related to the investigation procedures, results, conclusions and recommendations relevant to the RD process is summarized below.

3.2.1 Initial Rockfall Hazard Evaluations

Engineering geologic mapping and evaluation of Pit 3 and Pit 4 was completed at a level of detail sufficient to identify general slope conditions and predominant pit-slope failure modes. Visible seeps and exposed features on the pit walls that could be pathways for groundwater inflows also were identified and mapped. Based on input from the geologic field investigation, rockfall simulation modeling was completed using the Colorado Rockfall Simulation Program (CRSP). CRSP was used to evaluate rockfall mitigation requirements for representative pit slope sectors having similar geologic and geometric characteristics. The report includes preliminary analyses for sizing perimeter rockfall catchments (either trenches or berms) that should be maintained during construction to contain rock falls and debris from shallow slope failures. The report also includes recommendations for monitoring of specifically identified sectors of the pits where shallow to intermediate depth slope instability is possible based on the engineering geologic characterization. A summary of the rockfall and slope stability contained in the *Geologic Investigations of Pits and Assessment of Sediments Design Investigation Report – Revision 2* (MGC, 2011a) is presented below. Information regarding additional rockfall hazard investigations is presented in Section 3.2.2.

Rockfall and Shallow Slope Instability. Rockfall is the primary mode of failure and presents the highest risk to workers in the pits due to the high likelihood of occurrence. Rockfall and shallow rock slide hazards were rated as moderate to high hazard potential, and are present on all pit slope sectors in both Pit 3 and Pit 4. Based on this preliminary analysis, the principal recommended rockfall mitigation approach for the period of pit construction work consists of a 15-foot deep trench (or 15-foot high berm), and a minimum 25-foot horizontal offset to be maintained at the base of the pit walls as the backfill is placed. It is likely that the required trench depths and horizontal offset requirements can be reduced as the increasing fill height results in decreasing rockfall energy at the fill surface. Other rockfall mitigation measures such as scaling, fences, drapes, and netting also may be considered to supplement the perimeter catchment trench in high risk zones. These other mitigation measures may also be implemented during the initial stages of fill placement and in areas where there is inadequate space for implementation of the catchment trench.

Intermediate-Depth Slope Instability. Intermediate-depth failure modes from unfavorably-oriented joints or fractures were considered less likely to occur than rockfall or shallow-depth rock slides, but were reported to present a significant hazard due the larger consequences should a failure of this type occur. Examples of this failure mode were observed as existing and historic significant slide areas in both pits that were mapped on the report figures.

Deep-seated Mass Instability. This failure mode from large-scale, pit slope failure across multiple benches was reported to be highly unlikely and therefore presents a low risk to workers over the temporary construction time frame. The pit highwalls are reported to be generally stable in terms of deep-seated (mass) stability due to the generally advantageous rock mass characteristics (e.g., low continuity of joints) and favorable orientation of geologic structural features (e.g., shear and fault zones oriented normal to the highwall slopes), and past performance.

3.2.2 Additional Rockfall Hazard Evaluations

Pit Slope Movement Monitoring. A network of survey prisms were installed during the spring of 2011 to allow for periodic monitoring of pit slope movement, and monitoring of the tension crack near the crest of Pit 4. These prisms (or movement monuments) are surveyed quarterly and the results reported to the EPA. The movement monument survey results and tension crack monitoring through the first quarter of 2015 have not indicated measurable movements.

Rockfall Hazard Monitoring. The rockfall hazard analyses discussed above in Section 3.2.1 were made using the CRSP program at four critical locations within Pit 3, and three similar locations within Pit 4. Parameters for the analyses were based on assumed conditions that were estimated using existing photographs and mapping available at that time. The developers of CRSP recommend that "in order to achieve the highest degree of accuracy from CRSP, the program should be calibrated to each distinct study site." Therefore, further evaluations and field calibration of the rockfall hazard models, based upon rockfall monitoring, were performed to support the RD. These activities were performed between the fall of 2011 and summer of 2013 and are summarized in the *Proposed Rockfall Hazard Monitoring for Midnite Mine, Revision 1* (MWH, 2011a) and the *Midnite Mine Rockfall Hazard Monitoring Summary Report* (MWH, 2013b) technical memoranda.

Rockfall Hazard Monitoring Study Objectives. The primary purpose of the rockfall monitoring program was to provide site-specific data to calibrate for the rockfall simulation model. Specifically, the proposed rockfall monitoring provided additional information regarding the:

- Range of rock sizes that can be expected in different sectors within the pit.
- Typical rockfall velocities and runout distances encountered along the pit floor.

- Rockfall frequency in different sectors.
- Seasonal variation in rockfall frequency.

The rockfall monitoring included digital image analysis using motion-activated video cameras at the site to meet the objectives stated above.

In addition to the video monitoring, supplemental still photographs were taken at regular intervals during periods when the surfaces of the pit lakes were frozen. The still photographs were evaluated to estimate: 1) The number and size of additional rocks that have accumulated on the ice surface, and 2) the point of origin (to the extent possible) and the runout distance across the ice surface. The photographs showed the accumulation of over 1,000 rocks on the pit lake ice and video monitoring documented 50 rockfall events during the 17-month monitoring period.

Rockfall Mitigation Evaluation. A specialty rockfall-mitigation contractor (Rock Solid Solutions) performed a Site visit during October 2013 to assess the potential hazards associated with the planned RA construction activities. Rock Solid Solutions also used the results of the rockfall monitoring performed between 2011 and 2013 (discussed above) to re-calibrate and re-run the CRSP model. The results of the Rock Solid Solutions Site visit and updated CRSP modeling are included in an attachment to Appendix D.

Conclusions and design implications based on the Site visit and updated CRSP modeling include:

- Physical and hydraulic scaling of the pit walls should be conducted to reduce the rockfall hazard prior to initiating work in the pits. Scaling should include removal, or identification and monitoring, of rockfall sources larger than 3-feet in size as appropriate.
- The rockfall catch berm/ditch design (10-feet deep and 15-feet wide horizontally) and work sequence proposed in Appendix D of this BODR should significantly reduce the risk of rockfall impacting the work areas during pit backfilling operations. The dimensions and construction sequence for maintaining the proposed rockfall berm/ditch is shown on the Section 4 Drawings.
- A portable rockfall barrier should be used in areas where personnel need to work outside of construction equipment prior to construction of rockfall catch berms (i.e. during sump drilling/blasting, sump excavation, drainage system construction, and liner placement) or in areas where rockfall catch berms cannot be constructed due to site space constraints.

3.2.3 Completed Characterization of Seeps and Groundwater Pathways

Completed Pit Seep Mapping. Mapping of the pit walls was performed during the summer and fall of 2010 to identify existing seeps and pit wall fractures, bedding, and joint sets that could be potential pathways for groundwater inflows. This information was obtained to help assess rates and identify key sources of groundwater flow to Pits 3 and 4 and assess technologies for reducing rates of inflow through grouting or other technologies. Seeps observed in Pit 3 and Pit 4 do not appear to be a source of significant flow into the pits.

Seeps were mapped in Pit 3 in the N, NE, E, and SW sectors of the pit. All of the seeps that could be accessed had estimated flows of 1 gpm or less. The seep flows typically do not reach the pit bottom or are reduced to drips suggesting that the total discharge from the seeps is small. In Pit 4, seep flow of less than approximately 1 gpm was observed near the toe of the north highwall. The seep supports shallow ponds (less than 6-inches deep) and associated wetland areas. It appears that additional flow may discharge from the Pit 4 floor to support the ponds and associated wetland area.

3.2.4 Additional Characterization of Seeps and Groundwater Pathways

Because the seep mapping discussed above was performed during summer and fall during base flow, additional visual inspection and mapping of seeps in pits 3 and 4 was conducted during 2012 in the spring when groundwater levels are typically higher. These data were used to help define locations and design of drains that will be constructed in the consolidated wastes to intercept inflow from the pit-wall seeps. The additional pit-seep monitoring was conducted in accordance with the *Additional Pit Wall Seep Monitoring Supplement to the Work Plan for Geologic Investigation of Pits and Assessment of Pit Sediments, Revision 1* (MWH, 2012b). The results of the supplemental investigation were reported in the *Midnite Mine Field Activity Summary Report- Pit Seep Monitoring, Pit 3 and Pit 4 (*Plumley and Associates, 2012).

The results of the 2012 pit seep monitoring investigation identified six pit seepage areas in Pit 3. These pit seepage areas are the same areas that were identified in the summer of 2010. No new seep areas were identified during this investigation in Pit 3. Although, the aerial extent and flow of some of the seepage areas observed in April 2012 was noted to be larger than observed in the summer/fall of 2010; the estimated flow rates for each of the seepage area was still relatively small (less than 2 gpm) at the time of the 2012 monitoring. Seep monitoring observations in Pit 4 indicate that the seepage areas and flow volumes are generally similar to the conditions described from the summer/fall of 2010. However, as with Pit 3, the seeps were more extensive, and the associated shallow ponding near the toe of the north highwall area was expanded compared to the conditions observed in the summer/fall 2010. Two new seeps were identified in the toe of the north highwall area near the ponds; and on the floor of the pit. The new seep identified on the floor of the pit is likely controlled by seasonal runoff.

3.2.5 Characterization of Pit Bottom Sediment and Sediment Management Strategies

Pit 3 sediment (approximately 3,300 cubic yards [cy] total volume) typically occurs in a layer approximately three inches thick on the pit floor with a somewhat thicker layer around the perimeter of the pit floor. Pit 4 sediments (approximately 2,400 cy total volume) are typically in a thicker layer of one to two feet thick on the pit bottom. The sediment in both pits is predominately saturated, silt-sized material, with somewhat coarser material around the margins of the pit floors.

The *Geologic Investigations of Pits and Assessment of Sediments Design Investigation Report – Revision 2* (MGC, 2011a) mentions that during the RA, sediment on the pit bottoms would be removed and stored temporarily prior to disposal in the backfilled pits. The reported approach to sediment management focuses on the use of conventional earth-moving equipment (excavators, front-end loaders, open haul trucks) and the addition of a drying material from fine-grained waste rock or soil to imported cement or fly ash when needed. Additional details of pit dewatering, drying, temporary storage, dust control, and worker safety are discussed in the report.

3.3 BORROW SOURCE DESIGN INVESTIGATION

The *Borrow Source Design Investigation Report – Revision 2* (MGC, 2011b) describes the results of the investigations to identify available quantities and characteristics of candidate borrow sources needed to implement the RA. The materials needed in significant quantities for specific design components include drain rock, cover soil, and topsoil/growth media. Materials also were identified that can be used as cushion materials for the geomembrane and rock for lining surface-water conveyance ditches. Based on the estimates provided in the *Borrow Source Design Investigation Report*, adequate quantities of suitable borrow materials have been identified to complete the RD. The conclusions from the report are provided below.

3.3.1 Ford Borrow Area

The Ford Borrow Area near the DMC Millsite (located approximately 20 miles from the Site) is an approximately 332-acre tract that is a resource for large volumes of granular soil comprising primarily two types of materials:

- Clean uniform sands – These materials have potential applications for use in drainage zones, as geomembrane cushioning materials, and potentially as drainage layers within the soil cover.
- Broadly graded sandy gravels - These materials potentially could be screened, with various products used for durable, permeable drain rock, rock for channel linings and cover soil.

3.3.2 Rhoads Property Borrow Area

The Rhoads Property Borrow Area is an approximately 81-acre parcel situated just southwest of the mine site. Two phases of investigation were performed at the Rhoads Property Borrow Area, which are summarized in the *Borrow Source Design Investigation Report – Revision 2* (MGC, 2011b) and the *Technical Memorandum Rhoads Property Borrow Investigation Phase II – Revision 1* (MGC, 2011c). Phase I borrow investigations indicate this area may yield more than 600,000 cubic yards of clayey sand materials, and Phase II investigations increased this estimate to over 700,000 cubic yards. These materials are considered potentially suitable for use as reclamation soil cover or cap.

3.3.3 Lane Mountain Stockpiles

The Lane Mountain Silica Sand Company has a processing facility near Valley, Washington, about 40 road-miles northeast of the Site. Stockpiles of fines from sand washing operations are an available commercial resource for silty clay and silty sand, for use as topsoil/growth media. The reported volume of this material is approximately 350,000 cy.

3.3.4 On-site Resources – Pit 3 East Rim

Residual soil and weathered rock deposits above the rim of the east high wall of Pit 3 were identified during the RI as a potential resource for fine-grained reclamation cover materials. The borrow investigation found that clayey soil in the identified area is only about 4 to 6 feet thick above bedrock. The small tract (less than 13 acres) and shallow thickness of soil above bedrock could provide very limited quantities of borrow material (estimated on the order of 80,000 cy). As a result, this borrow area was not recommended for further evaluation.

3.3.5 On-site Resources – Mine Waste

Select portions of the mine waste rock, notably the Hillside Waste Rock Pile and the Lime Protore Stockpile 8, were previously identified as potentially suitable for use as on-site borrow for the materials needed to construct the drainage blankets in Pit 3 and Pit 4. The Lime Protore

Stockpile was determined to be not suitable for drain material due to its lack of durability. The Hillside Waste Rock Pile was determined to be suitable for drain material. A complete discussion of the suitability of the Hillside Waste Rock Pile for drain rock is presented in the Mine Waste Investigation Report summary below.

3.3.6 Commercial Resources for Supplemental Borrow

The report identifies several commercial borrow pits located within 30 miles of the Site that could be used to supplement the sources described above if one or more of the necessary material types was found to be in short supply during the RA.

3.4 MINE WASTE INVESTIGATIONS

3.4.1 Mine Waste Investigations Scope and Objectives

Investigations were performed to characterize key aspects of the mine waste and impacted materials. These investigations included:

Waste Rock Pile Investigations. Drilling, test pitting, sampling and testing of waste rock and ore/protore stockpiles to:

- Refine estimates of in-place quantities of waste rock.
- Estimate waste rock foundation over-stripping requirements and volumes.
- Characterize Hillside Waste Rock Pile and Lime Protore Stockpile 8 materials to determine geotechnical and geochemical suitability for use as on-site borrow resources for drain rock.

Access Road Mine Waste Investigations. Radiologic surveys, sampling and testing of areas along and adjacent to site access roads to:

- Identify and map lateral extent and thickness of roadside areas requiring cleanup.
- Estimate mine waste quantities along access roads.

Mine Drainage Sediment Investigations. Radiologic surveys, sampling and testing of mine site drainages to:

- Identify and map lateral extent and thickness of mine drainage sediments requiring cleanup.
- Estimate mine drainage sediment cleanup quantities.

Mine Waste Characterization Evaluation. Existing Site geochemical and radiological data were evaluated in the *Technical Memorandum – Mine Waste Characterization* (AES, 2011a) to guide placement of the mining wastes as they are consolidated into Pits 3 and Pit 4 during the RA. The objectives of the evaluation were to pre-characterize the wastes so that materials with a high ARD generating potential can be placed in the upper portions of the pits (above groundwater), and materials with a high radon-generating ability can be placed in lower portions of the pits (beneath the upper 15 to 20 feet of materials classified with low to moderate radon-generating ability) to prevent radon emissions at the ground surface.

3.4.2 Mine Waste Investigations Results

The following conclusions were presented in the *Mine Waste Investigations* report (MGC, 2011d):

- The depth of waste rock determined from the drilling program varied from that estimated previously from pre and post-mining topography. Based on the depths of waste rock from the drilling program, the estimated volume of waste rock (including ore and protore piles) to be excavated and placed in Pits 3 and 4 is 16.7 million cy. The estimated maximum quantity from the Feasibility Study was 18.2 million cy (EPA, 2005c). The estimate from the ROD is 16.3 million cy.
- The depth of foundation material under the waste rock piles that will be excavated varied considerably among the piles throughout the site. The waste rock locations were subdivided to refine the estimate of the volume of foundation materials that would require excavation based upon the testing results. The total estimated volume of foundation material is 895,000 cy. Assuming an average depth of contamination of one foot in the impacted areas outside of the waste rock pile footprint, the report estimates 995,000 cy of over-excavation of foundation and impacted material in peripheral areas.
- The waste rock from the Hillside Waste Rock Pile was evaluated for particle size, acid base accounting (ABA) testing, durability testing and leach testing. Based on the results of these tests, material from the Hillside Waste Rock Pile could be used for drain rock as part of the pit backfill. The Hillside Waste Rock material will likely require additional processing (crushing) to achieve sufficient quantities of the required size fraction for the drain material. Therefore, additional samples of waste rock from the Hillside Waste Rock Pile were collected for testing to determine the suitability of crushed rock for use as drainage materials (Phase II Field Investigation), and additional samples were collected

from previously un-sampled locations in order to better quantify the amount of usable material that exists in the pile (Phase III Field Investigation). The Phase II and Phase III field investigations were performed during the fall of 2011. These activities were conducted in accordance with the *Evaluation of Supplemental RD Data Needs – Revision 2* (MWH, 2012a) and the *Supplement to the Work Plan for Mine Waste Investigations – Hillside Waste Rock – Revision 1* (MGC, 2011f). An *Addendum to the Waste Rock Investigations Report* (WME, 2012a) was submitted on July 20, 2012, inclusive of all of the results from the additional sampling and analyses which concluded that the Hillside Waste Rock material could, with screening and crushing, be used for drain material. The estimated volume of material to be excavated and placed in Pit 3 and Pit 4 (i.e., 16.7 million cy) is inclusive of the Hillside Waste Rock material that has been proposed for use as drain rock

- The Lime Protore material did not meet durability requirements for drain material and will be placed in Pits 3 and 4 along with the other waste rock, above the drain material. This volume is incorporated into the estimate of total waste rock volume to be emplaced (16.7 million cy).
- A gamma survey supplemented by soil sampling determined the extent and approximate volume of contaminated soil in and along the haul roads. A range in volume of 36,600 to 87,000 cy was estimated. A gamma survey also was used to estimate the location and volume of sediments in the drainages. The volume of sediment in the drainages was estimated to range from 17,200 to 160,000 cy. An additional investigation performed during 2013 (summarized below in Section 3.16) indicated that a relatively small volume of sediments in the Far Western (Whitetail Creek) drainage exceeds the cleanup levels. Therefore, it is not anticipated that the overall volume of sediment from the drainages will be different than previously estimated for the drainages discussed above. The information from this study has been incorporated into the design.
- The amount of sediment in Pits 3 and 4 is estimated to be 5,700 cubic yards as presented in the Geologic Investigations of Pits and Assessment of Sediment Design Investigation Report.
- The volume of material to be excavated and disposed of in Pits 3 and 4 includes mine waste rock, stockpiled mine ore and protore, over-excavation of foundation material and areas adjacent to the waste rock piles, the haul roads, drainage sediments, and pit sediments. The estimated total ranges from approximately 17,800,000 to 19,500,000 cy.

- The estimated total capacity for disposal of material in Pits 3 and 4 ranges from 19,700,000 to 20,900,000 cy.

Table 3-1 provides the refined estimates of the materials to be disposed of and the capacities of the disposal areas. These estimates suggest that the materials can be disposed of according to the ROD, although the final design will require flexibility to accommodate some variability in the actual quantities during remedy implementation, which is common for this type of engineering design. The increase from the low estimate to the high estimate of materials to be consolidated is 8.7 percent, although there is no supporting information available to evaluate the higher estimate of waste rock materials in the FS.

Based on geochemical and radiological characterization, the relative ARD generation potential and radon-generating ability of the mine waste materials is classified as low, moderate, or high, as summarized on Table 3-2. Placement of the mine waste materials in the pits with respect to their relative ARD generation potential and radon-generating ability will be determined during the RD and dependent on the fill prisms for Pit 3 and Pit 4 and the sequence of material excavation and consolidation. Of the total estimated volume of material to be consolidated in the pits, the combined volume of mine waste materials classified as high for either ARD generation or radon-generating ability is small. Due to the relatively small quantity, this material can be placed in the central portions of the pits above the groundwater level and deeper than 15 to 20 feet from the surface. The majority of the mine waste materials to be consolidated in the pits are classified as low-moderate ARD generation potential and moderate radon-generating ability.

3.5 SITE ACCESS ROAD DESIGN INVESTIGATION

The *Site Access Roads Design Investigation Report – Revision 1* (Tetra Tech, 2011a) summarizes the results of the literature review, field activities, and laboratory testing performed to provide pre-design information related to using the exiting East and West access roads during the RA. However, because portions of the existing roads were constructed using waste rock and require remediation prior to long-term use, and because the locations of the existing roads present challenges to the phased RA construction activities and long-term post-remedy Site operations, it was determined during the RD that constructing a new access road has advantages over using the existing roads. The design considerations for the new access road are presented in Appendix D. Information contained in the *Site Access Roads Design Investigation Report – Revision 1* (Tetra Tech, 2011a) that is relevant to remediation of the existing access roads is summarized below.

3.5.1 Historic Road Construction Information

No design documents, construction plans, or specifications are available for the existing Site access roads. DMC staff indicated that the existing roads were constructed by conventional methods of balancing cut and fill slopes and filling in valleys with waste rock or local borrow material.

3.5.2 Mine Waste Rock in Access Roads

The *Site Access Roads Design Investigation Report* (Tetra Tech, 2011a) includes several figures that depict the estimated areas and depths of waste rock to be removed from the access roads. These areas are based on the results of the geotechnical subsurface investigation and the mine waste investigation of the access roads and will be verified during the RA.

3.6 SITE SEISMICITY ANALYSIS

The *Midnite Mine – Site Seismicity Analysis* technical memorandum (MGC, 2010) provides a review of available site-specific seismicity information and recommendations for ground motion parameters. The conclusion of the technical memo is that the peak ground acceleration for a probability of exceedance = 10 percent in 250 years is 0.131*g* based on USGS National Seismic Hazard map values. A peak ground acceleration value greater than the 0.1g requires seismic forces be considered for the slope stability analysis of cover soils (EPA, 2004). EPA (2004) lists the use of the pseudo-static factor of safety method as acceptable and conservative method to evaluate seismic forces. Seismic forces were considered for the veneer stability analysis of the cover and the analysis is provided in Attachment D-7.

3.7 GROUNDWATER INVESTIGATIONS

In order to understand surface water and groundwater flows both during remedy construction and post-remedy implementation, groundwater investigations were performed during 2010 to:

- Identify sources and pathways of surface water and groundwater flow to Pit 3, Pit 4, and the Backfilled Pits under current conditions.
- Estimate groundwater flow rates into Pit 3, Pit 4, and the Backfilled Pits.
- Estimate mine impacted surface water and groundwater flow volumes that will require management to support design of a water treatment plant and pit groundwater extraction systems.

- Evaluate potential technologies for reducing groundwater flow into the pits including surface water controls, grouting, cutoff walls, and groundwater interceptor trenches.

These investigations are summarized in the *Midnite Mine Design Investigation Report - Groundwater Investigations – Revision 2* (MGC, 2011e).

Groundwater investigation field activities performed in 2010 included pit dewatering, monitoring well transducer installation, flow meter installation, and surface water monitoring station installation. Additionally, alluvial groundwater pumping was performed and monitoring wells were installed in the Western and Central Drainages. Historic data and data collected during 2010 were evaluated, including climate, stormwater flow, seep-collection rates, alluvial groundwater well discharge, groundwater level, and pit lake level. A summary of the Groundwater Investigations results is presented below.

3.7.1 Sources and Pathways of Flow to Pit 3, Pit 4, and the Backfilled Pits

Pit 3 and Pit 4 were dewatered during summer and fall 2010. While the pits were at minimum elevations, wells surrounding the pits were monitored for water levels and water quality. Water table contour maps of the pit areas were constructed to define the pit groundwater capture area, and an analysis of water quality was performed. The pits are groundwater sinks with a capture zone extending around their perimeter.

The water quality analysis indicates Pit 3 surface water quality is comprised of PCP pumpback water mixed with precipitation, pit seep, and MA well water. Water quality data comparison indicates Pit 4 surface water quality is similar to the water quality in the pit area wells. The Pit 3, Pit 4, and pit area well water quality is different from the up-gradient well water quality, indicating water quality degrades as it contacts mineralized zones and potentially oxidized zones near where fractures intersect the pit walls.

3.7.2 Groundwater Flow Rates into Pit 3 and Pit 4

Groundwater inflow to Pit 3 and Pit 4 was estimated by URS (2002) using MODFLOW groundwater flow modeling. Estimated groundwater discharge to Pit 3 was 16.5 gpm, and discharge to Pit 4 was 7.9 gpm. URS (2002) reported values obtained by SMI (2001) during dewatering of the Boyd Pit (backfilled pit) of 7.5 gpm for a sustained pumping rate and a recovery rate of 5 gpm during a period of no precipitation.

Empirical estimates of groundwater inflow rate to the pits were made based on data collected during the recovery period following the 2010 dewatering. Estimated groundwater inflow to Pit 3 ranged from approximately 15.1 gpm to approximately 19.9 gpm, and estimated groundwater inflow to Pit 4 was approximately 14 gpm.

The variation in estimated long-term groundwater inflow rates between the modeled values (URS, 2002) and empirically measured values collected in 2010 is not considered significant with respect to the pit dewatering system design, which will have to remove much larger volumes of water during and immediately following implementation of the remedy. This information does provide a level of confidence that the actual amounts following remedy implementation will be close to these long-term estimates.

3.7.3 Groundwater Flow into the Backfilled Pit Area

The *Evaluation of Supplemental RD Data Needs* (MWH, 2012a) evaluated topographic mapping and drilling logs in the vicinity of the BPA in order to assess the potential for groundwater flow into the BPA. The results of this evaluation indicate that that there will be little or no groundwater flow into the BPA once waste rock to the north and west of that area is removed. It is likely that once the BPA is capped, the majority of the water currently infiltrating through the waste rock into the BPA will be shed from this area as clean surface water runoff. As a result, it is not anticipated that the groundwater intercept trench currently included in the Selected Remedy will be necessary. However, if the topography is different than anticipated from the pre-mine, post-mine, and current mine topographic surfaces information, then once waste rock is removed during the RA, additional studies, design, and construction of the subsurface drains or other controls will occur as necessary.

3.7.4 Water Volumes Requiring Management

Surface water and groundwater flow volumes that require management (capture, storage, and treatment) during the construction and post-remedy periods have been estimated for annual, monthly, and daily periods. A range of values was provided based on variability in available data, and a sensitivity analysis was provided for modeled values. Estimated results were compared with 11 years of current-condition values (from 1999 to 2010) derived from measurement from the various components of the existing water management systems.

Construction period water management volumes were estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al., 1994). Conditions modeled during the construction period assumed that approximately 60 percent of the current mine disturbed area would be roads or areas being actively or recently excavated. These areas were assumed to have a hard-packed surface that would generate an elevated amount of runoff compared to the waste rock. Return-period (100-year) estimates of water volumes generated during the construction period were used to provide a range of potential values and do not suggest actual design values. Daily peak water management values were modeled assuming rain-on-frozen-ground or rain-on-ice conditions resulting in nearly all precipitation running off.

Water requiring treatment following implementation of the remedy (post-remedy) was assumed to consist of collected seepage and inflows to Pit 3, Pit 4, and the Backfilled Pits. Runoff during post-remedy was assumed to be dischargeable without treatment; however post-remedy testing would be required to verify this assumption. Table 3-3 provides a range of estimated water management volumes for the construction and post remedy period with current condition values provided for comparison.

In addition to the water volumes discussed above, an evaluation was performed to account for water storage requirements to account for a scenario where the operating WTP is off line during the RA due to unforeseen circumstances (MWH, 2012c). The contingency scenario assumes that the WTP is off-line for a six-week period that coincides with either 100-year or 500-year peak runoff conditions. It is estimated that the water storage requirements for such a contingency scenario during the RA range from approximately 58 million gallons (assuming 100-year runoff conditions when the WTP is off-line for a six week period) to approximately 71 million gallons (assuming 500-year runoff conditions when the WTP is off-line for a six week period). This contingency water storage evaluation is discussed further in Appendix E.

3.8 SURFACE WATER DESIGN INVESTIGATION

The *Surface Water Design Investigation Report – Revision 1* (Tetra Tech, 2011b) includes the climatic and streamflow data and the required input parameters necessary to:

- Perform hydrologic and hydraulic modeling to support design of diversion channels and other surface water control features.
- Evaluate the erosional stability of the cover over waste containment areas during RD.

Data collected and evaluated in the *Surface Water Design Investigation Report* includes:

- Climatic Data from the onsite weather station
- Streamflow Data
- Design Storm Information
- Precipitation-Runoff Methods

- Curve Number Evaluation
- Routing and Transformation Methods
- Conveyance Roughness (Manning's n values)

3.9 ION EXCHANGE TREATABILITY TESTING

The *Midnite Mine Ion Exchange Treatability Testing Data Report* (TTDR; Tetra Tech, 2010b) summarizes the pilot-scale treatability testing of Midnite Mine influent water conducted at the Midnite Mine WTP by Tetra Tech and Water Remediation Technologies (WRT). The pilot-scale treatability tests were designed to generate information necessary to determine the technical feasibility and cost effectiveness of full-scale design and implementation of ion exchange (IX) treatment of the source water to the WTP that would result in reduction of uranium concentrations in the WTP sludge under dynamic flow conditions.

The information collected during the IX pilot testing provided data on the following:

- Effectiveness of pretreatment of the feed water prior to IX treatment and investigation of resulting waste product (e.g., backwash solids).
- pH adjustment testing using a two-stage precipitation process provided preliminary information on an alternative process for uranium removal and waste disposal.
- Selection of the appropriate IX resin for uranium removal, determination of the number of bed volumes before uranium breakthrough occurred and the effect of resin regeneration on the efficiency of uranium removal and post-regeneration capacity for uranium.
- Concentration of uranium and Toxicity Characteristic Leaching Procedure (TCLP) metals in the resins at exhaustion and regeneration, and in IX effluent lime treatment sludge.
- Evaluation of sludge disposal options following initial IX treatment then lime treatment of the effluent from that process.
- Evaluation of on-site versus off-site regeneration techniques.

The treatability study resulted in the following findings:

- Based on the testing results, the *Midnite Mine Ion Exchange Treatability Testing Data Report* recommended that the full-scale design of IX treatment include pre-filtration of the feed water to the system, including possible coagulant addition.

- Based on the two-stage pH adjustment testing, the report recommended that further testing in the future may be warranted.
- Based on the resin testing, a) WRT Z-92A media should be considered as a candidate resin for full-scale design, b) DOWEX 21K XLT media, Test No. 10 showed the most promising results of the DOWEX resins and could be considered for full-scale design, and c) DOWEX SAR strong base Type II and the WRT Z92B weak-base resins should not be considered for full-scale design.
- Testing of resin after regeneration for TCLP leachable metals and uranium indicates that the TCLP metals would not leach allowing for non-hazardous waste disposal. Uranium was nearly totally stripped from the resin after regeneration, and the final uranium concentration measured was 3 mg/kg.
- The Midnite Mine Ion Exchange Treatability Testing Data Report recommends optimization of lime addition to the effluent water stream in full-scale design based on actual operating conditions. The backwash solids could be metered back into the front end of the WTP or directed back to Pit 3 for full-scale design. Preliminary evaluation of the data indicates that the sludge produced after lime treatment of IX effluent to remove uranium and metals can be disposed of at U.S. Ecology, Inc. (a hazardous and radioactive waste facility) located in Grandview, Idaho. However, the location selected for sludge disposal will be proposed and supported in annual residuals management plans subject to EPA approval.

3.10 ION EXCHANGE TREATABILITY EVALUATION

The *Ion Exchange Treatability Testing Evaluation Report* (TTER: Tetra Tech, 2010c) uses the results of the treatability testing (summarized above in Section 3.9) to present a conceptual level cost/benefit analysis for potential modifications to the WTP to design, build, and operate an IX system. The TTER includes the following:

- Existing WTP process changes
- Existing WTP system modifications
- Sludge disposal and resin regeneration
- Conceptual-level capital and O&M costs
- Public and worker safety requirements as a result of WTP modification

- Conceptual-level design process and instrumentation diagrams
- Conceptual-level operation and regeneration schedules

A goal of the treatability testing was to determine if the use of selected IX resins on influent water to the WTP would result in reduced uranium concentrations in the WTP sludge, allowing the sludge to be classified as non-source material. Criteria used during the treatability testing were that uranium concentrations in the effluent from the IX needed to be less than 2.3 mg/L and the sludge must be less than 0.05 percent uranium (wet weight) for WTP-produced sludge to be classified as non-source material (Tetra Tech, 2009b). As determined by the treatability testing, the uranium concentration could be reduced from approximately 14 mg/L in the IX influent to less than 2.3 mg/L in the IX effluent. Of the four IX resins tested, two strong base Type I IX resins (DOWEX 21K XLT and Z-92A) had the best performance in terms of uranium removal, regeneration, and run duration. The treatability testing results presented in the TTER, indicate that the Z-92A resin had a slightly greater capacity for uranium removal than the DOWEX 21K XLT.

3.11 ADDITIONAL ION-EXCHANGE PILOT STUDY (2012)

An additional pilot-study was conducted in 2012 to further evaluate the operational requirements for an IX system, in accordance with the *Work Plan for Additional Pilot-Scale Testing of Uranium Removal Using Anionic Exchange Resins* (MGC, 2012). The objectives of the additional IX pilot study were to: 1) produce sufficient source material waste to support waste material dewatering equipment design (filter press) at the equipment manufacturer; 2) determine the IX system regeneration capability through multiple regeneration cycles and rinse water quality at expected rinsing rates to optimize the design of the full scale system operations; 3) determine precipitation reaction rates and the settling rates of source material waste from IX system pregnant brine; 4) provide data to characterize the final source material waste and lime treatment sludge for future disposal; and 5) provide data to characterize the final effluent to support the NPDES permitting process. The results of the additional study are summarized in the report titled *Pilot-Scale Test Results for Uranium Removal Using Anionic Exchange Resins and Chemical Precipitation, Revision 0* (MWH, 2012h).

3.12 BLUE CREEK/BLUE CREEK DELTA SEDIMENT CHARACTERIZATION

The Blue Creek and Delta Sediment Contingent Action work element of the Selected Remedy requires that the Settling Defendants submit a Blue Creek and Delta Assessment Work Plan to propose studies to assess the chemistry, biological toxicity and benthic conditions of Blue Creek and Delta to determine if impacts in all or part of the creek warrant active cleanup, and if sediment conditions indicate significant progress towards achieving sediment cleanup within 10 years of the completion of mine waste containment. In response to this requirement, the *Blue Creek and Delta Assessment Work Plan – Revision 0* (MWH, 2011b) was submitted to EPA in October 2011 and was included in the 30% BODR. The *Blue Creek and Delta Assessment Work Plan* established procedures and a schedule to characterize baseline conditions, triggers to determine if active remediation is warranted prior to mine remedy completion based on these data, monitoring and data analysis procedures once baseline conditions have been established to determine the need for active remediation after the remedy has been completed, and to demonstrate monitored natural attenuation (MNA) will meet remediation objectives.

Comments on the Blue Creek and Delta Assessment Work Plan were received from EPA on June 13, 2014, and a technical meeting was held during late June 2014 to discuss the work plan and path forward. It was concluded at the meeting that additional work is needed to define or redefine the scope and objectives of the overall Blue Creek contingency as well as the assessment work plan, and that responding to EPA comments and updating the assessment work plan is premature at this time. In response to the meeting discussions, a field reconnaissance occurred on March 8 and 9, 2015 to characterize the fluvial geomorphology of the stream and to identify areas of sedimentation which may contain constituents related to historical operations of the nearby Midnite Mine. The *Lower Blue Creek Reconnaissance Technical Memorandum* (MWH, 2015) summarizing the field reconnaissance was submitted on April 21, 2015. EPA comments on the Blue Creek reconnaissance technical memorandum were received on June 8, 2015, and a revised technical memorandum is due back to the EPA by July 8, 2015.

3.13 STORAGE POND SITE INVESTIGATIONS

Under current Site operations, mine-impacted surface water and groundwater is stored in Pit 3 and Pit 4 prior to water treatment and discharge. Because these pits will be backfilled during the RA, temporary storage ponds will be needed during RA construction to control sediment and to store the mine-impacted water when the pits are no longer available for water storage.

Investigations were performed during the summer/fall of 2011 in accordance with the *Work Plan for Storage Pond Site Investigations – Revision 2* (MGC, 2011g) to identify suitable alternate water storage locations outside of the existing fenced mine-area boundaries. The objectives of this site investigation were to develop sufficient subsurface data and geotechnical information to evaluate the dam foundation conditions and to characterize potential borrow source materials that would be used for dam construction at each of the candidate dam sites. While the investigations were in progress, it was decided at the request of the Tribe that the storage ponds will be located within the existing fenced mine-area boundaries rather than at the locations being investigated. Since the investigations and testing were near completion, the investigations were completed and summarized in a report titled *Storage Pond Investigation Report* (MWH, 2012g).

Because the Tribe has expressed desire that the storage facilities be constructed within the existing fenced mine-area boundaries, additional investigations were performed to evaluate the feasibility of constructing a temporary storage pond in the SWRP. These investigations were conducted in accordance with the *South Waste Rock Pile Storage Pond Investigation Work Plan – Revision 1* (MWH, 2012d). Data provided information regarding the engineering properties (i.e. shear strength, gradation, plasticity, and relative density) and stratigraphic profile of the subsurface materials in the area downslope (south) of the proposed storage pond to facilitate design. The results of the investigation are presented in Appendix E of this BODR and were used to support design of the SWRP storage pond.

3.14 ONGOING DATA COLLECTION TO SUPPORT NPDES PERMIT APPLICATION

Data collection and evaluation activities are continuing in accordance with the *Data Collection for NPDES Permit Application Work Plan - Revision 3* (Rescan Consultants, Inc., 2011) with the following objectives:

- Perform a technology evaluation, which will include the information in the Midnite Mine FS in support of the application for a reissued NPDES Permit.
- Characterize the water quality in the receiving water where treated water will be discharged (i.e., the Spokane River Arm of Lake Roosevelt).
- Characterize the physical conditions of the receiving water.
- Estimate the size of the mixing zone.
- Characterized the effluent from the existing WTP.

The application to support reissuance of the existing NPDES permit was submitted to the EPA for review on March 20, 2013. At the request of EPA, additional memoranda to support the application were submitted including:

- *Hg/TL analysis – Midnite Mine* (Miller, 2013) – presents results from additional thallium and mercury analyses on the WTP effluent.
- *Effluent Discharge Mixing Evaluation for the Midnite Mine Water Treatment Plant* (MWH, 2013d).
- *Midnite Mine Permit Application – Lake Roosevelt Additional Sampling and Analysis for Total Thallium* (WME, 2013e) – planning document for sampling that occurred during December 2013.
- Midnite Mine NPDES Permit Application – *Lake Roosevelt Additional Sampling and Analysis for Total Thallium Results* (WME, 2014a) – presented thallium results for samples collected during December 2013.
- *Midnite Mine NPDES Permit Application Work Plan and QAPP Addendum (Revision 1): Lake Roosevelt Additional Sampling and Analysis for Total Thallium* (WME, 2014b) – planning document for monthly thallium sampling that began during May 2014 and continued through March 2015. The results are included in the April 2015 monthly report submitted by the Supervising Contractor to the EPA.

Work plans were developed and approved to evaluate technologies to further reduce aluminum and arsenic concentrations in the WTP effluent. The investigation is scheduled to begin in June, 2015 with results and reporting anticipated during the summer of 2015.

3.15 DATA COLLECTION TO SUPPORT DESIGN OF EFFLUENT PIPELINE TO LAKE ROOSEVELT

Geotechnical data were collected during September 2013 to support design of the effluent pipeline from the new WTP to the Spokane River Arm of Lake Roosevelt. The objectives included:

- Characterizing the subsurface conditions along the pipeline corridor in order to aid in efficiently determining the design elevations of the proposed pipeline.
- Delineating any potential wetlands along the corridor for avoidance during pipeline construction, where possible.

These data were collected in accordance with the *Blue Creek Pipeline Geotechnical Evaluation Work Plan – Revision 2* (MWH, 2012e). Results from these investigations did not impact the proposed alignment or depths of the pipeline, and will be useful for identifying equipment required for the pipeline installation. A report summarizing the geotechnical investigations was submitted to EPA in December of 2103 (MWH, 2013e).

Changes to the pipeline alignment between the 30% and 60% design submittal were the result of an April 25, 2013 technical meeting/site visit. During the April 2013 site visit, it was agreed that routing the pipeline in the Blue Creek thalweg just before the pipeline enters Lake Roosevelt is preferable to the originally proposed route through the campground in order to avoid potential cultural artifacts in this area. The effluent pipeline design is on hold at the 60% level pending re-issue of the NPDES permit.

3.16 WHITETAIL CREEK SEDIMENT EVALUATION

Results of the RI indicated that radionuclide concentrations in the sediments in Whitetail Creek exceeded background levels (EPA, 2005a). However, because the RI only included one composite sample in Whitetail Creek, Newmont/DMC initiated a phased sediment sampling survey during 2013 in accordance with the *Work Plan for White Tail Creek Sediment Evaluation* (WME, 2013a) to confirm the presence/absence and extent of mine-related contamination in the creek bed. The Phase I survey performed during September 2013 included:

- A field reconnaissance of Whitetail Creek and its side drainages from the mine to Ford-Wellpinit Road, including the stream segment that traverses the Rhoads Property. The objectives of the reconnaissance were to:
  - Map stream channel morphology
  - Determine areas of deposition of sediment and potential waste rock in and along Whitetail Creek.
  - Determine the lateral extent and thickness of sediment deposition and potential waste rock.
- Gamma survey using a backpack-mounted radiation instrument. The objectives of the gamma survey were to:
  - Determine gamma exposure rates along drainage and in designated background areas.
  - Generate maps indicating gamma exposure rate of areas along drainage.

These results are presented in the *White Tail Creek Sediment Evaluation – Phase 1 Data Transmittal Report* (WME, 2014d). The Phase I field reconnaissance identified a small waste rock pile located up-stream of the Rhoads Property near the Old Man Camp above a side drainage to the Whitetail Creek drainage area. The Phase I radiological survey indicated that portions of this area of the Whitetail Creek drainage exhibit gamma exposure rates greater than 2 times measured background exposure rates.

Based on the results of the Phase I survey, the Phase II survey performed during October 2013 included collecting surface material samples in targeted areas for laboratory analyses. The results of the Phase II survey are presented in the *White Tail Creek Sediment Evaluation – Phase 2 Data Transmittal Report* (WME, 2014e). The Phase II survey identified areas of Whitetail Creek where Ra-226 in sediments exceed the cleanup levels. These results were used in the RD to expand the areas requiring remediation and verification sampling (discussed in appendices D and S of this BODR, respectively).

3.17 WATER SUPPLY WELL INVESTIGATION

The *Water Supply Well Investigation Work Plan – Revision 2* (WME, 2013b) was prepared to describe locating, drilling, install and testing a potable water supply well at the Site capable of producing a sufficient rate and volume of water and of sufficient quality for use during implementation of the remedy. A constant, minimum water supply rate of approximately five to ten gpm is necessary to support remedy implementation.

The new well was installed in October 2013 near the former housing and shop facilities on the western side of the Site located outside of the mine-affected bedrock groundwater area as defined in the RI (EPA, 2005a). The results of the well installation, pump testing, and water quality sampling are presented in the *Man Camp Water Supply Well Data Evaluation Report* (WME, 2015). In summary, the pump test results indicate that the new well could produce approximately 4.3 gallons per minute on a sustained basis. This equates to approximately 6,000 gallons per day. Chemical analysis indicates that following minor treatment using locally proven technologies to remove uranium which is slightly above the drinking water standard, the well water is of sufficient quality to use as a water source for remedy construction.

3.18 BACKFILLED PITS DEWATERING

The objectives of the field activities described in the *Technical Memorandum - Backfilled Pits Area Pumping Plan Midnite Mine – Revision 3* (WME, 2013c) were to:

- Evaluate the operating condition of existing wells and equipment in Pit 2 and the Boyd Pit for use in initial dewatering of the BPA.

- Dewater Pit 2 and the Boyd Pit to evaluate the effect of varying water levels and pumping schemes on groundwater water levels within the waste rock backfill and surrounding bedrock to provide optimal water levels and dewatering well configurations for long-term dewatering of the BPA during implementation of the Site remedy.

The BPA pumping program was initiated in July 2013, and the *Backfilled Pits Area Pumping Plan - Phase I Data Transmittal Report, Rev 0* (WME, 2013d) was submitted in the July 2013 Monthly Report. The results of the Phase I activities verified that wells GW-54 and GW-58, and the associated pumps are capable of operating for long periods of time. Permanent electrical power was installed in August 2013. The second phase of pumping began on September 12, 2013 and is ongoing. The final sampling event occurred in July 2014, and the *Backfilled Pits Area Pumping Plan - Boyd Pit and Pit 2 Final Phase 2 Data Transmittal Report* (WME, 2014g) was submitted on December 1, 2014. The ongoing pump test data are included in the monthly reports to EPA and were used to inform the BPA dewatering design as described in Appendix D.

3.19 GEOCOMPOSITE INTERFACE TESTING

The objective of the *Geocomposite Interface Testing Work Plan, Revision 1* (MWH, 2013a) was to measure through testing the interface shear strength between the geomembrane and geocomposite drain materials being considered in the design. Data gathered from this effort supports the design of the composite cover system. Soils used in this testing were collected from bulk samples obtained during previous Rhoads Property borrow investigations (MGC, 2011b and 2011c) and stored in a locked storage container on site. These samples were shipped to Advanced Terra Testing in Lakewood, Colorado on October 9, 2013 for the direct shear testing on the GDL/Geomembrane interfaces. The results from this testing are incorporated in the cover stability analysis (included in Appendix D).

3.20 FORD BORROW MATERIAL SOIL-WATER CHARACTERISTIC TESTING

Soil-water characteristic curve (SWCC) testing of potential Ford Borrow material is described in the *Ford Borrow Material Soil-Water Characteristic Testing Work Plan – Revision 1* (MWH, 2013c). The primary objective of the proposed SWCC testing was to provide a more precise, site-specific SWCC curve for use in infiltration modeling of cover systems constructed of soils from the Ford borrow site. Although extensive testing of geotechnical, agronomic, and radiological properties was completed as part of previous borrow area design investigations (MGC, 2011b and 2011c), measurement of the SWCC, which is an input parameter for modeling of infiltration through the cover system was not included. For the purposes of preliminary 30% design, infiltration analyses for soil covers constructed of soil from the Ford borrow site were made using published correlations for SWCC based upon measured soil index properties. For final design, results from SWCC test performed on soils from the Ford borrow site are considered necessary to provide a more precise, site-specific estimate of the SWCC for input into infiltration analyses.

The field work, which included excavation, logging, and sampling of test pits at four locations was completed during October 2013 and samples were shipped to Advanced Terra Testing in Lakewood, Colorado for laboratory testing. The testing results were summarized in a memorandum titled *Ford Borrow Material Soil-Water Characteristic Testing Results Report* (MWH, 2014a). However, these data are not incorporated into the remedial design because approval to use the Rhoads Property Borrow area was obtained from the Tribe in the spring of 2014. These data will be evaluated if it becomes necessary to reconsider the Ford site as a source of borrow materials for the RA activities.

3.21 NEW MONITORING WELLS DOWNSTREAM OF CONFLUENCE OF OYACHEN AND BLUE CREEKS

At the request of the Tribe, four new monitoring wells were installed downstream of the confluence of Oyachen and Blue Creeks to evaluate groundwater conditions where Blue Creek becomes a losing stream. The objective of these new wells is to monitor shallow groundwater where potentially mine-affected surface water in Blue Creek is lost to the highly permeable sand and gravel terrace deposits in this area. The new monitoring have been included in the site-wide groundwater monitoring network described in the Site Wide Monitoring Plan (SMP; see Appendix Q). The new monitoring wells were installed and initially sampled in accordance with the *Blue Creek Monitoring Well Installation Work Plan, Revision 2* (WME, 2014c). The well installation activities are presented in a technical memorandum titled *Well Installation at Blue Creek near the Midnite Mine* (WME, 2014f). Pending implementation of the SMP, sampling results are included in the performance monitoring reports submitted by the Supervising Contractor to the EPA.

3.22 GEOTECHNICAL INVESTIGATIONS TO SUPPORT DESIGN OF THE ALLUVIAL GROUNDWATER CONTROLS

Investigations were performed during summer 2014 to obtain additional information for final design and to guide construction of the proposed alluvial groundwater controls (see Appendix

G). These activities were performed in accordance with the *Alluvial Groundwater Collection System Geotechnical Investigation Work Plan, Revision 1* (MWH, 2014b), and included a combination of geotechnical borings and seismic refraction surveys at the proposed locations of the extraction trenches and low-permeability barriers. Investigation data are used to estimate the final geometries of the trenches/barriers as described in Appendix G – Groundwater Controls.

4.0 REMEDIAL DESIGN CRITERIA AND COMPONENTS

This section presents the Selected Remedy work elements, associated cleanup levels, and Performance Standards as defined in the ROD and CD SOW. The cleanup levels are summarized on tables 4-1 through 4-5 and the Performance Standards are summarized on Table 4-6. This section also identifies the Remedial Design components that define how the Selected Remedy will be implemented at the Site, and where the associated design details and/or supporting documentation can be found within this BODR. The design components include: 1) engineering design sections that provide the detailed design information for the major Remedial Action work activities, 2) technical specifications that will be followed by the Remedial Action Contractors, and 3) supporting plans and documentation that provide guidance and information required for successful remedy implementation. These components are presented in appendices to this BODR as summarized in Table 4-7 and as discussed below.

4.1 REMEDY WORK ELEMENTS, CLEANUP LEVELS, AND PERFORMANCE STANDARDS

The main work elements of the Selected Remedy as defined in the CD SOW include:

- Mine Waste Containment, which includes the following work components:
  - Mine Waste Excavation
  - Pits 3 and 4 Mine Waste Containment
  - BPA Mine Waste Containment
- Water Collection and Treatment, which includes the following work components:
  - Water Collection and Conveyance
  - Water Storage and Treatment
  - Residuals Management
- Institutional Controls and Access Restrictions
- Long-Term Site Management
- Blue Creek and Delta Sediments Contingent Action

The cleanup levels (summarized in tables 4-1 through 4-5) were defined in the ROD and are media-specific contaminant concentrations that the RA must achieve to reduce human health and ecological health risks. The Performance Standards were developed in the CD SOW to define attainment of the RAOs (the RAOs are listed in Section 2.5.1). Table 4-6 summarizes the Performance Standards, which include General Performance Standards that are applicable to all work elements and work components, and Performance Standards applicable to individual work elements and work components. Table 4-6 also includes information on how the design meets each Performance Standard.

4.2 ENGINEERING DESIGN SECTIONS

Appendix A through Appendix J and Appendix AA contain the engineering design specifics for the major RA activities as listed in Table 4-7. The work activities include general and construction support facility information as well as specific RA work elements (e.g., Mine Waste Excavation and Containment, new Water Treatment Plant design). Each design appendix presents a narrative and supporting information including:

- Description of the work activity and, where applicable, construction phasing.
- Demonstration that the design meets the applicable Performance Standards identified in the CD SOW.
- Reference to the design drawings associated with the design element (design drawings are contained in Volume II of this BODR).
- Design assumptions and calculations/data that support the design.

4.3 TECHNICAL SPECIFICATIONS

Appendix K includes the Technical Specifications that will be adhered to by the RACs during the RA. The Technical Specifications are contract documents that provide the written requirements for materials, equipment, systems, standards, and workmanship for implementing the RA in accordance with the RD.

4.4 SUPPORTING PLANS AND DOCUMENTATION

The supporting plans and documentation are presented in appendices L through Z. Table 4-7 lists the plans and they are discussed below.

4.4.1 Health and Safety Plan

The *Midnite Mine Superfund Site Remedial Action Health and Safety Plan* (HASP) is included in Appendix L, and has been prepared in accordance with U.S. EPA guidance, Occupational Safety and Health Administration (OSHA) requirements outlined in 29 CFR 1920 and 1926; and U.S. Nuclear Regulatory Commission (NRC) Standards for Protection against Radiation included in 10 CFR 20. Because Midnite Mine is inactive, the Mine Safety and Health Administration (MSHA) regulations do not apply, but were considered and included where appropriate. The RA HASP presents the minimum requirements for all site workers and on-site contractors involved with the RA, and will be updated as necessary to address new or unforeseen hazards that are identified during the RA process. RACs will be required to prepare their own task-specific health and safety plans that are as stringent as, or otherwise comply with, the RA HASP.

4.4.2 Substantive Environmental Compliance Documentation

Appendix M summarizes the substantive environmental requirements for the Site remedial activities, and includes the project components, regulatory framework, project applicability, and the permitting and compliance strategy.

4.4.3 Tribal Access/Right of Way Documentation

A list of known or anticipated tribal access or right-of-way requirements is included in Appendix N. This includes siting, easements or rights of way, documentation related to the reissued NPDES permit for the WTP, and other regulatory and administrative requirements for access, remedy construction, and O&M.

4.4.4 Stormwater Management Plan

A Master SWMP is included in Appendix O to describe the over-arching framework for how stormwater and surface water will be managed to limit the release of sediment, pollutants, and deleterious debris to downstream areas during and following remedial actions at the Site. The SWMP, combined with the Surface Water and Sediment Controls described in Appendix F, describes how stormwater, surface water, and sediments at the Site will be managed to prevent the release of contaminants to unaffected downstream areas. The Master SWMP is the foundation document that provides the catalog of BMPs that will be applied to reduce the adverse impacts of stormwater. The construction contractor will be required to prepare a Construction Stormwater Pollution Prevention Plan (CSWPPP) that presents the stormwater management protocol and procedures that are specific to the phased construction activities. The construction contractor's CSWPPP will reference the Master SWMP for general stormwater management practices and will identify the BMPs that are applicable to the scheduled construction activities.

4.4.5 Operations Maintenance and Monitoring Plan – Water Management

Appendix P includes a comprehensive OM&M Plan for water management activities at the Site which addresses all site facilities, including surface water management, seep collection and pumpback systems, water storage, water treatment, and residuals management and disposal. The OM&M Plan will be updated periodically as the site features change throughout the phased RA construction activities to account for systems that are removed or taken off line, and to describe the OM&M of new systems as they are built.

4.4.6 Site-Wide Monitoring Plan

A RA SMP is included in Appendix Q. The SMP describes monitoring of groundwater, surface water, soils, sediments, and air during remedy implementation to determine if contaminants from the MA are being released to down-gradient or downwind areas. In general, the SMP uses the existing Performance Monitoring Plan (PMP; AES, 2011b) as the foundation for monitoring during the RA. The SMP includes a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP) by reference containing appropriate Standard Operating Procedures (SOPs). The EPA data quality objective (DQO) process (EPA QA/G-4HW; EPA, 2000a) was used to define the DQOs and guide the development of the SMP. The QAPP and FSP were prepared in accordance with the requirements of EPA QA/R-5 *EPA Requirements for Quality Assurance Project Plans* (March 2001), EPA QA/G-5 *EPA Guidance for Quality Assurance Project Plans* (December 2002), and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1998).

Following implementation of the Selected Remedy, the SMP will be updated to include monitoring of groundwater, surface water, soil, sediment, and radon (flux and airborne), as necessary to evaluate the effectiveness of the remedy in meeting the Performance Standards, RAOs, and cleanup levels. Baseline data collected historically and in accordance with the PMP during pre-remediation sampling will be compared with SMP data collected during the active-remediation and post-remediation to evaluate conditions throughout the remedial process. Monitoring of Blue Creek sediments will be performed separately in order to evaluate the need for contingent actions (see Sections 3.12 and 4.4.14).

4.4.7 Temporary Staging and Stockpiling Plan

A Temporary Staging and Stockpiling Plan is provided in Appendix R. Staging and stockpiling will be minimal during the RA as most of mine waste material will be directly loaded and hauled to its final destination in the pits and used as backfill. The only material anticipated to require stockpiling prior to placement in the containment area are 1) the pit-bottom sediments, which will be stockpiled on the waste rock piles, 2) material from the topsoil stockpile at the new WTP site, 3) excavation spoils from the construction of the groundwater control system, and 4) the drain rock that will be processed from the Hillside Waste Rock Pile (HSWRP), which will occur in Area 5. Ore Stockpile 7 and Ore Stockpile 6 will be consolidated by placing 7 on top of 6 so that the processed drain rock can be stored in Area 5.

4.4.8 Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments

An Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments is included in Appendix S. This plan describes the methods, equipment, and procedures for verifying that the remediated areas meet the cleanup goals described listed in Tables 4-1 and 4-2.

4.4.9 Water Source Identification and Development Plan

A Water Source Identification and Development Plan is included in Appendix T that identifies potential sources of water for use during the RA. The Water Source Identification and Development Plan includes the following information:

- Water use requirements (e.g., water necessary for dust suppression, equipment decontamination, compaction during backfill operations, etc.) and anticipated volumes of water needed for each activity.
- Water quality requirements (for the water uses listed above).
- Potential water sources and suitability (in terms of volume, delivery rate, and water quality).
- Permitting and access requirements.
- Conceptual design for water conveyance and/or water storage at the Site.

4.4.10 Construction Quality Assurance Plan

The RA CQAP is included in Appendix U. The CQAP describes the site-specific components of the QA program to ensure to the extent practicable that the completed RA meets all RD criteria, plans, and specifications.

4.4.11 Procurement Plan

The RA Procurement Plan is included in Appendix V. The Procurement Plan describes the contracting strategy, including contract terms and conditions, qualifications and training requirements, health and safety training, contract submittals, and requirements for compliance with applicable laws, including TERO.

4.4.12 Engineer's Cost Estimate

The engineer's cost estimate is provided in Appendix W. At this 100 percent design stage, this cost estimate has a +20 percent -10 percent level of accuracy.

4.4.13 Remedial Action Schedule

The RA schedule is provided in Appendix W. This schedule includes the construction phasing and work elements envisioned at this 100 percent design stage.

4.4.14 Blue Creek and Delta Assessment Work Plan

The Blue Creek and Delta Assessment Work Plan is included in Appendix Y of the 30% BODR (MWH, 2012i). As of June 2015, the Blue Creek and Delta Assessment Work Plan approach and timing for submittal is under discussion with EPA and the Tribe. Although the Selected Remedy anticipates that sediments in Blue Creek and Blue Creek Delta will meet cleanup standards through natural recovery within a reasonable timeframe, active sediment remediation may be required under certain conditions. This work element includes assessment and, in accordance with the Selected Remedy, removal of in-stream and riparian sediments in Blue Creek and Delta in accordance with the performance standards stated in the CD SOW. Refer also to Section 3.12 for the current status of the Blue Creek and Delta evaluations.

4.4.15 Well Decommissioning Plan

A well decommissioning plan is included in Appendix Z. The plan describes how existing monitoring wells and piezometers will be plugged or removed prior to performing the RA activities. Existing wells that are scheduled for groundwater monitoring during and following the RA will not be decommissioned, and will remain functional until changes are made to the SMP (Appendix Q).

4.5 GREEN AND SUSTAINABLE REMEDIATION

In accordance with CD SOW Section 1.3 (EPA, 2011), GSR principles and BMPs have been incorporated into the RD to demonstrate a high standard of environmental stewardship. The overarching goal of GSR is to minimize the environmental impact of the cleanup action through thoughtful technical and cost-effective approaches to the design, construction, and operation of certain components following the RA without jeopardizing protection of human health and the environment. The engineering design team has used GSR principles and BMPs on a project-wide basis as well as within each individual engineering design element for the major RA activities. GSR design elements are presented throughout the design documents.

The following five core elements of an environmental footprint were used to assess potential environmental impacts of the RA as recommended by EPA (EPA, 2008b and 2012):

- Total energy use and use of renewable energy
- Air and atmospheric pollutants and greenhouse gas emissions
- Water use and impacts to water resources
- Construction materials management and waste reduction
- Land management and ecosystem services

The GSR BMPs and principles selected for implementation on a project-wide basis are described below in Section 4.5.1. GSR BMPs and principles to be implemented are included in the engineering drawings, specifications, and in Appendix B through Appendix J and Appendix AA for the major RA construction activities, as applicable. In addition, a Green and Sustainable Practices Specification (01585) has been developed to focus Contractor attention on several key areas of materials management, water management, and air emission reductions required during RA activities.

4.5.1 GSR Principles Selected for Implementation

Table 4-8 includes a list of specified GSR BMPs or GSR principles that have been selected for implementation on a project-wide basis during the RA activities. These GSR principles or BMPs to be carried forward in the successive design phases have been selected based on assessment of practicability for the RA at this site. The GSR strategies selected for implementation are consistent with:

- Governing statutes and regulations, including the CD SOW
- Cleanup objectives
- Cleanup timeframes
- Community interests

- Protectiveness of cleanup actions.

Where applicable, the engineering design sections included in Appendix B through Appendix J and Appendix AA include a discussion of applicable GSR technologies and BMPs, and specific GSR measures are specified in engineering drawings, technical specifications, and plans as applicable. Therefore, GSR savings of energy, air emissions, clean water use, and generated waste will be realized during the RA construction and during long-term OM&M at the Site. A summary of the significant GSR measures and their estimated savings for the project duration are included in Table 4-9. A total of approximately 1.5 million gallons of diesel will be saved through the implementation of the five primary measures quantified (Table 4-9). The GSR activities will be documented in the Midnite Mine Remedial Action Report prepared at the completion of the RA.

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Worthington Miller Environmental (WME), 2012. Addendum to the Mine Waste Investigations Report, Midnite Mine Hillside Waste Rock. July 20.

TABLE 2-1

INTERIM DISCHARGE LIMITS TO SURFACE WATER

Pollutant or Contaminant	Interim Discharge Limit [a,b]	Comments
Uranium[c] (total)	4,000 µg/L max. 2,000 µg/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that uranium concentrations of less than 200 µg/L are achievable under current conditions.
Radium-226[c] (dissolved)	10 pCi/L max. 3 pCi/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that dissolved radium-226 concentrations of less than 3 pCi/L are achievable under current conditions.
Radium-226[c] (total)	30 pCi/L max. 10 pCi/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that total radium-226 concentrations of less than 3 pCi/L are achievable under current conditions.
Manganese (total)	10,000 µg/L max. 3,000 µg/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that manganese concentrations of less than 1,500 mg/L are achievable under current conditions.
Copper[d] (total)	184 µg/L max. 126 µg/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that copper concentrations of less than 20 µg/L are achievable under current conditions.
Cadmium[d] (total)	15 µg/L max. 10 µg/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that cadmium concentrations of less than 4 µg/L are achievable under current conditions.
Zinc[c] (total)	1000 µg/L max. 500 µg/L avg.	Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions. Permit discharge reports indicate that zinc concentrations of less than 20 µg/L are achievable under current conditions.
pH[c]	6-9	
TSS[c]	30 mg/L max. 20 mg/L avg.	
COD[c]	200 mg/L max. 100 mg/L avg.	

COD chemical oxygen demand

TSS total suspended solids

µg/L micrograms per liter

[a]Discharge limits are consistent with NPDES Permit WA-002527-1 and must not be exceeded. Treatment system discharge shall meet the lowest concentrations achievable with the treatment methods currently in use and as appropriate for site conditions.

[b]Monitoring of parameters shall continue per NPDES Permit WA-002572-1 until alternate monitoring plan is approved by EPA. Alternate plan may include monitoring per methods in 40 CFR 136 for whole effluent toxicity (WET), ammonia, temperature, DO, TDS, antimony, mercury, lead, iron, sulfate, and other parameters necessary to develop a future permit application. EPA may also require interim monitoring of COCs (aluminum, barium, beryllium, cobalt, lead, nickel, silver, lead-210, uranium-238, and uranium-234).

[c]NPDES permit limit based on technology-based effluent limit guidelines (ELGs) for uranium mines at 40 CFR 440.32 and 440.33.

[d]NPDES permit limit based on Washington State water quality standards at the time the permit was issued.

Source: *Midnite Mine Superfund Site Record of Decision* (EPA, 2006a)

TABLE 3-1

ESTIMATED VOLUME OF DISPOSAL MATERIALS AND CAPACITY OF DISPOSAL AREAS

	VOLUME (Cubic Yards)	
Mine Waste	**(Low Estimate)**	**(High Estimate)**
Roads	36,600	87,000
Mine Drainage Sediments	17,200	160,000
Pit Sediments	5700	5700
Foundation Materials	995,000	995,000
Waste Rock	16,700,000	18,200,000
TOTAL VOLUME	**17,800,000**	**19,500,000**
	CAPACITY (Cubic Yards)	
Disposal Area Capacities	**(Low Estimate)**	**(High Estimate)**
Pit 4	4,000,000	4,500,000
Pit 3	15,200,000	15,900,000
Existing Backfilled Pit Area	540,000	540,000
TOTAL CAPACITY	**19,700,000**	**20,900,000**

Source: *Mine Waste Investigations – Revision 1* (MGC, 2011d)

TABLE 3-2

RELATIVE COMPARISON AND CLASSIFICATION OF ACID ROCK DRAINAGE (ARD) AND RADON GENERATION POTENTIAL

Mine Waste	Area	Approximate Volume (CY)	ARD Generation Potential[1]	Radon Generating Ability[2]
Waste Rock	South Waste Rock Pile	10.5 million	Moderate	Moderate
	East Waste Rock Pile	1.1 million	Moderate	Moderate
	Hillside Waste Rock Pile	2.5 million	Low	Moderate
	Pit 4 Overburden Pile[3]	433,000	Low	Moderate
	Area 5 Waste Rock Pile[4]	772,000	Moderate	Moderate
Ore/Protore	Protore Stockpile #1	45,000	High	High
	Protore Stockpile #2	40,500	High	High
	Ore Stockpile #3	72,000	High	High
	Protore Stockpile #4	250,000	High	High
	Ore/Protore Stockpile #5	42,000	High	High
	Ore/Protore Stockpile #6	611,000	Moderate	High
	Ore Stockpile #7	64,000	Moderate	High
	Lime Protore Stockpile #8	344,000	Low	High
Other Materials	Pit Sediment	5700	Moderate[5]	High
	Mine Drainage Sediment	17,200-160,000	Low[5]	Low
	Access Road Material	36,600-87,000	Low[5]	Low
	Foundation Material	995,000	Low[5]	Low

[1]Relative classification of ARD generation potential based on acid base accounting (ABA) guidelines:

Low - material will not generate acidity or the ARD generation potential of the material ranges from potentially acid neutralizing to uncertain net acid production.

Moderate - ARD generation potential of materials are considered to be uncertain with respect to the acid generation or neutralization guidelines, but have a mineralogic composition indicating that the material may have a low potential to generate acid

High - materials are potentially acid generating according to ABA guidelines.

[2]Radon-generating ability is classified as low, moderate or high relative to the comparative evaluation of the measured ^{226}Ra activity concentrations and/or gamma exposure rates for each of the mine waste material areas.

[3]Classified same as Hillside Waste Rock Pile since both piles were generated from Pit 4.

[4]Classified same as South Waste Rock Pile.

[5]Classified based on chemical concentration data.

Source – Technical Memorandum Mine Waste Characterization (AES, 2011a)

TABLE 3-3

ESTIMATED WATER MANAGEMENT VOLUMES

Current Conditions (1999-2010)	Construction Period	Post-Remedy
Estimated Annual Water Management Volumes (gallons)		
Average Annual 52,700,000	Average 79,000,000	Low estimate 18,000,000
Maximum 110,000,000	Maximum (100-year) 149,000,000	High estimate 25,600,000
Minimum 26,000,000		
Estimated Monthly Treatment Volumes (gallons)		
	Construction Period	**Post-Remedy**
	Average 24,000,000	Low estimate 2,500,000
	Maximum (100-year) 60,000,000	High estimate 3,600,000
Estimated Peak 24-Hour Treatment Volumes (gallons)		
	Maximum (100-year) 15,000,000	
	High Estimate (10-year) 10,400,000	

Source: Midnite Mine Design Investigation Report - Groundwater Investigations – Revision 2 (MGC, 2011e).

TABLE 4-1

CLEANUP LEVELS FOR MIDNITE MINE SURFACE MATERIAL

COC	Cleanup Level	Risk Driver	Basis for Cleanup Level
Uranium (total)	43 mg/kg	Human Health and Ecological	Background
Lead-210	7.5 pCi/g	Human Health	Background
Radium-226	4.7 pCi/g	Human Health	Background

Source: Midnite Mine Superfund Site Record of Decision (EPA, 2006a)

Note: Radium cleanup level in soil is consistent with OSWER Directive No. 9200.4-25, Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA sites, dated February 12, 1998.

COC contaminant of concern
mg/kg micrograms per kilogram
pCi/g picoCuries per gram

TABLE 4-2

CLEANUP LEVELS FOR MIDNITE MINE SEDIMENTS

COC	Cleanup Level	Risk Driver	Basis of Cleanup Level
Lead-210	20 pCi/g	Human Health	Background
Uranium-238	31 pCi/g	Human Health	Background
Uranium-234	41 pCi/g	Human Health	Background
Radium-226	13 pCi/g	Human Health	Background
Chromium	43.4 mg/kg	Ecological	Spokane Tribe Sediment Standard (HSCA)
Manganese	1,179 mg/kg	Human Health and Ecological	Background
Selenium	1.7 mg/kg	Ecological	Background
Uranium (total)	93.2 mg/kg	Human Health and Ecological	Background
Vanadium	41 mg/kg	Ecological	Background

Source: Midnite Mine Superfund Site Record of Decision (EPA, 2006a)

COC contaminant of concern
mg/kg micrograms per kilogram
pCi/g picoCuries per gram

TABLE 4-3

CLEANUP LEVELS FOR MIDNITE MINE SURFACE WATER

COC	Cleanup Level	Risk Driver	Basis of Cleanup Level
Lead-210	2.5 pCi/L	Human Health	Background
Uranium-238	7.6 pCi/L	Human Health	Background
Uranium-234	8.8 pCi/L	Human Health	Background
Aluminum (total)	9,073 µg/L	Ecological	Background
Barium (total)	165 µg/L	Ecological	Background
Beryllium (total)	0.53 µg/L	Ecological	Benchmark, EPA Regions 4 and 9
Cadmium (dissolved)[a]	2.0 µg/L (acute) 0.5 µg/L (chronic)	Ecological	National recommended water quality criterion
Cobalt (total)	3 µg/L	Ecological	Background
Copper (dissolved)	13.4 µg/L (acute) 8.96 µg/L (chronic)	Ecological	Spokane Tribe WQS
Lead (dissolved)	64.6 µg/L (acute) 2.52 µg/L (chronic)	Ecological	Spokane Tribe WQS
Manganese (total)	72 µg/L	Human Health and Ecological	Background
Nickel (dissolved)	468 µg/L (acute) 52 µg/L (chronic)	Ecological	Spokane Tribe WQS
Silver (dissolved)	3.2 µg/L (acute) 0.8 (chronic)	Ecological	National recommended water quality criterion
Uranium (total)	19.6 µg/L	Human Health and Ecological	Background
Zinc (dissolved)	114 µg/L (acute) 105 µg/L (chronic)	Ecological	Spokane Tribe WQS

COC constituent of concern
µg/L micrograms per liter
pCi/L picoCuries per liter
WQS Water Quality Standard
[a] Criteria are hardness dependent. Cleanup level calculated at a hardness of 100 mg/L as $CaCO_3$. Actual Applicable or Relevant and Appropriate Requirements (ARARs) are equations used to derive the values.

Source: *Midnite Mine Superfund Site Record of Decision* (EPA, 2006a)

TABLE 4-4

CLEANUP LEVELS FOR MIDNITE MINE GROUNDWATER

COC	Cleanup Level	Risk Driver	Basis of Cleanup Level
Uranium-238	35 pCi/L	Human Health	Background
Uranium-234	37 pCi/L	Human Health	Background
Manganese	1,990 µg/L	Human Health	Background
Uranium (total)	88 µg/L	Human Health	Background

Source: *Midnite Mine Superfund Site Record of Decision* (EPA, 2006a)

COC constituent of concern
µg/L Micrograms per liter
pCi/L picoCuries per liter

TABLE 4-5

ALLOWABLE RADON FLUX THROUGH THE COVER

COC	Cleanup Level	Risk Driver	Basis of Cleanup Level
Radon-222	20 picoCuries per square meter per second[1]	Restricted land uses in areas where waste is contained under a soil cover	EPA standard for radon release rates at inactive uranium mill tailings sites closed under 40 CFR 192.02(b)(1) and 40 CFR 61.222(a).

Source: *Midnite Mine Superfund Site Record of Decision* (EPA, 2006a)

COC constituent of concern

[1] The release rate, or "flux", is measured at the surface of the cover and takes into account the contribution of soil cover material to the overall release rate.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.3 General Standards Applicable to All Work Elements and Work Components		
2.3.1	All Work performed and proposals made by the Settling Defendants are subject to the review and approval of EPA.	All Remedial Design/Remedial Action (RD/RA) submittals listed in the CD SOW (and summarized in Section 5.0 of the *Remedial Design Work Plan* (RDWP; MWH 2012f) are submitted to EPA for review and approval prior to performing RA activities.
2.3.2	All documents submitted for review and approval to EPA by the Settling Defendants shall be of high quality. Documents shall be free of typographical and formatting errors and shall include document title, submittal date, revision number, and page number on every page. Draft documents shall be thorough and of sufficient quality that multiple review cycles by EPA are not required.	RD documents are prepared in accordance with Quality Assurance/Quality Control (QA/QC) requirements outlined in Section 6.0 of the RDWP. All BODR text, tables, figures, drawings and calculations are reviewed by qualified personnel prior to submittal to EPA.
2.3.3	Settling Defendants shall use EPA guidance documents as the basis for development of work plans, sampling plans, monitoring plans, and other documents. EPA guidance to be used for these purposes include: *USEPA Superfund Remedial Design and Remedial Action Guidance* (OSWER Directive 9355.0-4A, June 1986) and other EPA RD/RA guidance. *EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans* *EPA QA/G-5, EPA Guidance for Quality Assurance Project Plans* *EPA QA/G-4, Data Quality Objectives Process for Hazardous Waste Site Investigations*	The overall RD is prepared in accordance with: *USEPA Superfund Remedial Design and Remedial Action Guidance* (OSWER Directive 9355.0-4A, June 1986). The supporting "other named plans" listed in Section 5.0 of the RDWP and as described in Section 3 of the CD SOW, are prepared in accordance with *EPA QA/R-5, EPA QA/G-5,* and *EPA QA/G-4*, as applicable.
2.3.4	Settling Defendants shall meet with EPA as necessary to facilitate the orderly, effective, and efficient implementation of the Work. At a minimum, Settling Defendants and EPA will meet annually in or around mid-October to discuss the Work and project schedule. In addition, design review meetings shall be held for each phase of the design (30 percent, 60 percent, and 90 percent design phases).	Technical Managers Meetings (as described in Section 1.2.2 of the RDWP) were held throughout the RD process.
2.3.5	Settling Defendants shall integrate and coordinate as appropriate each Element of Work with all other Elements of Work and with all other Site operations and activities.	Process to ensure the RD is integrated and coordinated includes having a single Project Manager and a single Engineering Manager to ensure the various plans and design submittals meet the requirements of the CD SOW and are integrated and coordinated among the various technical teams and with EPA/Tribe.
2.3.6	Settling Defendants shall demonstrate achievement of the Performance Standards set forth in Sections 2.3 (General Performance Standards) and 2.4 (Elements and Components of Work and Performance Standards).	The BODR includes information throughout to demonstrate how the RD achieves the Performance Standards (including this summary table and a similar table in each design appendix).
2.3.7	Unless otherwise specified within a specific work plan for a given Element of Work, achievement of the Performance Standards shall be demonstrated at representative locations and using methods that are proposed by the Settling Defendants and are subject to the review and approval of EPA.	Design-related performance standards are addressed as discussed in the Engineering Design Sections (appendices A through I, and AA) and as summarized on this table.
2.3.8	All Work performed by Settling Defendants shall be performed in accordance with the deliverables and schedules set forth under Sections 3 and 4 (of the CD SOW).	The updated RA Schedule (which identifies the delivery milestones set forth under Sections 3 and 4 of the CD SOW) is included in Appendix X of this BODR.
2.3.9	Other than Waste Materials identified for disposal in designated locations in specific Elements of Work, the Settling Defendants shall dispose of, or arrange and provide for the disposal of, Waste Materials generated from implementing the Work.	The process for handling/disposal of RA-derived wastes (other than Waste Materials identified for disposal in the pits) will be presented in the Remedial Action Work Plan (RAWP), which will be prepared following approval of the final RD. In addition, handling of wastes from the demolition of structures, including mine buildings, is described in Appendix H – Demolition.
2.3.10	In the event that the performance of Work under this SOW results in the damage or destruction of any building, structure, or other similar facility outside of the ownership of the Settling Defendants, the Settling Defendants shall either repair or replace, as necessary, such building, structure, or other similar facility with one that provides the same function in a manner that is subject to the approval of EPA provided that EPA believes that such building, structure, or other similar facility is needed for a future use. If the Settling Defendants disagree with EPA as to the need for the building, structure, or other similar facility and the Settling Parties subsequently fail to reach an agreement as to either the necessity for or scope of the repair or replacement of such building, structure, or other similar facility, the Settling Defendants may seek dispute resolution under Section XIX of the CD. Notwithstanding the above, the Settling Defendants shall not dispute the need for such a building, structure, or other similar facility that is part of an established use at the time of lodging of the CD and EPA decides that such use shall be allowed to continue at the site in the future.	DMC/Newmont is committed to repairing any damage caused by the RA in accordance with the Performance Standards. The RAWP and contract documents between DMC/Newmont and the RA Contractors (RACs) will include language regarding damages incurred during the RA and the RAC liabilities and insurance requirements.
2.3.11	Buildings, facilities, structures, and equipment not needed for the remediation shall be demolished, disposed or otherwise removed in a timely manner as determined during RD.	The overall RA Schedule in Appendix X of this BODR shows the anticipated timing for demolition/disposal of buildings, facilities, structures, and equipment not needed for the remediation. All non-essential buildings, facilities, structures, and equipment will be demolished and disposed of with the mine wastes backfilled into Pit 3 and Pit 4 during the course of the RA.
2.3.12	Waste Material generated in the performance of the Work that requires disposal shall either be disposed of On-site or Off-site in accordance with the following requirements: If disposed of Off-site such disposal shall be in compliance with all applicable laws and regulations including the Off-site Disposal Rule (40 C.F.R 300.440); or If disposed of On-site, such disposal shall only occur at locations approved by EPA. Disposal within any designated On-site disposal areas shall be in accordance with material handling and waste acceptance requirements specified by EPA, Spokane Tribe of Indians, and the Bureau of Indian Affairs for the disposal area.	RA-derived wastes (other than Waste Materials identified for disposal in the pits) will be handled/disposed of as defined in the RAWP that will be prepared for the RA. It is anticipated that any wastes disposed of off-Site will qualify as municipal waste or construction debris (i.e., will not be contaminated/hazardous). However, all off-Site disposal will be in accordance with the Off-site Disposal Rule (40 CFR 300.440), if necessary. All wastes disposed of on-Site during the RA will occur in pits 3 and 4. Appendix D - Mine Waste Excavation and Containment describes all on-Site waste containment in the pits.
2.3.13	In order to identify the presence of threatened, endangered, proposed, or candidate species, or their habitat, within the vicinity of the Remedial Action, Settling Defendants shall prepare for EPA approval a draft Biological Assessment (BA) to support compliance with the substantive requirements of the Endangered Species Act. The draft BA shall characterize baseline conditions of existing habitat; address potential project impacts that the Remedial Actions may have on these species, their habitat, and their food stocks; and describe best management practices (BMPs) and conservation measures designed to avoid or minimize any negative impacts.	A Biological Assessment is included in Appendix M – Substantive Environmental Compliance.
2.3.14	If in-water Work including dredging or capping is part of the Remedial Action (e.g., for construction of the WTP outfall or for excavation of sediments), Settling Defendants shall submit a draft memorandum that provides sufficient information to demonstrate compliance with the substantive requirements of Sections 401 and 404(b)(1) of the Clean Water Act (CWA). The memorandum shall document the information gathered regarding practicability and cost, long and short-term impacts from all proposed alternatives, minimization of adverse effects, and an analysis of the need for any mitigation.	All RA work conducted in jurisdictional wetlands or water bodies will have a memorandum prepared with sufficient information to demonstrate substantive compliance with the requirements of Sections 401 and/or 404(b) of the CWA. Necessary memos will be developed for specific RA activities requiring them during later design stages. The Preliminary Substantive Environmental Compliance Documentation for this RA is included in Appendix M (including the process for Wetland Delineation). This document lists all the possible permits and regulations that will have to be substantially complied with during the RA.

Note: The status column on this table that was present on earlier iterations of the design was removed because issues/action items associated with the design are complete at this step of the process (100% design). Moving forward the RAWP, design drawings, and specifications will guide construction of the remedy to completion.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.3.15	Unless otherwise approved by EPA, the Settling Defendants shall implement, install, and/or use the controls specified below during all construction activities.	In general, the Construction Quality Assurance Plan (CQAP; located in Appendix U) and the RAWP that will be prepared following approval of the 100% BODR details how each of the subcategories below will be satisfied.
2.3.15 A	Any necessary archeological inspections shall be coordinated with the Tribe and any other parties that have applicable authorities under state, tribal, or federal law as follows. Portions of the Work Area are associated with historic and prehistoric uses and may contain archeological deposits that may represent a cultural resource of importance to the Spokane Tribe. Should any bones, shards, implements, or other archeological deposits be discovered during the construction phase of the Work, all construction activities within the immediate area of the discovery shall stop and the designated Tribal cultural or natural resources staff as well as any other parties that have applicable authorities under state or federal law shall be notified. The Tribe or any other parties that have applicable authorities under state, tribal or federal law shall be given a reasonable opportunity to document or recover the finds. If significant artifacts are found that are intermingled with contaminants, the Settling Defendants shall work with the Tribe to evaluate options for their removal or protection. In the event that human remains are located, Work shall be halted within a sufficient surrounding area to maintain the integrity of the remains and the Tribe shall be promptly notified. Construction in the affected area may be resumed upon approval of the Tribal cultural resources director.	The processes used during the pre-remedy implementation element of work has been successful at informing the Tribal representatives during the work plan preparation stage, well before proceeding with any construction activities. Similar procedures will be written to comply with this performance standard and will be described in detail in the RAWP. Once approved by EPA in consultation with the Tribe, those procedures will be followed during the RA.
2.3.15. B	Access to active Work Areas shall be restricted through the use of appropriate measures (e.g., fencing, barricades, etc.) as necessary to supplement the existing perimeter fence installed around the Mined Area. For purposes of this provision, active Work Areas shall mean those areas of the Work Area in which construction associated with the Work is occurring and such construction activities would represent a potential safety hazard to the general public or other site workers if access were not controlled. Active Work Areas shall also include those portions of the Work Area where, as a result of the ongoing construction activities, exposure to contaminants is temporarily greater than that which existed prior to the implementation of the construction activities.	Access restrictions to Active Work Areas will be defined in the RAWP. It is anticipated that access to Active Work Areas will be restricted to one (or possibly two) controlled access locations. During the early works, the permanent Site Access Road and decontamination area will be constructed and access to the work areas will be restricted by the existing perimeter fence. Upon completion of the permanent Site Access Road and decontamination area, access to the site will be restricted to the Permanent Site Access Road. A security post will be built at the gate where the Site Access Road passes through the existing perimeter fence. All persons accessing the site will be required to check in at the security post. Once inside the fence, the Site Access Road passes through the support corridor, which includes construction support facilities and the WTP (and associated facilities). This corridor will be completely enclosed by a combination of proposed fencing and the existing perimeter fence. Any vehicles or personnel wishing to access any part of the site outside the support corridor (including the work areas) must pass an additional checkpoint at the north end of the corridor. Once vehicles or personnel leave the support corridor and enter the Mine Site Proper by crossing the fence-line forming the northern boundary of the support corridor they will be required to pass through the decontamination area (and undergo appropriate decontamination procedures) before leaving the Mine Site. These details are contained in Appendix B - Construction Support Facilities and Early Works and the Section 2 design drawings contained in Volume II.
2.3.15. C	Controls as outlined in Work-specific Health and Safety Plans shall be implemented to prevent unacceptable contaminant exposures to workers within the Work Area and adjacent communities.	The decontamination and personal protective equipment (PPE) requirements described in the *Remedial Action Health and Safety Plan* (HASP) included in Appendix L present the procedures and protocols to prevent unacceptable contaminant exposures to workers within the Work Area and spread of contaminants outside of work areas. The HASP also defines the health and safety requirements for the remedial action contractors (RACs).
2.3.15. D	Mitigation measures as specified in the applicable work plans shall be implemented to fulfill the requirements of the CWA Sections 401 and 404 and the Endangered Species Act.	Impacts to waters of the U.S. and Endangered Species will be minimized to the extent practicable by limiting the footprint of the drainage clean-up in the Western, Central, and Eastern Drainages and Lake Roosevelt. In addition, the use of BMPs described in the Stormwater Management Plan (Master SWMP; Appendix O) will be used to reduce sediment runoff and minimize turbidity in Lake Roosevelt that could affect the federally listed bull trout. Mitigation will be implemented under requirements of Sections 401/404 of the Clean Water Act and Endangered Species Act once impacts are further refined in later design phases, if necessary.
2.3.15. E	Removals and other excavations conducted as part of the construction activities shall be performed in a manner that allows for proper drainage from the excavated area. Drainage from Work Areas that may have come into contact with contaminants shall be captured and conveyed to the WTP for treatment. No drainage from Work Areas that may have come into contact with contaminants shall be allowed to infiltrate or discharge to natural drainages where water treatment collection and conveyance controls are not in place and operating.	The RA will be performed such that all water that potentially contacts mining wastes is captured and treated. To the extent practical, mine waste excavations will be completed beginning at the upstream (northern) end of the Western, Central, and Far Eastern Drainages and continued in a downstream direction. Excavation areas will be graded in a manner that contains surface water runoff from excavation areas wholly within the excavation areas, from where it will either drain by gravity, or be pumped initially into Pit 3, and as construction progresses, into various storage ponds that will be constructed and ultimately to the WTP for treatment. Topography will be maintained throughout the RA construction activities such that clean water sheds away from the work areas, and mine-affected water is captured before it can discharge to the downstream drainages. These details are described in the following design appendices: Appendix D – Mine Waste Excavation and Containment describes how excavations will be performed in a manner to capture and contain potentially mine-affected surface water. Appendix E – Water Management Ponds describes how the pits and temporary surface water impoundments will be used to capture and store mine-affected water. Appendix F – Surface Water and Sediment Controls – provides the analysis and design of the surface water (SW) and sediment controls for post-closure conditions and for temporary channels installed during the RA construction phases. Appendix I – Water Treatment Plant describes how the mine-affected water will be treated and discharged. Appendix J – Influent and Effluent Pipelines describes how the mine affected water will be conveyed to the WTP and how the treated water will be conveyed to the discharge location.
2.3.15. F	The placement of contaminated materials in Pits 3 and 4 is expected to take several construction seasons. For this reason, the Settling Defendants shall develop plans to conduct the Work in stages and ensure that precipitation, snow melt, and storm water that enters the pits prior to closure is captured and conveyed to the WTP for treatment. The measures used to capture and convey this water shall to the maximum extent practicable prevent water from infiltrating through contaminated materials.	Waste excavation and fill placement will occur year-round during the RA (RA schedule is included in Appendix X). The subwaste and dewatering system will be operated continuously throughout construction to keep water from accumulating on the subwaste liner from entering the subwaste drainage system (subwaste liner and drainage system is described in Appendix D).
2.3.15. G	Construction activities located within surface water, water ways, or wetlands shall be performed using the controls specified within the Stormwater Management Plan (SWMP) developed by the Settling Defendants to address controls, best management practices, and wetland mitigation for the site. The SWMP is subject to the review and approval of EPA. The SWMP shall be prepared in coordination with the CWA Section 401 and 404(b)(1) analyses. If contingent cleanup of Blue Creek and Delta sediments is required, a revised or new SWMP and 401 and 404(b)(1) analyses shall be submitted.	With a few specific exceptions (e.g., sediment cleanup within drainages; construction of the WTP effluent pipeline in the Blue Creek Delta), the RA work will not occur within surface water bodies. To the maximum extent practical, sediment cleanup within drainages will be conducted during summer and early autumn when water typically is not present in the intermittent drainages. Excavations for installing the WTP effluent pipeline only will occur above the water line of the Blue Creek delta; all pipeline/diffuser materials below the water line will be placed on the streambed or lakebed surface. The Master SWMP in Appendix O contains the BMP catalog, including BMPs to minimize the transport of sediments to adjacent water bodies. The SWMP will be updated as necessary throughout the RA, including updates required to address the contingent actions in Blue Creek.
2.3.15. H	To the extent practicable, construction activities shall be conducted in a manner that does not result in the re-contamination of areas already remediated or contamination of areas that were previously uncontaminated. Any such re-contaminated or newly contaminated areas shall be addressed by the Settling Defendants in a manner that is subject to the review and approval of EPA.	The phased mine waste excavation plans contained in Appendix D - Mine Waste Excavation and Containment were developed such that construction activities will not result in re-contamination of areas already remediated or contamination of areas that were previously uncontaminated. For example, contaminated materials will not be hauled across remediated or previously uncontaminated areas. Likewise, contaminated materials will not be staged/stockpiled in remediated or previously uncontaminated areas without engineering controls to prevent contamination, as approved by EPA. Removal of contaminated materials will be required prior to construction in the support facilities area as described in Appendix B -Construction Support Facilities.
2.3.16	Construction quality control and quality assurance monitoring shall be conducted in accordance with the provisions of the Project Quality Assurance/Quality Control Plan and be coordinated with EPA's oversight of the Work; however, oversight by EPA shall not in any way relieve the obligation of the Settling Defendants to conduct the Work in accordance with the provisions of the CD and Work Plans.	The Remedial Action Construction Quality Assurance Plan (CQAP) is included in Appendix U.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE
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CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.3.17	All construction activities shall be conducted in a manner such that active Work Areas are maintained in an orderly manner. The sites shall be kept free from accumulations of waste materials, rubbish, and other debris resulting from the Work. At the completion of the Work, waste materials, rubbish, and debris from and about the Work Area as well as tools, appliances, construction equipment, machinery and surplus materials shall be removed. Any material requiring disposal shall be disposed of in accordance with applicable provisions of this SOW.	The RA contractor(s) will meet this Performance Standard through compliance with the appropriate technical specifications in Appendix K. The RAWP will have procedures for orderly site maintenance.
2.3.18	Best Management Practices (BMPs) shall be used as specified below during all construction activities to minimize the transport of disturbed material by water, wind erosion or vehicles. The Settling Defendants shall develop a catalog of BMPs that shall be used at the Site and shall identify the primary activities requiring those BMPs. The BMP catalog shall be comprehensive and is subject to the review and approval of EPA. The minimum BMPs that must be contained in the BMP catalog are presented below. The Settling Defendants shall include these BMPs in the BMP catalog along with additional BMPs that may be necessary to complete the Work. A Storm Water Management Plan (SWMP) shall be prepared which contains the BMP catalog and identifies BMPs and specific sediment control measures to be employed before, during, and after construction.	The Master SWMP included in Appendix O describes the over-arching framework for how stormwater and surface water will be managed to limit the release of sediment, pollutants, and deleterious debris to downstream areas during and following the RAs. The Master SWMP is the foundation document that provides the catalog of BMPs that will be applied to reduce the adverse impacts of stormwater. The RAC will be required to prepare a Construction Stormwater Pollution Prevention Plan (CSWPPP) that presents the stormwater management protocol, procedures, and BMPs that are specific to the phased construction activities. The RAC's CSWPPP will be updated annually and will reference the Master SWMP for general stormwater management practices/BMPs that are applicable to the scheduled construction activities.
2.3.18. A	The Work shall be conducted in a manner that minimizes the generation of fugitive dust. If the application of water or other dust suppressants to Work Areas is used to control the generation and migration of fugitive dust, such application of dust suppressants shall comply with the following requirements:	The dust-control BMPs are described in the Master SWMP included in Appendix O. The primary dust-control mechanism will be watering or other environmentally safe alternatives as approved by EPA and the Tribe. The Technical Specifications included in Appendix K also include requirements for dust control.
2.3.18. A.i	Dust suppressants containing brine, or other materials that are harmful to surface water or vegetation shall not be used. Subject to EPA approval, water treated to meet the WTP discharge limits may be used for dust suppression in the Work Area, provided it will not result in releases to surface water or adversely affect worker health and safety.	See response to 2.3.18.A above. The design assumes that water from the WTP will be used for dust control in the MA on contaminated materials. It is assumed that this water would not be used on areas that are outside of the MA or have been cleaned up to applicable standards.
2.3.18. A.ii	Application of dust suppressants shall be performed in a manner that minimizes surface water runoff, over spray of chemical suppressants into surface water bodies, wetlands or other sensitive habitats, and/or generation of muddy conditions.	Water or dust suppressants will be applied in sufficient quantity to control dust, but not generate free liquids. This information is stated in the Master SWMP included in Appendix O.
2.3.18. B	At a minimum, the following BMPs shall be used to minimize the transport of sediment from Work Areas:	BMPs to minimize sediment transport from the work areas are identified in the Master SWMP contained in Appendix O. A primary objective of the BMPs included in the Master SWMP is to minimize sediment transport away from the work areas.
2.3.18 B.i	Staging areas, accumulation areas and other areas where Work is to be performed on exposed slopes shall be isolated with appropriate BMPs to minimize transport of potentially contaminated sediments from the Work Areas by surface water runoff.	The Master SWMP in Appendix O contains the BMP catalog, including BMPs to minimize the transport of sediments. Examples include erosion control blankets, pipe slope drains, and straw bale barriers. Note that all potentially contaminated surface water in the excavation areas will be captured and diverted to the operating WTP, and all associated sediments will be captured and consolidated with the mining wastes. These surface water and sediment control structures described in Appendix F and depicted on the Section 6 design drawings contained in Volume II.
2.3.18 B.ii	The required sedimentation controls and BMPs as defined in the SWMP shall be maintained throughout the construction activities. Inspection of the sedimentation controls shall occur as necessary to prevent failure. Repairs, removal, and disposal of accumulated sediments shall be conducted to maintain the function of the controls.	The Master SWMP in Appendix O defines the requirements for inspecting, maintaining, and repairing sedimentation controls and maintaining BMPs throughout construction. Site inspections will be conducted at least once a week and within 24-hours of storms likely to cause a stormwater discharge from the Site (e.g., storms producing 0.25 inches or greater of precipitation in 30 minutes, or a 24-hour total greater than 0.5 inches). During winter, when the Site may be inaccessible and typically covered in snow, it will not be practicable to observe Site BMPs or make repairs. As the Site becomes accessible during the spring melt season, inspections and maintenance will resume.
2.3.18 B.iii	Work that occurs within surface water bodies shall be performed in accordance with the requirements of the SWMP in the approved Remedial Action Work Plan to minimize sediment migration from the Work Area and mitigate damage to existing vegetation. All such Work shall be performed in a manner that limits harm to wetlands and surface water. In addition, the Work shall be performed in a manner that minimizes the release of sediments beyond the Work Area. BMPs shall be employed and refined as necessary to minimize the release of sediment.	With a few specific exceptions (e.g., sediment cleanup within drainages; construction of the WTP effluent pipeline in the Blue Creek Delta), the RA work will not occur within surface water bodies. To the maximum extent practical, sediment cleanup within drainages will be conducted during summer and early autumn when water typically is not present in the intermittent drainages. Excavations for installing the WTP effluent pipeline only will occur above the water line of the Blue Creek delta; all pipeline/diffuser materials below the water line will be placed on the streambed or lakebed surface. The Master SWMP in Appendix O contains the BMP catalog, including BMPs to minimize the transport of sediments to adjacent water bodies.
2.3.18 B.iv	Any dewatering or diversion of surface water and groundwater shall be performed in a manner that minimizes the release of sediments to the extent practicable beyond the Work Area and limits harm to wetlands and surface water.	See response to 2.3.18 B.iii above. The majority of excavation activities are expected to occur above the water table. If groundwater is encountered or if stormwater accumulates in the excavations, the water will be contained and transferred to temporary surface water impoundments and ultimately treated at the WTP. All sediments potentially contaminated by Site COCs will be captured and consolidated in the pits with the mining wastes. The surface water and sediment control structures to be constructed in the excavation areas are described in Appendix F. Sediment migration in the remediated areas will be managed in accordance with the Master SWMP (Appendix O).
2.3.19	Decontamination of equipment prior to the equipment leaving a controlled Work Area, shall be performed to control physical tracking of contaminants off site or through remediated areas. For purposes of this provision, a controlled Work Area shall mean an area where contaminated material has been disturbed by the construction activities. Adequate decontamination shall be determined by visual inspection. Equipment staining without the surface accumulation of material shall not require decontamination. Surface accumulations of materials on the tires, tracks, chassis, and truck body shall be removed either by brushing (or similar activity) or by washing with water.	The equipment and procedures associated with decontamination during the RA will be presented in the RAWP, including decontamination between controlled work areas and decontamination at the Construction Support Zone (i.e., the Site main access point). The planned decontamination facilities are described in Appendix B - Construction Support Facilities and Early Works, and are depicted in the Section 2 design drawings. The decontamination area will be on the border between the Active Work Area and the construction support facilities area (in the construction support zone).
2.3.20	All loads of materials that are transported for disposal off-site shall be covered to control spills and dust migration. Loads of material delivered from off-site to the Work Area shall be covered or otherwise managed to minimize the generation of fugitive dust. Fugitive dust generated by vehicles, in the transport of materials in the Work Area, and other Work shall be minimized through the use of BMPs and shall be monitored. BMPs shall be amended as necessary to ensure effective control of dust.	The RAWP will include procedures for handling of materials that are transported to and from the Site, including the requirement to cover all loads to control spills and dust. The Master SWMP included in Appendix O describes the dust mitigation measures to be implemented during the RA. The Master SWMP includes information regarding how it will be amended if necessary during the RA to update BMPs.
2.3.21	All construction activities associated with the Work shall be conducted in accordance with applicable spill control and countermeasure procedures that shall be specified in the work plan for that activity.	The RAWP will include a Contingency Plan that includes spill control and countermeasure procedures to be implemented during the RA.
2.3.22	The Settling Defendants shall provide, install, and maintain barricades, signage, flashers, and other temporary safety measures during the implementation of the Work, in accordance with the Manual of Uniform Traffic Control Devices, and appropriate State and Tribal regulations regarding traffic safety during construction.	Traffic controls, signage, barricades, and other safety measures will be implemented on temporary and permanent site roads, as necessary. The equipment and procedures associated with traffic control and safety during the RA will be presented in the RAWP.
2.3.23	Temporary water storage and conveyance systems and such systems no longer to be used shall be demolished in a timely manner.	The temporary water management ponds will be decommissioned as soon as practicable during the phased of RA activities as described in Appendix D – Mine Waste Excavation and Containment. Likewise, stormwater conveyance systems that are not part of the final Site configuration will be decommissioned as soon as practicable during the phased of RA activities.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.3.24	All water requiring treatment shall be conveyed to and treated at the water treatment plant operating at the time of conveyance.	**Surface Water** – During the RA, surface water that contacts mine wastes will drain to the mine pits or temporary surface water impoundments that will store the mine-impacted water. The water in the impoundments will be conveyed to the operating WTP via conveyance channels and pipelines. The topography of the reclaimed areas will shed clean water away from any wastes that are pending excavation (i.e., during the phased RA construction activities), and away from the consolidated wastes (upon remedy complete). **Groundwater** – During the RA, groundwater discharging from seeps in the mine wastes will be captured and conveyed the temporary surface water impoundments, and ultimately treated by the operating WTP. Groundwater that accumulates in the consolidated wastes in the pits and BPA will be captured by groundwater extraction wells, and treated at the WTP. These details are described in the following design appendices: Appendix D – Mine Waste Excavation and Containment describes how excavation of mine waste will occur such that surface water drains to the impoundments. Appendix E – Water Management Ponds describes how the mine pits and temporary impoundments will be used to capture and store potentially mine-impacted water. Appendix F – Surface Water and Sediment Controls describes the temporary and permanent structures that will convey surface water and control sediments. Appendix J - Influent and Effluent Pipelines describes how mine-affected water will be conveyed from the impoundments and seeps to the operating WTP.
2.3.25	To the degree practicable, clean surface and ground waters shall be segregated from contaminated water to minimize water volumes requiring treatment.	**Surface Water** - The RA construction will be phased such that segmented areas of mine wastes can be consolidated in the pits and those excavated areas reclaimed. Excavation topography and SW controls will be maintained during each RA construction phase such that potentially mine-affected water drains to the pits or temporary impoundments, and clean water drains away from the construction activity. Topography of the reclaimed areas will shed the clean water away from the remaining areas of mine waste. Likewise, the final reclaimed topography of the caps and excavated areas will shed clean water away from the consolidated wastes in the pits and the BPA. **Groundwater** - Mine-affected groundwater in the consolidated wastes in the pits will be isolated from clean groundwater by lining the pit bottoms. Mine affected groundwater that accumulates in the consolidated wastes in the pits and BPA will be extracted and treated. Groundwater extraction will suppress groundwater levels to prevent migration away from the pits and BPA, and will limit groundwater contact with consolidated wastes at higher elevations within the pits/BPA. These details are described in the following design appendices: Appendix D – Mine Waste Containment describes excavation topography to drain mine-affected water to the pits and temporary impoundments; lining the pits to prevent groundwater migration; groundwater extraction from the pits and BPA to prevent groundwater migration and contact with overlying mine wastes; topography of the reclaimed surfaces during the phased construction to segregate mine-affected and clean water; and final topography of the caps and reclaimed surfaces to shed clean water away from the consolidated wastes. Appendix F - Surface Water and Sediment Controls describes the temporary and permanent structures that will divert or segregate clean water from mine-affected water during the phased RA construction activities.
2.4.1 Pre-Remedy Implementation Element of Work *(Not included in this table as these performance standards refer to ongoing site management and interim measures that are not addressed by this Remedial Design)*		
2.4.2 Mine Waste Containment Work Element		
2.4.2.3 Mine Waste Excavation Work Component		
A. Mine Waste Excavation		
2.4.2.3.2 A.i.	Above-Grade Mine Waste Excavation - Mine Wastes located above the premining topographic surface within the MA with the exception of mine wastes currently located in the Backfilled Pits Area shall be excavated. All of the above-grade materials located in the MA that exceed the cleanup levels identified in Table 4-1 shall be excavated for consolidation and containment in Pits 3 and 4.	Above-grade mine wastes located above the pre-mining topographic surface will be excavated to the pre-mining topography as shown on the Section 4 design drawing (located in Volume II) and consolidated in the Pit 3 and Pit 4 backfill areas. The Pit 3 and Pit 4 Mine Waste Containment Areas will be contiguous and continuously capped. As such, Area 5 between Pits 3 and Pit 4 will be regraded and capped in-place, as opposed to being excavated and placed in either Pit 3 or Pit 4. Appendix D - Mine Waste Excavation and Containment has text, calculations, and references drawings in Volume II, explaining/depicting how the above-grade mine wastes will be excavated to the pre-mining topographic surface. Delineations of the above-grade mine waste and volume estimates are based on data and information in the *RI Report* (EPA, 2005a) and *Mine Waste Investigations* (MGC, 2011d). The *Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments* is included in Appendix S. This plan describes the necessary equipment and procedures for confirming then verifying the cleanup levels are met in the areas requiring excavation.
2.4.2.3.2 A.ii.	Contaminated Soils and Sediments Excavation - Contaminated soils (impacted by roads or other areas of mine waste) and sediments located in the MA and MAA that exhibit contaminant concentrations above the cleanup levels in Tables 4-1 and 4-2 shall be excavated for consolidation and containment in Pits 3 and 4.	As described in Appendix D – Mine Waste Excavation and Containment, areas where contaminated soils and sediments have been identified or will be investigated during the RA construction and are shown on the Section 4 design drawing (located in Volume II). Investigations of the extent contaminated soils and sediments, and volume estimates for contaminated soil cleanup within the MA and MAA are based on data and information provided in the *RI Report* (EPA, 2005a) and *Mine Waste Investigations* (MGC, 2011d). In addition to those areas identified on the drawings, it is assumed that an average of 1-foot of contaminated soils and sediments exist under areas overlain by Above-Grade Mine Waste and will require excavation and relocation in the Waste Containment Area. The actual extent of soil contamination and cleanup will be determined during RA construction using procedures defined in the *Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments* (Appendix S).
2.4.2.3.2 A.iii.	Mine Drainage Sediments Excavation - Mine Drainage Sediments located in drainages downstream of the MA in the MAA that exhibit contaminant concentrations above the cleanup levels presented in Table 4-2 shall be excavated for consolidation and containment in Pits 3 and 4.	See response to 2.4.2.3.2 A.ii, above.
2.4.2.3.2 A.iv.	Road Materials Excavation – Mine wastes used for the construction of roads and any soils and sediments below, adjacent to, and downstream of the roads that exceed the cleanup levels presented in Table 4-2 shall be excavated for consolidation and containment in Pits 3 and 4. The extent of contaminated materials requiring excavation shall be determined during RD.	See response to 2.4.2.3.2 A.ii, above.
2.4.2.3.2 A.v.	Soil/sediment sampling shall be conducted following removals to ensure that remaining soils and sediments meet cleanup levels identified in Tables 4-1 and 4-2. The sampling design and frequency shall be developed using methodology that conforms with EPA guidance for the development of sampling and analysis plans and quality assurance project plans.	The *Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments* is included in Appendix S. This plan describes the necessary equipment and procedures for confirming then verifying the cleanup levels are met in the areas requiring excavation.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.4.2.3.2 A.vi.	A layer of suitable soil or soil amendments, as determined during RD, shall be placed over areas cleared of mine waste. Such areas shall be graded and re-vegetated to minimize erosion and ARD formation and to channel water away from waste containment areas.	Clean soil from an approved borrow source (or soil amendments) will be placed in areas cleared of mine waste where subsoil excavation and removal is required. These areas will be graded to shed clean water away from the consolidated wastes toward the natural drainages south of the mined area, and re-vegetated to prevent erosion. These details are described in the following appendices: Appendix C – Borrow Area describes the sources of borrow material that will be used to construct the cap and cover. Appendix D - Mine Waste Excavation and Containment describes how the cap and cover areas will be constructed, graded, and re-vegetated.
B. Surface Water and Stormwater Management and Controls During Excavation		
2.4.2.3.2 B.i.	During the excavation of contaminated materials, surface water and stormwater BMPs shall be applied to prevent, to the extent practicable, sediment transport and the contact of clean surface water and stormwater with contaminated materials.	During the RA, all surface water in the Work Areas will be captured and treated, and associated sediments will be captured and consolidated in the pits with the mining wastes. Surface water in the remediated areas will be allowed to shed to the natural drainages down gradient of the Site. The RA will be performed in phases such that surface water from remediated areas can be shed away from the active excavation areas as soon as practicable. Surface water will be segregated by site grading to manage and direct drainage, and using permanent and temporary drainage channels to divert clean surface water away from the active construction areas. Appendix D (Mine Waste Excavation and Containment) describes the phased excavation activities, and the site topography at the end of each phase is depicted Section 1 design drawings (located in Volume II). Appendix F (Stormwater and Surface Water Controls) includes the design information for the diversion channels and the phased stormwater controls are shown on the Section 6 design drawings. Examples of the surface water and stormwater BMPs that are included in this design include erosion control blankets, gravel filter berms, diversion ditches, and filter fences. These and other BMPs that will be implemented during the RA are described in the Master SWMP contained in Appendix O. The Master SWMP defines the requirements for inspecting, maintaining, and repairing BMPs throughout construction.
2.4.2.3.2 B.ii.	To the extent practicable, clean water coming into contact with contaminated materials in the excavation areas that results in surface water concentrations exceeding the surface water cleanup levels identified in Table 4-3 shall be collected and conveyed to the WTP for treatment.	To the extent practicable, the mine waste excavations will occur in a downhill direction, and be bermed and contoured such that such that all surface water that enters the excavations (and potentially contacts mine wastes) will be captured in the excavation. This water will either gravity drain or be pumped to the temporary storage impoundments pending treatment at the operating WTP. These details are included in Appendix D – Mine Waste Excavations and Containment and Appendix F – Surface Water and Sediment Controls.
2.4.2.3.2 B.iii.	Sediments captured by surface water and stormwater controls shall be contained and removed to an approved location designed to prevent redistribution of the sediments to the surrounding environment. The disposition of the sediments shall be determined by sampling the sediments at a frequency and for analytes determined during RD.	Sediments will be captured during construction in a variety of temporary surface water and sediment controls structures discussed in Appendix F and BMPs identified in Appendix O (Master SWMP). The process for verifying Site COC concentrations in sediments is included in the *Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments* contained in Appendix S. Sediment determined to be contaminated (or assumed to be contaminated based on the location of the BMP) will be incorporated into the waste containment areas in Pits 3 and 4. Captured sediments that are determined to be clean may be incorporated into soil cover layers as part of remedial construction.
2.4.2.3.2 B.iv.	Surface water and stormwater controls and water collection and conveyance systems shall remain in place and be monitored for effectiveness until such a time as all contaminated materials requiring excavation have been removed for consolidation and containment in Pits 3 and 4.	The surface water and sediment controls (described in Appendix F), and water collection and conveyance systems (described in Appendix J) will be constructed, operated and removed according to a phased construction approach as described in Appendix A – General Design Information. These temporary structures and systems will remain in place until permanent structures/systems are built and water in the remediated areas can be shed to the natural drainages down gradient of the Site. The Operations Maintenance and Monitoring Plan (OM&M Plan) in Appendix P defines O&M requirements for the surface and stormwater controls during the RA activities. In addition, surface water down gradient of the Site will be monitored in accordance with the Site-Wide Monitoring Plan (SMP), contained in Appendix Q, to evaluate the effectiveness of these engineering controls during the RA.
2.4.2.3.2 B.v.	The Settling Defendants shall develop a monitoring program to ensure that the concentrations of contaminants in surface water leaving the MA are below those listed in Table 4-3. If concentrations are greater than those listed in Table 4-3, the water shall be collected and conveyed to the water treatment plant for treatment.	To the extent practicable, all surface water that contacts mining wastes within the MA will continue to be captured during the RA activities and conveyed to the operating WTP. These details are described in Appendix D – Mine Waste Excavation and Containment, Appendix E – Water Management Ponds, and Appendix F – Surface Water and Sediment Controls. However, as noted in the ROD, achievement of the surface water cleanup levels down gradient of the MA will require a period for natural attenuation to occur after the remedy is completed. Therefore, the design does not include provisions to capture and treat surface water down gradient of the MA. The Site-Wide Monitoring Plan (SMP) in Appendix Q defines the monitoring program that will be implemented both during and following the RA to evaluate contaminant concentrations in surface water down gradient of the MA. The SMP defines the action levels that will be used during the RA to evaluate if mine-related contaminants are being released to surface water as a result of the RA activities. The SMP also describes how surface water will be monitored following the RA for comparison with the cleanup levels listed on Table 4-3.
2.4.2.3.2 B.vi.	If, during the course of excavation, the surface water and stormwater BMPs in the BMP Catalog are found to be insufficient to address surface water and stormwater management issues, the Settling Defendants shall develop and implement new BMPs, subject to EPA review and approval.	As described in the Master SWMP included in Appendix O, the Project Engineer will perform periodic inspections and monitoring to confirm that the BMPs are adequate and functioning as intended, or to determine if additional BMPs are necessary. If necessary, the Project Engineer will immediately initiate actions to correct existing BMPs or develop and implement new BMPs.
C. Excavated Materials Staging/ Stockpiling		
2.4.2.3.2 C. i.	If it is determined during design that staging of excavated materials prior to their consolidation and containment is necessary, a Staging/Temporary Stockpile Plan shall be developed and included in the RD.	A Staging/Temporary Stockpiling Plan is included in Appendix R.
2.4.2.3.2 C. ii.	The Staging/Temporary Stockpile Plan shall include a list of BMPs that complies with applicable worker protection requirements. In addition, the BMPs shall ensure, to the extent practicable, that staged/stockpiled materials are isolated from contact with surface water and stormwater and that staging/stockpiling processes do not result in the generation of ARD and/or conditions that could lead to the migration of contaminants to the surrounding environment.	A Staging/Temporary Stockpiling Plan is provided in Appendix R. Temporary stockpiling of contaminated materials is designed to occur within existing mine waste areas (i.e., all runoff from the stockpiled materials will be captured and treated); therefore BMPs (other than those described in the Master SWMP) will not be needed. Engineering controls to capture stormwater and surface water in the mine waste areas are described in Appendix F (Surface water and Sediment Controls) and are depicted in the Section 6 design drawings included in Volume II. Applicable worker protection requirements for construction activities are included in Appendix L – RA Health and Safety Plan (HASP).
2.4.2.4 Pits 3 and 4 Work Component		
A. Temporary Facilities during Construction Activities		
2.4.2.4.2 A.	During performance of the Pits 3 and 4 Component of Work, temporary facilities, such as covers, runoff controls, temporary sumps, and water capture and removal systems, shall be provided, as determined in the SWMP and RD. Water requiring treatment shall be conveyed as soon as practicable to the WTP for storage and treatment.	Design sections contained in Appendix E (Water Management Ponds), Appendix F (Surface Water and Sediment Controls), Appendix J (Influent and Effluent Pipelines); and the associated design drawings in sections 5, 6, and 10 of Volume II describe/illustrate how surface water and impacted site water will be managed upon completion of each major phase of construction. Water will be transferred to the WTP as soon as practicable in order to maintain capacity in the impoundments for future storm events. In addition, the Master SWMP included in Appendix O describes the over-arching framework for how stormwater and surface water will be managed to limit the release of sediment, pollutants, and deleterious debris to downstream areas during RAs.
B. Groundwater Intrusion into Pits 3 and 4		

Note: The status column on this table that was present on earlier iterations of the design was removed because issues/action items associated with the design are complete at this step of the process (100% design). Moving forward the RAWP, design drawings, and specifications will guide construction of the remedy to completion.

TABLE 4-6
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CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.4.2.4.2 B.i.	Groundwater adjacent to each pit shall be collected and diverted away from the pits or blocked from flowing into the pits, as practicable, by methods determined during RD.	The primary mechanism proposed for diverting groundwater from the pits is to provide a continuous surface cover system over the majority of the contributing areas (to Pit 4, Pit 3, and the BPA) where surface infiltration provides a recharge source for groundwater reporting to the pits. This cap will extend beyond the consolidated-waste crests and include areas that currently infiltrate and contribute to pit seepage (e.g., Area 5). Water from the surface cover system that historically has reported to the pits will be collected in the surface water diversions and routed away from the pit areas. Details regarding the continuous surface cover system are included in Appendix D - Mine Waste Excavation and Containment and depicted in the design drawings contained in Section 4 of Volume II.
2.4.2.4.2 B.ii.	To the degree practicable, clean groundwater shall be segregated from contaminated waters to minimize water volumes requiring treatment.	See response to 2.4.2.4.2 B.i. above.
2.4.2.4.2 B.iii.	To the degree practicable, groundwater entering the pits shall not contact reactive mine waste or waste capable of causing groundwater contamination.	Appendix D - Mine Waste Excavation and Containment contains text, calculations, and references drawings in Volume II to illustrate the groundwater pump-back system. In general, an underdrain system constructed of non-reactive rock will be installed in the bottoms of pits 3 and 4 to collect groundwater before it contacts reactive mine-waste backfill located higher in the pits, as depicted in the Section 4 design drawings. The pit-bottom drainage system will be separated from overlying reactive mine waste backfill by a synthetic geomembrane (i.e., the sub-waste liner). In addition, a 20-foot thick layer of less reactive waste rock will be placed above the geomembrane to provide additional separation between pit groundwater and more reactive mine waste. The drain system will be extended up the walls of Pit 3 in areas where pit wall seepage is occurring in order to intercept these seeps and convey them to the underdrain system before they contact reactive mine waste in the backfill. A separate Waste Rock Dewatering System will be installed above the geomembrane liner to collect water that infiltrates through the overlying waste rock and collects on the geomembrane liner.
2.4.2.4.2 B.iv.	Contaminated groundwater shall be captured and treated in the WTP.	Contaminated groundwater that accumulates in the consolidated wastes will be collected and pumped to the operating WTP. This information is described in Appendix D - Mine Waste Excavation and Containment and illustrated in Volume II Section 4 design drawings. Contaminated alluvial groundwater will be captured in the three main drainages south of the MA and pumped to the operating WTP. This information is described in Appendix G – Groundwater Controls and illustrated in Volume II Section 7 design drawings.
C. Surface Water Management - Pits 3 and 4		
2.4.2.4.2 C.i.	Surface water and stormwater management shall be conducted in accordance with the SWMP. Surface water and stormwater management BMPs shall be developed and constructed to divert clean surface water and stormwater away from the pits during construction. Surface water and stormwater that enters the pits shall be captured and conveyed to the WTP. Surface water and stormwater BMPs constructed shall remain in place and be monitored for effectiveness until consolidation and containment of excavated materials in the pits is completed and permanent surface water and stormwater management facilities are in place and functional.	The Master SWMP included in Appendix O includes both a Construction Stormwater Pollution Protection Plan (CSWPPP) and a Permanent Stormwater Control Plan (PSWCP). The Master SWMP includes a BMP catalog, which includes BMPs for diverting clean water away from the construction areas. Examples include dike and swales, rip-rap lined ditches, and earthen waterbars. The Master SWMP also includes the provisions for the Project Engineer to monitor the effectiveness of the temporary and permanent stormwater control facilities. Water that enters the pits or temporary impoundments will be conveyed to the operating WTP. This will be accomplished via a system of pumps and conveyance lines as described in Appendix J – Influent and Effluent Pipelines, and as depicted on the associated design drawings contained in Section 10.
2.4.2.4.2 C.ii.	Facilities shall be constructed to divert clean surface water away from the pits. The diversion facilities shall be designed using standard engineering techniques for capacity and erosional stability to convey the 100-year, 24 hour storm event in a stable manner and to withstand a 500-year, 24 hour storm event.	Clean surface water will be diverted away from the pits via a series of diversion channels and the grading of the final cover system. Appendix F (Stormwater and Surface Water Controls) includes the design information for the diversion channels and the phased stormwater controls are shown on the Section 6 design drawings (located in Volume II). The conveyance capacity of these facilities has been designed for the 500-year, 24-hour storm event. Erosional stability of the cover system has been designed for the 100-year, 24-hour event as described in Appendix D (Mine Waste Excavation and Containment).
2.4.2.4.2 C.iii.	To the degree practicable, clean surface water shall be segregated from contaminated water to minimize water volumes requiring treatment.	The RA will be performed in phases such that surface water from remediated areas can be shed away from the active excavation areas as soon as practicable. Surface water will be segregated by site grading to manage and direct drainage, and using permanent and temporary drainage channels to divert clean surface water away from the active construction areas. Appendix D (Mine Waste Excavation and Containment) describes the phased excavation activities, and the site topography at the end of each Phase is depicted on the Section 1 design drawings (located in Volume II). Appendix F (Stormwater and Surface Water Controls) includes the design information for the diversion channels and the phased stormwater controls are shown on the Section 6 design drawings.
2.4.2.4.2 C.iv.	Contaminated surface water shall be captured and treated in the WTP.	Excavation activities will be performed such that drainage patterns are maintained to shed potentially contaminated surface water to diversion channels and temporary impoundments, and ultimately to the operating WTP. Appendix D (Mine Waste Excavation and Containment) describes the excavation activities. Appendix F - Surface Water and Sediment Controls contains text, calculations, and references drawings in Volume II that show the temporary engineering controls (e.g., temporary drainage channels) that will be constructed to capture and convey contaminated water to the Water Management Ponds (Appendix E). Water from these ponds will be conveyed to the WTP for treatment.
D. Pits 3 and 4 Preparation and Mine Waste Excavation		
2.4.2.4.2 D.i.	Each pit shall be dewatered prior to any mine waste emplacement.	Pits 3 and 4 will be dewatered prior to placing the wastes as described in Sections D6.2 and D7.2 of Appendix D - Mine Waste Excavation and Containment and shown on the Remedial Action Schedule (Appendix X).
2.4.2.4.2 D.ii.	Water removed during such dewatering shall be conveyed to and treated at the WTP.	Water removed during dewatering of Pits 3 and 4 will be conveyed to the WTP (either via the intermediate storage pond or directly to the WTP, depending on the WTP operating requirements) for treatment. Appendix D - Mine Waste Excavation and Containment describes how water removed from each pit during the initial dewatering will be extracted and conveyed to the WTP for treatment. The associated Mine Waste Excavation and Containment design drawings are included in Section 4 of Volume II.
2.4.2.4.2 D.iii.	To the extent practicable, water shall be kept from accumulating in the pits during and after construction of the containment system. If water accumulates in the pits during construction, the water shall be collected and conveyed for treatment at the WTP.	Appendix D - Mine Water Excavation and Containment contains information related to the water removal from the pits. Specifically, the underdrain sump/dewatering system shown on the Section 4 design drawings (located in Volume II) will be installed upon completion of pit-bottom grading and preparation and will remain operational through backfilling and completion of RA construction. Likewise, the mine waste dewatering system will be installed upon completion of the geomembrane liner and will remain operational from that point forward. Duplicate dewatering risers, including pumps and piping are proposed to avoid shutdowns in the dewatering system due to maintenance or mechanical failure.
2.4.2.4.2 D.iv.	Existing sediments which have collected at the bottom of the pits shall be removed prior to preparation of the pit floors. Such removed sediments shall be staged for subsequent re-emplacement in the pits. The need and process for dewatering of the sediments and conveyance and treatment of water from the sediments shall be determined during RD.	Pit-bottom sediments shall be removed as described in Appendix D and stockpiled for replacement in the pits as described in an approved Staging/Temporary Stockpiling Plan (Appendix R).
2.4.2.4.2 D.v.	As determined during RD, pit walls shall be prepared to ensure worker health and safety during construction.	Appendix D – Mine Waste Excavation and Containment includes design details related to rockfall protection.
2.4.2.4.2 D.vi.	The pit surfaces shall be contoured to efficiently drain water entering the pits to low points located below the drainage layer. The need to perform additional excavation of the current pit bottoms to ensure gravity drainage to the low points shall be determined during RD.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references Pit 3 and Pit 4 drawings in Volume II that include drawings for recontouring the bottom of pits 3 and 4 (Bottom Excavation and Grading Plan). Pit 4 will require recontouring and excavation of a sump, as shown in Section 4 of the Drawings, so that gravity flow in the pit bottom can be accomplished. Pit 3 will require some cleanup, but in general water in Pit 3 gravity flows to the last mined area (drop cut) which forms the low point of the pit. Pit bottom surface preparation and grading are discussed in Appendix D, and shown on the Section 4 design drawings (located in Volume II).
E. Drainage Layer – Pits 3 and 4		
2.4.2.4.2 E.i.	A continuous drainage layer of non-reactive rock or other suitable material, approved by EPA, shall be constructed overlying the base of the pit and	Appendix D - Mine Waste Excavation and Containment includes the design information for the drainage layer, and references Pit 3 and Pit 4 design drawings in Volume II that include Pit Liner Installation Plan and Sections.

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CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
	extending up the sides of each pit as necessary to intercept groundwater entering the pit.	This drain material will come from Hillside Waste Rock Pile (HSWR Pile) which has been determined suitable for use as drain rock source. Pit underdrain systems are described in Appendix D and shown on the Section 4 design drawings (located in Volume II).
2.4.2.4.2 E.ii.	If during RD suitable material for the drainage layer can be found on site, EPA may approve the use of such materials, following consultation with the Tribe.	Results of investigations presented in the *Mine Waste Investigations Report* (MGC, 2011d) and the *Addendum to the Mine Waste Investigations Report* (WME, 2012a) indicate that suitable material for the drainage layer can be processed from the HSWR Pile. It is anticipated that this material will be used for construction of the drainage layer as described in Appendix D – Mine Waste Excavation and Containment.
2.4.2.4.2 E.iii.	The drainage layers shall extend vertically along the side walls of each pit to elevations determined during RD, to keep water entering the pits from contacting mine waste and to effectively channel water to the pit bottoms.	Locations of pit wall seeps were mapped as part of investigations for the *Geologic Investigations of Pits and Assessment of Pit Sediments Design Investigation Report* (MGC, 2011a), Midnite Mine Field Activity Summary Report *Pit Seep Monitoring Pit 3 and Pit 4* (WME, 2012b), and *Midnite Mine Field Activity Summary Report- Pit Seep Monitoring, Pit 3 and Pit 4* (Plumley and Associates, 2012). The drain configuration shown in the Section 4 design drawings (located in Volume II) is designed to intercept these seeps and convey them to the pit-bottom sump without contacting reactive mine waste materials in the pit backfill.
2.4.2.4.2 E.iv.	The drainage layers shall be designed and constructed in a manner to provide efficient drainage of water along the sidewalls and bottoms of each pit.	See response to 2.4.2.4.2 E.iii above
2.4.2.4.2 E.v.	Water entering the pits and transported through the drainage layers shall be collected in a sump or sumps placed at the bottom of the pits. The water collection sump(s) shall be constructed in the lowest portion of the pit bottom and gravity drainage from the pit walls and pit bottom shall be used to direct water to the sump. The design of such sump(s) may require additional excavation into the pit bottom to ensure gravity drainage.	Appendix D - Mine Waste Excavation and Containment includes design information for Pit bottom grading, drainage sumps, and drain placement. The associated design drawings are contained in Section 4 of Volume II.
2.4.2.4.2 E.vi.	The installation of the drainage layers along the pit walls and bottoms shall be coordinated with the emplacement of mine wastes into the pits and the sub-waste liners, described below.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references Pit 3 and Pit 4 drawings in Volume II that include information related to the necessary drainage structures extending up the pit walls to capture seeps. No seeps were encountered in Pit 4 walls. The sequence for drain installation and waste placement are discussed in appendices D and X (RA Schedule), and shown on Section 4 of the design drawings contained in Volume II.
2.4.2.4.2 E.vii.	Water levels in the sumps shall be maintained at elevations determined during RD which minimize hydraulic head, scaling, and fouling, and prevent water contact with the mine waste. Water collected in the sumps shall be conveyed by pumping or gravity for treatment at the WTP.	The anticipated range of operating water levels within the underdrain (pit bottom) and waste rock dewatering (overliner) sumps presented in Appendix D - Mine Waste Excavation and Containment. The proposed range of water level fluctuations will ensure that the water level will remain within coarse drain rock of the sump backfill, thus avoiding water level fluctuations over the greater pit floor and liner surfaces, while avoiding drawing the water levels down to the elevation of the screened sections of dewatering risers. The plans to minimize fluctuations in water levels in an attempt to minimize scaling and fouling while preventing direct contact with the mine waste rock will be described in the Operation Maintenance and Monitoring Plan (OM&M Plan) for Water Management (Appendix P) when it is updated following construction of the pit dewatering systems.
F. Sub-waste Liner – Pits 3 and 4		
2.4.2.4.2 F.i.	A sub-waste liner shall be constructed in each pit below and adjacent to the emplaced mine wastes in locations and to vertical elevations determined during remedial design.	Sub-waste liners will be placed between the drain systems and overlying mine waste in Pit 3 and Pit 4 as described in Appendix D - Mine Waste Excavation and Containment and depicted in the Section 4 design drawings (located in Volume II). It is anticipated that the liner section will include a geomembrane cushion (geofabric layer) under the geomembrane, and an overliner cushion layer of fine-grained soil.
2.4.2.4.2 F.ii.	The sub-waste liners shall be placed between the mine wastes and the drainage layers: additional materials shall be placed, as necessary, to protect the integrity of the sub-waste liners, as determined during RD.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that include information regarding the Pit 3 and Pit 4 "pit liner plans and sections." Sub-waste liners will be placed between the drain systems and overlying mine waste in Pit 3 and Pit 4. Details regarding placement of the liners and protection of the liners by placement of various construction materials are detailed in Appendix D and depicted on the associated drawings in Volume II.
2.4.2.4.2 F.iii.	The sub-waste liners shall be constructed of a synthetic material determined during RD.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that includes information regarding the materials used for construction of the sub-waste liners in pits 3 and 4. It is proposed that the sub-waste liner be constructed of High-Density Polyethylene geomembrane.
2.4.2.4.2 F.iv.	The sub-waste liners shall be designed to effectively isolate the mine waste and minimize the passage of both water and mine waste particles between the adjacent drainage layers and the emplaced mine wastes.	See responses to 2.4.2.4.2 F.i, 2.4.2.4.2 F.ii, and 2.4.2.4.2 F.iii, above.
2.4.2.4.2 F.v.	The sub-waste liners shall be constructed in such a way as to transmit water collected on the liners to sump(s) located above the liner at its low point. The sumps shall be constructed in such a manner that water from the mine waste materials shall concentrate in the sump area using gravity drainage.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that includes information regarding the configuration of the sub-waste liners and collection/conveyance of waters in pits 3 and 4 in a sump installed within the sub-base liner. Proposed grading for the sub-waste liners are shown on the Section 4 design drawings contained in Volume II. This grading provides for gravity drainage of water on the liner surface toward sumps, which will be dewatered by pumping from waste rock dewatering risers located within the sumps.
G. Pits 3 and 4 Mine Waste Consolidation		
2.4.2.4.2 G.i.	All materials excavated as part of the Mine Waste Excavation Component of Work and existing sediments from the pit bottoms shall be consolidated in the pits.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that includes information regarding all material to be excavated and contained in pits 3 and 4. Materials excavated during Mine Waste Excavation will be consolidated in the pits as described in the Material Balance section of Appendix D.
2.4.2.4.2 G.ii.	Mine waste shall be emplaced in lifts above the sub-waste liner and any protective layer determined necessary during RD. Placement shall minimize settling.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that includes information regarding the emplacement of waste materials in pits 3 and 4. It is proposed that Mine Waste be placed in 10-foot maximum horizontal loose lifts over the protective overliner cushion layer.
2.4.2.4.2 G.iii.	The emplacement of mine waste lifts shall be coordinated with the installation of the adjacent sub-waste liner and drainage layer along the pit walls and bottoms, as determined during RD.	The relationship of the sub-waste liner to the drainage layer during construction is discussed in the text and shown in the design drawings (in Volume II) referenced in Appendix D - Mine Waste Excavation and Containment. Where required, drainage layer placement along the pit walls will occur concurrently with Mine Waste placement.
2.4.2.4.2 G.iv.	Mine waste emplaced in the pits shall be compacted to design specifications during backfilling.	Mine waste compaction during construction is discussed in the text and shown in the drawings (in Volume II) referenced in Appendix D - Mine Waste Excavation and Containment. It is proposed that Mine Waste be placed by dumping from trucks and spreading in 10-foot maximum horizontal loose lifts as discussed in Appendix D.
2.4.2.4.2 G.v.	Emplacement of mine waste in the pits shall ensure efficient drainage to sumps constructed above the sub-waste liner.	See responses to 2.4.2.4.2 G.ii and 2.4.2.4.2 G.iv above.
2.4.2.4.2 G.vi.	Water levels in the sumps above the sub-waste liner shall be maintained at an elevation determined during RD, which minimizes hydraulic head, scaling, fouling and infiltration through the sub-waste liner.	See response to 2.4.2.4.2 E.vii. above
2.4.2.4.2 G.vii.	Water collected in such sumps shall be conveyed by pumping or gravity for treatment at the WTP.	Appendix D - Mine Waste Excavation and Containment presents text, calculations, and references drawings in Volume II that discuss and depict the installation of extraction systems both above and below the sub-waste liner, withdrawal of that water, and the gravity feed from the pump house on the upper cover surface to the new WTP for treatment. Water collected in waste dewatering sumps will be pumped to the WTP through dewatering risers that will be raised concurrently with the rise of the waste backfill surface.
2.4.2.4.2 G.viii.	As determined during RD, the least reactive (ARD generating) mine waste materials shall be placed in portions of the pits below the surrounding groundwater level.	Appendix D - Mine Waste Excavation and Containment presents text and references drawings in Volume II that discuss and depict the emplacement of mine waste rock materials in the pits. As discussed in the CD, the least reactive wastes (e.g., the Hillside Waste Rock) will be placed at depths where it could/will encounter groundwater, more reactive material (e.g., protore) will be placed in the middle portion of the backfill, and the least radioactive mine waste rock (i.e., lowest radon-generating waste rock) will be placed at the top of the backfill, then covered with a synthetic liner and 2 to 3 feet of soil depending on the borrow source. The first 20 feet of

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		waste placed above the sub-waste liners will be low reactive waste as illustrated in Section 4 of the design drawings contained in Volume II.
2.4.2.4.2 G.ix.	As determined during RD, materials with high radon-generating ability, such as ore and proto-ore, shall be placed in the pits so as to minimize radon flux at the top of the backfill and below the cover.	See response to 2.4.2.4.2 G.viii above. As shown in Section 4 of the Drawings; ore, protore, or other materials identified as having high radon-generating characteristics will be excluded from the 20 feet of waste immediately underlying the cover in the containment areas.
2.4.2.4.2 G.x.	The mine waste materials shall be mounded above the top elevation of each pit and sloped to support a cover and surface water management system designed to maximize runoff and minimize infiltration into the mine wastes, while preserving slope stability.	The top surfaces of the waste containment areas will be graded as shown in Section 4 of the design drawings contained in Volume II to provide positive drainage of surface water from the cover surface. Erosional and slope stability calculations for the proposed cover surface are provided in attachments to Appendix D - Mine Waste Excavation and Containment.
H. Pits 3 and 4 Cover Construction		
2.4.2.4.2 H.i.	A cover made of geologic material and a synthetic liner shall be constructed over the emplaced mine waste in each pit in such a way as to permanently meet the Record of Decision (ROD) cleanup standards for soil and radon flux and to minimize the infiltration of water into the pits.	Appendix D - Mine Waste Excavation and Containment presents text and references drawings in Volume II that discusses and depicts the emplacement of mine waste rock materials in the pits and BPA, as well as the cover system to be used at the Site. A cover system consisting of a linear low-density polyethylene geomembrane overlain by a continuous soil cover, as shown on Drawing 4-83. The soil cover thickness will be a minimum of 3 feet thick if soil from the Rhoads Property Borrow area is used, but will be a minimum of 6 feet thick if the Ford Borrow area material is used in constructing the soil cover. On sloped areas steeper than 15 percent grade, a geocomposite drainage layer (GDL) will be included between the geomembrane and soil cover layers in order to reduce the potential for positive pore pressure and cover instability at the geomembrane soil interface.
2.4.2.4.2 H.ii.	Cover specifications shall be determined during RD and shall ensure that the thickness of the geologic materials alone shall be sufficient to limit the radon flux rate to less than 20 pCi/m^2/sec as required in Section 8 of the ROD, in accordance with the Nuclear Regulatory Commission guidance document NUREG 1620 (NRC 2000). Radon flux shall be measured using standard NRC techniques presented in 40 CFR Part 61, Appendix B, Method 115 to ensure that the average radon flux from the cover remains less than 20 pCi/m2/sec.	Appendix D - Mine Waste Excavation and Containment presents text and references drawings in Volume II that discusses and depicts the cover system to be used for the each of the backfilled pits as wells as the Backfilled Pits Area (BPA). Radon flux calculations were performed for two potential cover borrow sources and are been included in Appendix D.
2.4.2.4.2 H.iii.	The cover shall be constructed in compacted lifts and include a synthetic liner of a material determined during design, to minimize infiltration of precipitation into the underlying mine wastes.	The soil cover system described in response to item 2.4.2.4.2 H.i has been proposed to meet this performance objective. The cover soil will be placed as described in Appendix D and in the Earthwork Technical Specification contained in Appendix K.
2.4.2.4.2 H.iv.	The cover shall be constructed to efficiently minimize infiltration of water, while preserving slope stability, minimizing erosion and biointrusion, and supporting vegetation. The cover shall be designed using standard engineering techniques and a factor of safety of 1.3 for static and 1.0 for dynamic slope stability. The cover shall be erosionally stable under the 100-year, 24-hour storm event.	Appendix D - Mine Waste Excavation and Containment presents text and references drawings in Volume II that discusses and depicts the cover system to be used for the each of the backfilled pits as well as the BPA. The results of infiltration analyses of the cover system assuming the two different cover soil types are included in Appendix D. Erosional and slope (veneer) stability calculations are included as Attachments 6 and 7 to Appendix D, respectively. Appendix F - Surface Water and Sediment Controls contains discussions and references drawings in Volume II that depict the structures that will be emplaced to handle this storm event.
2.4.2.4.2 H.v.	The cover shall overlay mounded mine waste and shall slope out to a surface water management system to maximize runoff and minimize infiltration into the mine wastes, while preserving slope stability.	Refer to the response to 2.4.2.4.2 G.x. above
2.4.2.4.2 H.vi.	Once constructed, the cover shall be vegetated as determined during RD, in consultation with the Tribe, for purposes of evapotranspiration, ecological habitat, slope stability, and long-term effectiveness.	Specific methods of cover revegetation (including in the BPA) are presented in Appendix D. Appendix D discuses and drawings in Volume II depict the cover system revegetation. Technical specifications for revegetation are presented in Appendix K. In general, the cover will use native grasses and forbs that allow for effective evapotranspiration, assist in stabilizing the cap surface, provide long-term habitat for native species while not penetrating the synthetic cover material with roots. This will mean that trees and other deep-rooting vegetation types will not be allowed on the pit cover system. Infiltration calculations are presented in Appendix D. Although vegetation designs for remediated areas are ongoing, preliminary estimates of species that may be incorporated on cover surfaces was made based upon initial input from the Tribe. Vegetation parameters for infiltration analyses were selected on this basis.
2.4.2.5 Backfilled Pit Area Work Component		
A. Temporary Facilities During Construction Activities		
2.4.2.5 A.i.	During performance of the BPA Component of Work, temporary facilities, such as covers, runoff controls, temporary sumps, and water capture and removal systems, shall be provided, as determined in the SWMP and RD. Water requiring treatment shall be conveyed as soon as practicable to the WTP for storage and treatment.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 A above.
B. Groundwater Diversion - Backfilled Pit Area		
2.4.2.5 B.i.	Groundwater adjacent to the BPA shall be collected and diverted away or blocked from flowing into the BPA, as practicable, by methods determined during RD.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 B.i above.
2.4.2.5 B.ii.	To the degree practicable, clean ground water shall be segregated from contaminated ground water to minimize water volumes requiring treatment.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 B.ii above.
2.4.2.5 B.iii.	Contaminated groundwater shall be captured and treated in the WTP.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 B.iv above.
C. Surface Water - Backfilled Pit Area		
2.4.2.5 C.i.	Facilities shall be constructed to divert surface water away from the BPA. The diversion facilities shall be designed using standard engineering techniques for capacity and erosional stability to convey the 100-year, 24 hour storm event in a stable manner and to withstand a 500-year, 24 hour storm event.	Clean surface water will be diverted away from the BPA via a series of diversion channels and the grading of the final cover system. Appendix F (Stormwater and Surface Water Controls) includes the design information for the diversion channels and the phased stormwater controls are shown on the Section 6 design drawings included in Volume II. The conveyance capacity of these facilities has been designed for the 500-year, 24-hour storm event. Erosional stability of the cover system has been designed for the 100-year, 24-hour event as described in Appendix D (Mine Waste Excavation and Containment).
2.4.2.5 C.ii.	To the degree practicable, clean surface water shall be segregated from contaminated water to minimize water volumes requiring treatment.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 C.iii above.
2.4.2.5 C.iii.	Contaminated surface water shall be captured and treated in the WTP.	This work will be performed as part of the Phase 2 Pit 3 remediation. Refer to 2.4.2.4.2 C.iv above.
D. Groundwater Removal from Backfilled Pit Area		
2.4.2.5 D.i.	Water in the BPA shall be removed using wells or other methods approved by EPA during RD, to elevations determined during RD which minimize hydraulic head in the pit, scaling, and fouling.	The groundwater pump-back systems include extraction wells installed in the BPA as described in Appendix D - Mine Waste Excavation and Containment. This appendix contains text, calculations, and references drawings in Volume II to illustrate the groundwater pump-back systems. In general, wells currently on site that are effective at removing contaminated groundwater will be saved for continued use during the RA. Additional extraction wells may be installed and/or planned for installation in the BPA and used to convey contaminated water to the WTP for treatment.

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2.4.2.5 D.ii.	Water removed from the BPA shall be conveyed to the WTP for treatment.	Appendix D - Mine Waste Excavation and Containment presents text and references drawings in Volume II that discusses and depicts the groundwater extraction system to be used in the BPA. Water removed from the BPA will be conveyed to the WTP, either via the storage ponds or directly to the WTP, depending on WTP operating conditions at the time of removal.
E. Mine Waste Excavation and Consolidation		
2.4.2.5 E.i.	As approved during RD, mine waste materials shall be mounded above the top elevation of the BPA and sloped to support a cover and surface water management system designed to maximize runoff and minimize infiltration into the mine wastes, while preserving slope stability.	The elevation of the upper surface consisting of mine waste rock in the BPA will be greater than the current edge of the BPA as discussed in Appendix D and depicted on the drawings referenced in Volume II. This will allow the upper liner coming from Pit 3 to extend beyond this edge so that precipitation will run off the cover surface and be channeled away from the BPA. Cap slope stability also is discussed in Appendix D and there are calculations supporting the cover design including the slopes presented. Appendix F describes the design of a series of bench channels and down-drain channels that collect and convey surface water from the BPA. Sizing and erosion protection for these channels are designed to meet the requirements in 2.4.2.5 C.i above.
F. Cover Construction		
2.4.2.5 F.i.	A cover made of geologic material and a synthetic liner shall be constructed over the mounded mine waste in the BPA in such a way as to permanently meet the ROD cleanup standards for soil and radon flux and to minimize the infiltration of water into the pits.	Refer to 2.4.2.4.2 H.i. above.
2.4.2.5 F.ii.	Cover specifications shall be determined during remedial design and shall ensure that the thickness of the geologic materials alone shall be sufficient to limit the radon flux rate to less than 20 pCi/m2/sec as required in Section 8 of the ROD, in accordance with the Nuclear Regulatory Commission guidance document NUREG 1620 (NRC 2000). Radon flux shall be measured using standard NRC techniques presented in 40 CFR Part 61, Appendix B, Method 115 to ensure that the average radon flux from the cover remains less than 20 pCi/m2/sec.	Refer to 2.4.2.4.2 H.ii. above.
2.4.2.5 F.iii.	The cover shall be constructed in compacted lifts and include a synthetic liner of a material determined during design, to minimize infiltration of precipitation into the underlying mine wastes.	Refer to 2.4.2.4.2 H.iii. above.
2.4.2.5 F.iv.	The cover shall be constructed to efficiently minimize infiltration of water, while preserving slope stability, minimizing erosion and biointrusion, and supporting vegetation. The cover shall be designed using standard engineering techniques and a factor of safety of 1.3 for static and 1.0 for dynamic slope stability. The cover shall be erosionally stable under the 100-year, 24-hour storm event.	Refer to 2.4.2.4.2 H.iv. above.
2.4.2.5 F.v.	The cover shall overlay mounded mine waste and shall slope out to a surface water management system to maximize runoff and minimize infiltration into the mine wastes, while preserving slope stability.	Refer to 2.4.2.5 E.i. above.
2.4.2.5 F.vi.	Once constructed, the cover shall be vegetated as determined during remedial design, in consultation with the Tribe, for purposes of evapotranspiration, ecological habitat, slope stability, and long-term effectiveness.	Refer to 2.4.2.4.2 H.vi. above
2.4.3 Water Collection and Treatment Work Element		
2.4.3.3 Water Collection and Conveyance Work Component		
2.4.3.3.2 A.	All water requiring treatment, as described both above in this table and in this Component of Work, shall be collected and then conveyed to and treated at the WTP operating at the time of conveyance.	Surface water and groundwater requiring capture, containment, and conveyance to the WTP for treatment during the RA (and following the RA) are described in the text in Appendix D - Mine Waste Excavation and Containment, Appendix E - Water Management Ponds, Appendix F - Surface Water and Sediment Controls, and Appendix G - Groundwater Controls. These appendices reference associated drawings in Volume II that pertain to collection and treatment of contaminated Site waters. Calculations in these sections are provided to facilitate proper sizing of the groundwater and surface water collection, storage, and treatment systems capacities. In addition, the OM&M Plan (Appendix P) describes comprehensive water management activities for the Site.
2.4.3.3.2 B.	Water collection and conveyance facilities shall be provided with capacities and in locations to be determined in RD.	Refer to 2.4.3.3.2 A above
2.4.3.3.2 C.	Collection and conveyance facilities shall be sufficient to collect and convey all water requiring treatment and shall utilize BMPs for automatic operations, alarms, and other operational controls.	Automated operations, alarms, and other operational controls are described in Appendix I – Water Treatment Plant.
2.4.3.3.2 D.	Groundwater seeps in the MA and MAA that exceed concentrations listed in Table 4-4 or which may result in concentrations in surface water down gradient greater than the concentrations listed in Table 4-3 shall be intercepted and collected.	Mine-impacted groundwater seeps are currently collected and treated at the Site as part of the Phase I RD/RA Interim Water Management operations. These seep collection activities will continue throughout the RA construction. New seeps that are encountered during the earthworks will be captured, and conveyed to the operating WTP by the Surface Water and Sediment Controls described in Appendix F. Following remedy implementation, new seeps and springs will be identified during Site inspections as described in the SMP contained in Appendix Q. The new seeps will be evaluated to determine if the water requires capture and treatment or if the water can be shed to the natural drainages south of the Site (refer to the technical memorandum titled *Management of Stormwater Runoff in the Remediated Areas* included in the Master SWMP).
2.4.3.3.2 E.	Seep collection shall continue at the existing Eastern, Western and Central seep collection points, as well as any other seepage locations in the vicinity of these systems, unless otherwise approved by EPA.	Existing seep collection systems will continue to operate as described in the OM&M Plan (Appendix P).
2.4.3.3.2 F.	Following waste containment or as determined necessary by EPA, new seep collection structures shall be designed, constructed, operated and maintained to replace the current seep collection system and ensure effective capture of contaminated groundwater seepage to the ground surface. Such facilities shall continue to be operated, unless otherwise approved by EPA.	During and following waste containment and completion of the RA, site-wide monitoring outlined in Appendix Q will be performed. Groundwater, surface water, sediment and air will be sampled as deemed necessary to ensure the RA has been successful in meeting the cleanup levels. The results of the sampling will determine if new collection systems or upgrade of existing seep collection systems are necessary.
2.4.3.3.2 G.	Contaminated seep water shall be conveyed to the WTP for treatment.	Refer to 2.4.3.3.2 D. above.
2.4.3.3.2 H.	Construction of the new systems shall be coordinated with operation of the existing seep collection systems such that there is no lapse in seep collection and treatment.	Refer to 2.4.3.3.2 D. above.
2.4.3.3.2 I.	Contaminated groundwater in the alluvium and weathered bedrock that exceeds concentrations listed in Table 4-4 or which may result in concentrations in surface water down gradient greater than the concentrations listed in Table 4-3 shall be intercepted and collected.	Groundwater in the alluvium in the Western, Central, and Far East Seep drainages will be intercepted and collected as described in Appendix G - Groundwater Controls.
2.4.3.3.2 J.	This groundwater collection system shall be sited in locations to be determined during RD and shall consist of an interception trench excavated to competent bedrock, a designed drain backfill, a low permeability barrier on the down-gradient side of the drain backfill, and a collection sump and pump back system or other system approved by EPA.	Appendix G - Groundwater Controls contains text, calculations, and references drawings in Volume II that includes information regarding locations of the groundwater collection systems in the Western, Central, and Far East Seep drainages. The locations were selected to lie within the existing fenced mine area in order to limit the offsite footprint of the RA construction while maximizing the amount of impacted alluvial groundwater collected.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE
(Page 10 of 12)

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.4.3.3.2 K.	All water collected in the groundwater collection system shall be conveyed to the WTP for treatment.	Appendix G - Groundwater Controls contains text, calculations, and references drawings in Volume II that includes information regarding water collected in the groundwater collection system. Initially, it will be conveyed to the WTP via the PCP. When the PCP is decommissioned, groundwater will be conveyed directly to the WTP Equalization Pond.
2.4.3.3.2 L.	The groundwater collection system shall be constructed as early as practicable during the Work to provide effective capture of contaminated groundwater during up gradient construction and to accelerate the recovery of Blue Creek surface water and sediment quality.	The groundwater collection system will be constructed during the first phase of RA (i.e., Phase 1) as presented in the RA schedule presented in Appendix X.
2.4.3.3.2 M.	The groundwater collection system shall continue to be operated until otherwise approved by EPA.	The groundwater collection systems described in Appendix D - Mine Waste Excavation and Containment and Appendix G - Groundwater Controls have been designed for long-term operation, with maintenance systems including drain pipe cleanouts and easily accessible pump risers, to enhance long-term operation. Evaluation of the system will be based on results of the site-wide monitoring as described in Appendix Q as well as the CERCLA 5-year review process in which analytical results from the long-term monitoring provide information regarding the operation of all the systems installed during the RA and the need for continued operation.
2.4.3.4 Water Storage and Treatment Work Component		
2.4.3.4.2 A.	All water collected for treatment shall be delivered to the water storage and treatment facility as soon as practicable, as determined during design.	Stored water will be conveyed to the operating WTP as soon as practicable in order to maintain storage capacity in the temporary impoundments for stormwater during construction. The existing WTP has a 500 gpm capacity and the new WTP is conservatively designed with a maximum capacity of 500 gpm. The 500 gpm flow is based on an extreme snowmelt event that is expected to occur on a minimal frequency interval. The 500 gpm capacity of the existing and new WTPs is well above the anticipated nominal design flow rate of 125 gpm based on historical operations. This design information is included in Appendix I – Water Treatment Plant.
2.4.3.4.2 B.	Water treatment shall minimize the need for water storage, as determined during RD.	Water storage ponds for attenuation of peak flows will be required during RA construction and for some period of time after construction while the hydrologic system equilibrates to the remediated configuration. Sizing of these temporary storage ponds are discussed in Appendix E. The impacts of WTP flow capacity on the required water storage during construction are also discussed in Appendix E. Water impoundments for the new WTP is discussed Appendix I - Water Treatment Plant and the drawings are presented in Volume II. These impoundments have been minimally sized as discussed in the Earthworks and Equalization section in Appendix I. The capacity and the operation of the new WTP is designed to minimize water storage needs.
2.4.3.4.2 C.	The existing WTP shall reduce contaminant concentrations in collected water to interim discharge limits specified in BODR Table 2-1 or lower.	The current WTP meets the discharge limits specified in the CD.
2.4.3.4.2 D.	The existing WTP shall be operated and maintained as long as necessary, but not later than when off-site discharge to the Spokane River Arm of Lake Roosevelt is permitted and a replacement WTP is operational and functional, except as approved by EPA.	The existing WTP will be taken offline as soon as the new WTP is operational, which will occur following the issuing of the modified NPDES permit (with negotiated discharge limits), WTP design finalization, and construction of the new WTP. The assumed schedule for the new WTP is presented in Appendix X; however, that schedule is subject to the timing for the NPDES permit modification.
2.4.3.4.2 E.	A Clean Water Act NPDES permit shall be sought for off-site discharge to the Spokane River Arm of Lake Roosevelt. The application for the permit and all Work necessary to support the permit application shall be completed as soon as practicable by the Settling Defendants.	Data collection and evaluation activities are continuing pursuant to reissuing the NPDES permit (see BODR Section 3.14).
2.4.3.4.2 F.	A replacement WTP shall be designed, constructed, and made operational as soon as practicable.	Refer to 2.4.3.4.2 D
2.4.3.4.2 G.	As soon as practicable, but no later than completion of mine waste containment, all contaminated water collected must be treated to meet discharge limits in the applicable NPDES permit prior to off-site discharge via pipeline to the Spokane River Arm of Lake Roosevelt. If upon completion of mine waste containment a permit has not been granted, then subject to EPA approval discharge may occur on site pending issuance of the permit. Discharge must at a minimum meet the interim discharge limits in BODR Table 2-1; however, to aid in achievement of cleanup standards for surface water and sediment in Blue Creek, EPA approval of on-site discharge will consider the ability of the replacement WTP to achieve more stringent discharge limits, including those likely to be in the NPDES permit.	Refer to 2.4.3.4.2 D
2.4.3.4.2 H.	Offsite discharge of effluent from the replacement WTP shall comply with effluent discharge limits in the applicable NPDES permit.	The reissued NPDES permit will have negotiated discharge standards that allow for a mixing zone in the Spokane Arm of Lake Roosevelt.
2.4.3.4.2 I.	Settling Defendants shall perform water quality monitoring of site waters, WTP effluent, and downstream receiving waters as required by the NPDES permit. Additional water quality monitoring in these areas to include expanded frequency, locations, and analytes may be required to support site-wide and remedial action effectiveness monitoring activities. The need for such additional monitoring shall be determined during the implementation of this SOW.	The project OM&M Plan presented in Appendix P covers WTP effluent sampling and the project Site-Wide Monitoring Plan (SMP) in Appendix Q covers monitoring of water quality throughout the Site during and after the RA.
2.4.3.4.2 J.	Once the replacement water treatment plant is constructed and operational, all waters requiring treatment shall be treated at this plant, except as otherwise approved by EPA. The existing plant shall be dismantled and disposed in a manner determined during RD.	Please refer to 2.4.3.4.2 D for the timing of existing WTP replacement. Demolition of the existing WTP is presented in Appendix H -Demolition and drawings for the demolition are presented in Volume II.
2.4.3.4.2 K.	The pipeline to the discharge location of the WTP and the discharge outfall shall be sited in coordination with the Tribe, shall not interfere with the functioning of existing structures (e.g. roads, culverts, bridges), and constructed as determined in RD.	Representatives of the design team met with Tribal representatives in Wellpinit, WA to discuss the proposed alignment, which is reflected in this design submittal. Appendix J - Influent/Effluent Pipeline Design discusses the effluent pipeline route and minimization of effluent pipeline impacts. Drawings of the pipeline route are in Volume II.
2.4.3.4.2 L.	To ensure effective long-term water treatment, the replacement WTP shall be maintained and periodically replaced as determined in the remedial design and the long term operation of the plant.	The WTP will be maintained in accordance with the OM&M Plan included in Appendix P, and in accordance with the Remedy O&M Plan that will be prepared upon completion of the RA. The WTP is designed to be permanent with components that can be repaired or replaced as necessary.
2.4.3.5 Residuals Management Component of Work		
2.4.3.5.2 A.	Residuals shall be disposed of in accordance with a Residuals Management Plan approved by EPA.	The current *Residuals Management Plan* (RMP; WME, 2014h) was issued on November 3, 2014. It will be updated as necessary to comply with changes in the water treatment residuals.
2.4.3.5.2 B.	There shall be no onsite storage of residuals except as necessary to accumulate residuals for transportation, in compliance with ARARs and as approved by EPA.	Residuals will be handled and stored as necessary to accommodate transportation, as presented in the RMP or updates to that plan which are approved by EPA.
2.4.3.5.2 C.	Residuals shall be handled and transported in compliance with applicable laws, regulations, permits, and policies.	Residuals will be handled, including stored and transported in compliance with applicable laws, regulations, permits, and policies, as presented in the RMP or updates to that plan which are approved by EPA.
2.4.3.5.2 D.	Offsite disposal of residuals shall comply with applicable laws, regulations, permits, and policies.	Residuals disposal will comply with applicable laws, regulations, permits, and policies according to the RMP or updates to the RMP that are approved by the EPA.
2.4.3.5.2 E.	If the treatment plant requires modification, Settling Defendants shall prepare and submit design documents and, as necessary, modifications to the Residuals Management Plan for EPA approval.	Necessary design documents will be prepared and submitted to EPA (including revisions to the RMP) if treatment plant modifications are proposed in the future.
2.4.4 Institutional Controls Work Element		
2.4.4.3. A.	Institutional controls shall, to the degree practicable, be implemented to achieve the RAOs and to meet the objectives for the geographic areas as described in Section 12.2.5 of the ROD.	Institutional controls (ICs) and access restrictions (ARs) are required to protect the integrity of the Selected Remedy and preclude use that would result in unacceptable risks from exposure to contaminants. ICs/ARs will be emplaced as described in the *Institutional Controls Implementation and Assurance Plan, Revision 1* (ICIAP, MWH 2014c).

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.4.4.3. B.	In coordination with the Tribe, BIA and landowners, Settling Defendants shall submit for EPA review and approval an Institutional Controls Implementation and Assurance Plan (ICIAP) in accordance with Section 4 for implementing, maintaining, monitoring and reporting on the Institutional Controls selected in the ROD. The ICIAP shall include mechanisms to ensure long-term effectiveness of the institutional controls.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented.
2.4.4.3. C.	If Tribal ordinances, land-use planning documents, and other mechanisms solely within the Tribe's authority are used to establish institutional controls, Settling Defendants shall assist the Tribe by providing information and other assistance necessary.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented.
2.4.4.3. D.	If agreements or Proprietary Controls are used to establish institutional controls, Settling Defendants shall make best efforts to secure such controls.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented.
2.4.4.3. E.	During RD, Settling Defendants shall make best efforts to coordinate with the Tribe and BIA on future land use plans for the mined area and adjacent areas in order to, as reasonable, adjust aspects of the RD (such as utilities corridors, infrastructure, revegetation, siting of facilities) to support or, at a minimum, not to conflict with such uses.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented. This was also submitted to the Tribe for their input. Discussions with the Tribe are on-going.
2.4.4.3. F.	In accordance with the ROD, and as otherwise approved during RD, physical barriers to access shall be installed and maintained to meet the objectives of Section 12.2.5 of the ROD.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented.
2.4.4.3. G.	Access restrictions shall be designed and constructed to prevent damage to the integrity of the remedy. This includes a permanent barrier, such as a boulder barrier, to prevent unauthorized vehicle access to the waste containment area, fencing around water collection, storage and treatment facilities, signage, and other facilities as appropriate and approved by EPA.	The *ICIAP* (Rev 1) was submitted to EPA in February 2014 for review and approval. It includes details that satisfy this performance standard once implemented.
2.4.5 Long-Term Site Management Element of Work		
2.4.5.3 A.	Operations and Maintenance shall be performed as necessary to ensure that the Remedy continues to function as designed and to meet Performance Standards in perpetuity.	Following completion of the RA, a Remedy O&M Plan will be prepared to describe the long-term O&M of the permanent remedy components.
2.4.5.3 A.i.	Surface Water and Stormwater Management shall be performed to ensure that the Remedy functions as intended and that contaminants are not transported off-site in surface water, stormwater, and sediment. Surface Water and Stormwater Management includes the development of a Storm Water Management Plan (SWMP) for the site that details techniques and methods that shall be employed to manage and monitor surface water, stormwater, and sediment following the implementation of the Remedy.	The Master SWMP in Appendix O includes both a Construction Stormwater Pollution Prevention Plan (CSWPPP) and a Permanent Stormwater Control Plan (PSWCP). The permanent stormwater controls are based on the erosional stability information contained in BODR Appendix D - Mine Waste excavation and Containment and the hydraulic calculations contained in BODR Appendix F – Surface Water and Sediment Controls. Permanent stormwater controls will include drainage benches, diversion channels, and retention basins. Permanent erosion control of the remediated surfaces will be accomplished by a combination of vegetating the disturbed surfaces and placement of riprap on steeper slopes.
2.4.5.3 B.	Monitoring shall be performed in accordance with the Site Wide Monitoring Plan (SMP) as discussed in Section 3 to demonstrate the integrity and functioning of the Remedy, to monitor the continued effectiveness of the Remedial Action in achieving Performance Standards, to document the effectiveness of Institutional Controls and access restrictions, to demonstrate progress towards achieving cleanup levels in sediment, surface water, and groundwater, and to develop appropriate corrective action if necessary.	The SMP (Appendix Q) will be updated upon completion of the RA, and will be used to monitor the continued effectiveness of the completed RA.
2.4.5.3 C.	Annual reports shall document O&M and monitoring results, and a corporate officer of a Settling Defendant shall certify whether, to the best of his or her knowledge, the access restrictions and institutional controls remain in place and have been complied with, and shall propose corrective actions as needed, for EPA approval.	Annual reports prepared to document O&M and monitoring efforts will inform the stakeholders if the remedy continues to be effective or if additional corrective action is necessary. DMC/Newmont will certify whether, to the best of their knowledge, the access restrictions and institutional controls remain in place and have been complied with. If there are problems identified with the ICs, will be proposed and implemented as approved by EPA.
2.4.6 Contingent Action - Blue Creek and Delta Sediments Element of Work		
2.4.6.3 A.	Settling Defendants shall perform studies to assess the chemistry, biological toxicity and benthic conditions of Blue Creek and Delta to determine whether impacts in all or part of the creek warrant active cleanup and whether sediment conditions indicate significant progress towards achieving sediment cleanup levels within 10 years of completion of mine waste containment. Waste containment shall be considered complete upon Final Construction Inspection, unless otherwise determined by EPA.	The progress and current status of the Blue Creek investigations pursuant to the Contingent Action component of the Selected Remedy is discussed in BODR Section 3.12.
2.4.6.3 B.	Settling Defendants shall submit a Blue Creek and Delta Assessment Work Plan in accordance with Section 3.9 and Section 4. The work plan shall propose (1) an appropriate reference area and an approach to synoptic sediment characterization, including benthic analysis, toxicity testing, and sediment chemistry; (2) criteria for determining (a) what biological and chemical characteristics warrant remediation of sediments before waste containment is completed and (b) what biological and chemical characteristics warrant removal of the sediments within the first ten years after waste containment is completed; and (3) a detailed monitoring plan (including SAP and QAPP) and schedule for monitoring, assessing and reporting on conditions in Blue Creek and the Delta. The work plan shall address (a) assessment of baseline conditions for natural recovery, (b) assessment of depositional and erosive areas, source control, and other relevant aspects of the natural recovery process (c) estimation of rates of natural recovery, (d) monitoring at intervals before, during, and upon completion of the ten year period to assess the need for active remediation and/or to verify predicted natural recovery.	The *Blue Creek and Delta Assessment Work Plan (Rev 0)* was submitted to EPA on October 3, 2011 for review and approval. Comments on the Blue Creek and Delta Assessment Work Plan were received from EPA on June 13, 2014, and a technical meeting was held during late June 2014 to discuss the work plan and path forward. It was concluded at the meeting that additional work is needed to define or redefine the scope and objectives of the overall Blue Creek contingency as well as the assessment work plan, and that responding to EPA comments and updating the assessment work plan is premature at this time. In response to the meeting discussions, a field reconnaissance to determine the approximate location and thickness of sediments in Blue Creek occurred on March 8 and 9, 2015. The *Lower Blue Creek Reconnaissance Technical Memorandum* (MWH, 2015) summarizing the field reconnaissance was submitted on April 21, 2015.
2.4.6.3 C.	Settling Defendants shall implement the approved work plan and shall submit reports with recommendations regarding sediment cleanup. EPA may at any time determine that sediment cleanup is necessary.	Refer to 2.4.6.3 B.
2.4.6.3 D.	If during the ten year period following waste containment, and in consultation with the Tribe, EPA determines that sediment cleanup is necessary to address (i) significant biological effects or (ii) sources of contamination to downstream areas, or (iii) sediments that do not show or are unlikely to show significant progress towards meeting sediment cleanup levels within the ten year timeframe, Settling Defendants shall submit a focused feasibility study for evaluation of sediment removal methods and, upon EPA selection of a method, shall design and implement the cleanup in accordance with remedial design and remedial action submittals determined necessary by EPA.	The need for a focused feasibility study, design, and remediation of sediments in Blue Creek will be evaluated based on the results of the additional characterization and monitoring described in BODR Section 3.12
2.4.6.3 E.	For any contaminated sediments removed as part of the contingent sediment remediation, disposal shall be either off-site, in compliance with all applicable laws and regulations, including the Off-site Disposal Rule (40 C.F.R 300.440), or on-site, as approved by EPA and following consultation with the Spokane Tribe of Indians and the Bureau of Indian Affairs.	It is anticipated that Blue Creek sediments removed during a contingent action would be placed in a cell constructed in Pit 3. This option is conceptually discussed in Appendix D – Mine Waste Excavation and Containment.

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TABLE 4-6
PERFORMANCE STANDARD COMPLIANCE

CD SOW Reference Number	Performance Standard	How/Where the Remedial Design/Remedial Action Achieves the Performance Standard
2.4.6.3 F.	If after the ten year period sediments do not meet the cleanup levels, EPA, in consultation with the Tribe, may determine that additional sediment cleanup is necessary. Settling Defendants shall submit a focused feasibility study for evaluation of sediment removal methods and, upon EPA selection of a method, shall design and implement the cleanup in accordance with remedial design and remedial action submittals determined necessary by EPA.	The need for a focused feasibility study, design, and remediation of sediments in Blue Creek will be evaluated based on the results of the additional characterization and monitoring described in BODR Section 3.12.
2.4.6.3 G.	Settling Defendants shall conduct environmental monitoring during and following any active cleanup of Blue Creek and Delta sediments and shall minimize and repair any damage to habitat in and adjacent to Blue Creek and the Delta.	Plans for environmental monitoring during and following any active cleanup of Blue Creek and Delta sediments will be prepared when it is determined that contingent actions are necessary.
2.4.6.3 H.	Settling Defendants shall incorporate long-term monitoring of Blue Creek and the Delta into the SMP and shall conduct monitoring to document surface water and sediment concentrations.	See 2.4.6.3 B. Upon completion of baseline monitoring, the SMP will be updated to include long-term monitoring in Blue Creek.

AR	Access Restriction
ARD	acid rock drainage
BA	Biological Assessment
BMP	Best Management Practice
BODR	Basis of Design Report
BPA	Backfilled Pits Area
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
CQAP	Construction Quality Assurance Plan
CSWPPP	Construction Stormwater Pollution Prevention Plan
CWA	Clean Water Act
EPA	Environmental Protection Agency
GDL	geocomposite drainage layer
HASP	Health and Safety Plan
HSWR	Hillside Waste Rock
IC	Institutional Control
ICIAP	Institutional Control Implementation and Assurance Plan
MA	Mined Area
MGC	Miller Geotechnical Consultants
NPDES	National Pollution Discharge Elimination System
NRC	Nuclear Regulatory Commission
OM&M	operation, maintenance and monitoring
PCP	Pollution Control Pond
PPE	personal protective equipment
PSWCP	Permanent Stormwater Control Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RAC	Remedial Action Contractor
RAWP	Remedial Action Work Plan
RD	Remedial Design
RDWP	Remedial Design Work Plan
RMP	Residuals Management Plan
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SMP	Site-wide Monitoring Plan
SOW	Statement of Work
SWMP	Stormwater Management Plan
Tribe	Spokane Tribe of Indians
WME	Worthington Miller Environmental
WTP	Water Treatment Plant

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TABLE 4-7

REMEDIAL DESIGN COMPONENTS

ENGINEERING DESIGN SECTIONS (Engineering Design Drawings are contained in Volume II)
Appendix A – General Design Information (Section 1)
Appendix B – Construction Support Facilities (Section 2)
Appendix C – Borrow Area (Section 3)
Appendix D – Mine Waste Excavation and Containment (Section 4)
Appendix E – Water Management Ponds (Section 5)
Appendix F – Surface Water and Sediment Controls (Section 6)
Appendix G – Groundwater Controls (Section 7)
Appendix H – Demolition (Section 8)
Appendix I – Water Treatment Plant (Section 9)
Appendix I – Influent and Effluent Pipeline Designs (Section 10)
Appendix AA – Power Distribution and Pump Controls (Section 11)
TECHNICAL SPECIFICATIONS
Appendix K – Technical Specifications
SUPPORTING PLANS AND DOCUMENTATION
Appendix L – Remedial Action Health And Safety Plan (HASP)
Appendix M – Substantive Environmental Compliance Documentation
Appendix N – Tribal Access/Right-Of-Way Documentation
Appendix O – Stormwater Management Plan (SWMP)
Appendix P – Operations Maintenance and Monitoring Plan – Water Management (OM&M Plan)
Appendix Q – Site-Wide Monitoring Plan (SMP) - includes Field Sampling Pan (FSP) and Quality Assurance Project Plan (QAPP)
Appendix R – Staging/Temporary Stockpiling Plan
Appendix S – Analytical Support and Verification Plan for Remediation of Surface Materials and Sediments
Appendix T – Water Source Identification and Development Plan
Appendix U – Construction Quality Assurance Plan (CQAP)
Appendix V – Procurement Plan
Appendix W – Engineer’s Cost Estimate
Appendix X – Remedial Action Schedule
Appendix Z – Well Decommissioning Plan

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TABLE 4-8
SUMMARY OF GREEN AND SUSTAINABLE REMEDIATION MEASURES
TO BE IMPLEMENTED

CATEGORY	BMP OR GSR PRINCIPLE	MEANS OF VERIFICATION
Project Administration		
Materials Management	Use of electronic system to post procurement documents and obtain quotes. Submittals are reviewed and shared electronically	G&S Practices Specification and contractor's MMP submittal
Materials Management	Use of on-site printers set to automatically print double-sided	G&S Practices Specification and contractor's MMP submittal
Materials Management	On-site collection of plastic, paper, cardboard, and aluminum for recycling	G&S Practices and Temporary Facilities Specifications and contractor's MMP submittal
Materials Management	Recycle and reuse of approved, uncontaminated materials and equipment when economically feasible	Contractors MMP submittal
Remedial Design and Remedial Action		
Stormwater Management	Use of erosion and sediment controls to minimize runoff, in conformance with Federal, State, and Local regulations	Engineering Drawings
Materials Management	Use of "green" concrete with fly ash; percentage varies based on strength requirements of concrete	Concrete Specification
Water Management and Conservation	Use of water-wise fixtures	Accessories, Equipment, and Temporary Facilities Specifications
Energy Minimization	Use of Energy Star compliant equipment and appliances, premium-efficiency motors, high-efficiency impellers, variable refrigerant flow for HVAC, tinted double-pane windows, and high efficiency lighting (LED or fluorescent)	Equipment Specifications
Energy Minimization	Optimized use of gravity flow in pipelines and at the Water Treatment Plant	Engineering Drawings
Remedial Action		
Air Emissions Reduction	Phasing in of air emission standards for non-road diesel powered construction equipment	G&S Practices Specification
Air Emissions Reduction	Use of ultra-low sulfur diesel in construction equipment and support vehicles	G&S Practices Specification and contractor's ERP submittal
Air Emission Reduction	Implementation of a no-idle policy and speed limit signs for all construction equipment and support vehicles	G&S Practices Specification and contractor's ERP submittal
Air Emission Reduction	Sizing the equipment correctly with the task needs thereby minimizing the use of heavy equipment for small tasks	Equipment Specifications

CATEGORY	BMP OR GSR PRINCIPLE	MEANS OF VERIFICATION
	Remedial Action (continued)	
Air Emission Reduction	Transporting workers from centralized carpool and bus pickup locations	G&S Practices Specification and contractor's ERP submittal
Materials Management; Air Emissions Reduction	Use of nearest approved borrow source	Engineering Drawings
Materials Management; Air Emissions Reduction	Use of Hillside Waste Rock Pile for drain rock in pits to minimize import of offsite material	Engineering Drawings
Material Management	Maintaining a single point of entry/exit to the MA helps prevent re-contamination of areas previously remediated while minimizing required support facilities	Engineering Drawings
Energy Minimization	Use of fluorescent or LED lighting fixtures and bulbs and thermal window coverings in temporary facilities	Temporary Facilities Specification
Water Management and Conservation	Use of treated WTP discharge water for on-site dust suppression during the RA	G&S Practices Specification and contractor's WMP submittal
Water Management and Conservation	Use of dedicated sampling equipment to reduce use of clean decontamination water	Field Sampling Plan
Water Management and Conservation	Use of WTP for treatment of all sampling-derived and decontamination rinse water	OM&M Plan and FSP
Ecosystem Disturbance	Restoration of land surface within a timely manner to minimize erosion and prevent growth of invasive species	Engineering Drawings and Specifications, Appendix C
Ecosystem Disturbance	Enhancements of habitat, in the form of trees and other native landscaping to be completed following construction	Engineering Drawings and Specifications, Appendix C
Ecosystem Disturbance	Minimizing soil and habitat disturbance of effluent pipeline by aligning the pipeline with existing or proposed roadways	Engineering Drawings

BMP Best Management Practice
ERP Emissions Reduction Plan (construction contractor submittal)
FSP Field Sampling Plan
GHG Greenhouse Gas
G&S Green and Sustainable
GSR Green and Sustainable Remediation
kWh Kilowatt hour
LED light-emitting diode
MMP Materials Management Plan (construction contractor submittal)
OM&M operations, maintenance and monitoring
RA Remedial Action
RD Remedial Design
WMP Water Management Plan (construction contractor submittal)
WTP Water Treatment Plant

TABLE 4-9

SUMMARY OF SIGNIFICANT GREEN AND SUSTAINABLE REMEDIATION MEASURES AND THEIR ESTIMATED SAVINGS

GSR MEASURE	ANNUAL ENERGY SAVED (kWh/yr)	TOTAL ESTIMATED CO_2e EMISSIONS SAVED (MT)	ESTIMATED DIESEL EQUIVALENTSAVED[a] (gallons)
Rhoads Property Borrow Area versus Ford Borrow Area	--	8,500	836,000
Use of Hillside Waste Rock Pile for drain rock to minimize import of offsite material [b]	--	3,900	383,000
WTP - Green Concrete	--	90	8,700
WTP - Premium vs. Standard motors	12,000	140 [c][d]	13,500
Fluorescent Lighting in WTP Building[e]	200,000	2,200 [d]	217,000
Total	212,000	15,000	1,458,000

[a] Source: **www.epa.gov**/p2/pubs/resources/GHG**Conversion**.xls (22.53 lb CO_2e/gallon of diesel)

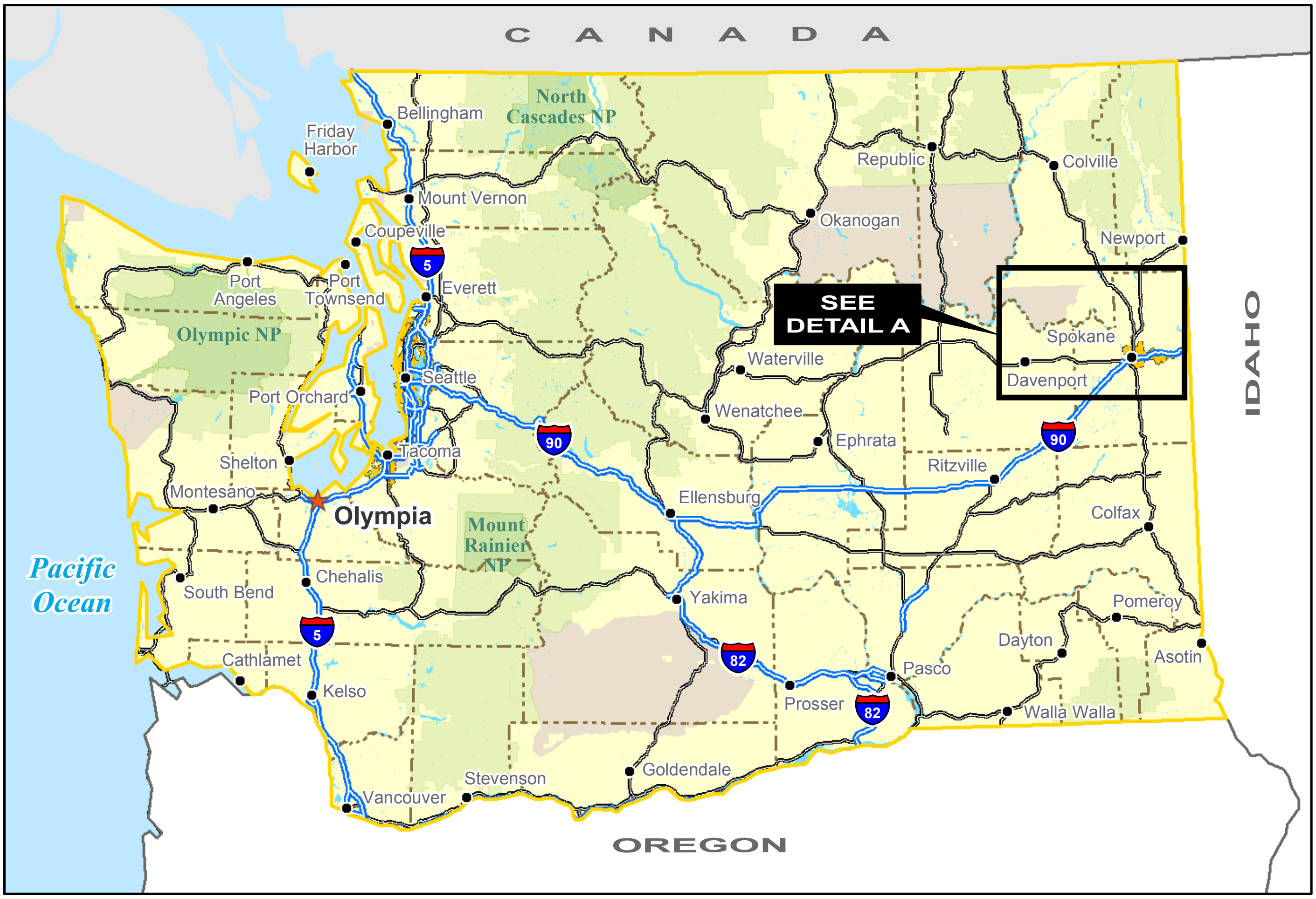
[b] Assume 2 million cubic yards of cover material available at the Waste Rock pile and suitable for use as cover material.

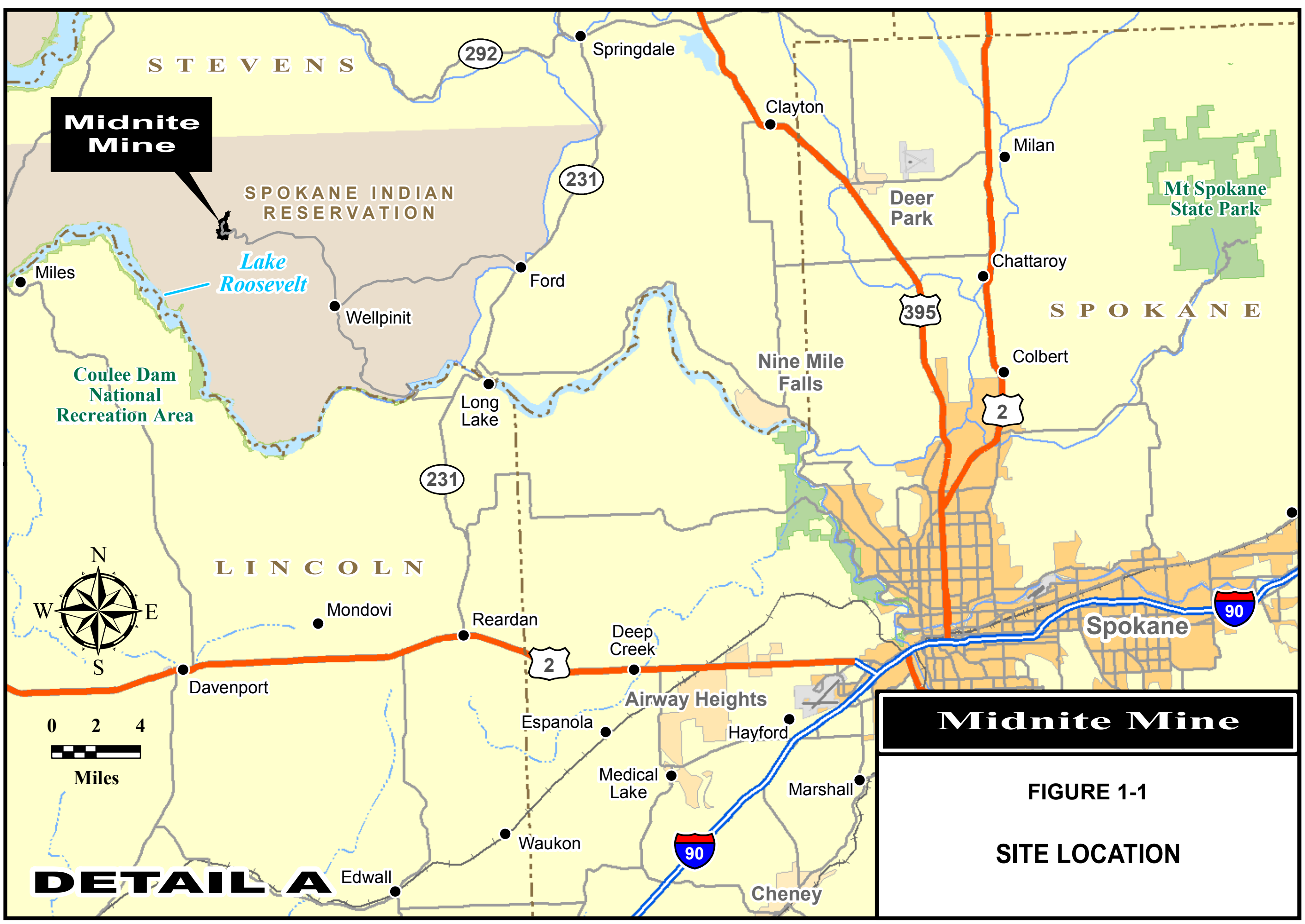
[c] 2009 eGrid Data – NWPP Region – CO_2e values. http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf - p. 1

[d] Assumed operational period of 30 years

[e] Assumed lights operate continuously, 24 hours per day; comparison completed versus incandescent lighting

CO_2e carbon dioxide equivalent
GSR Green and Sustainable Remediation
kWh kilowatt-hour
MT metric tons (equivalent to 2,204.6 pounds)
WTP water treatment plant
yr year



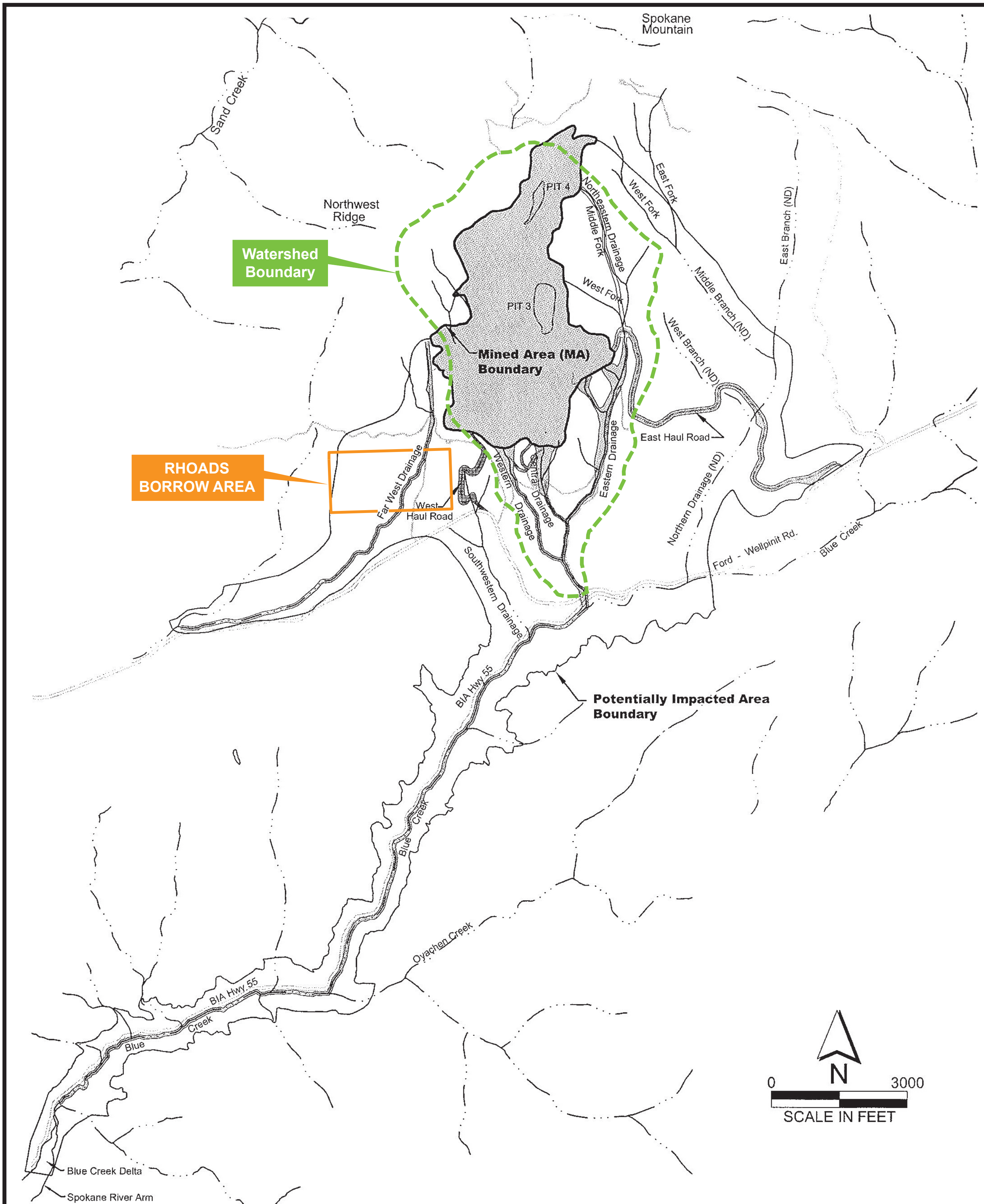


Midnite Mine

FIGURE 1-1

SITE LOCATION

FILE Fig 1-1_Midnite Mine_Site Location_8x11.mxd 21May2012



LEGEND

Mined Area Boundary

Potentially Impacted Area Boundary

Shaded areas represent the Mined Area (MA) and Mining-Affected Areas (MAA) as defined by the remedial investigation.

Stream

Road

MWH

SOURCE: Midnite Mine Record of Decision

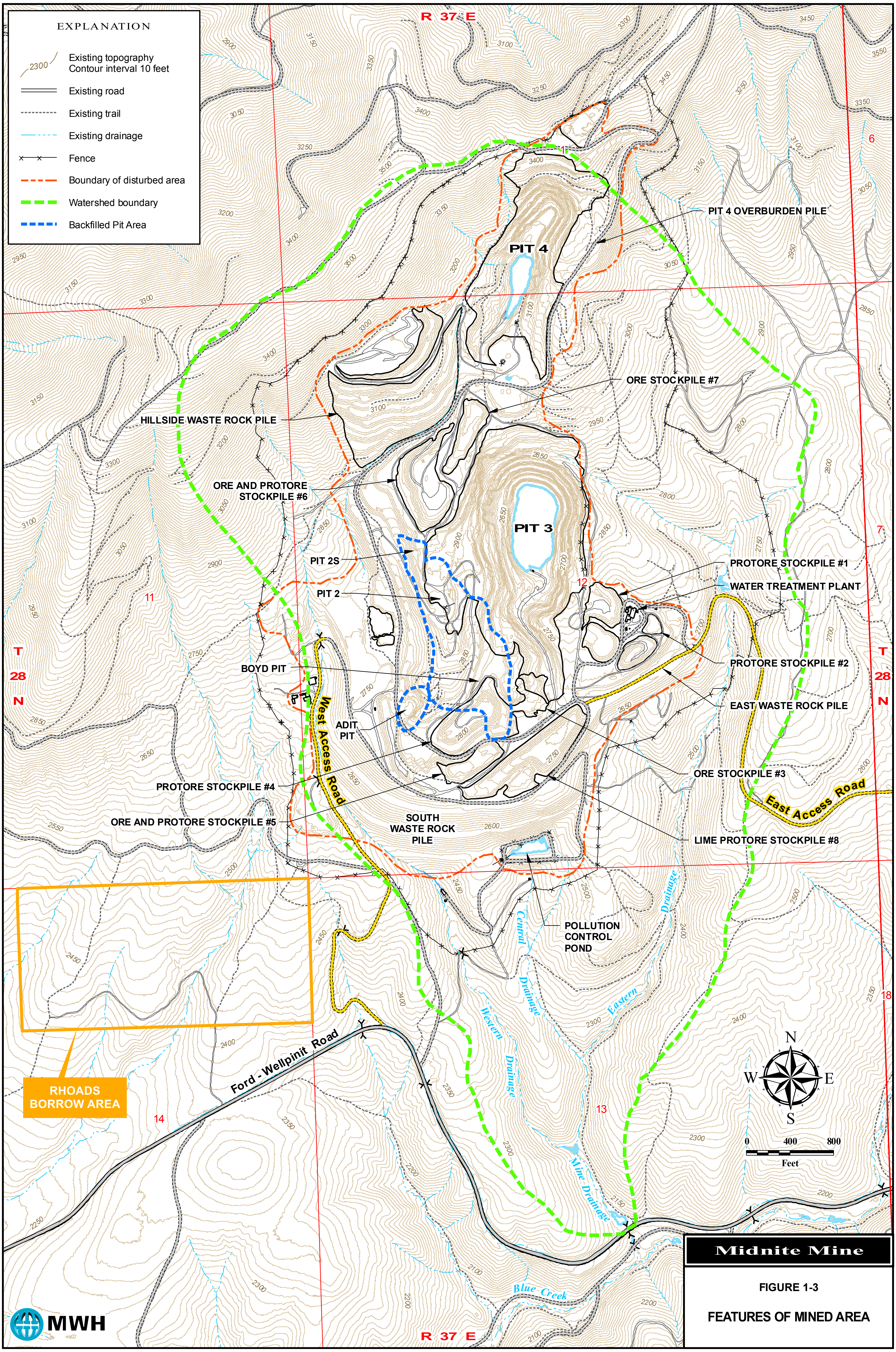
Midnite Mine

FIGURE 1-2

LOCATION OF MINED AREA AND MINING AFFECTED AREA

FILE: *Fig 1-2_Location of Mined Area and Mining Affected Area.ai* *21May2012*

FILE *Fig 1-3_Features of Mined Area_May2012.mxd* 23 May 2012

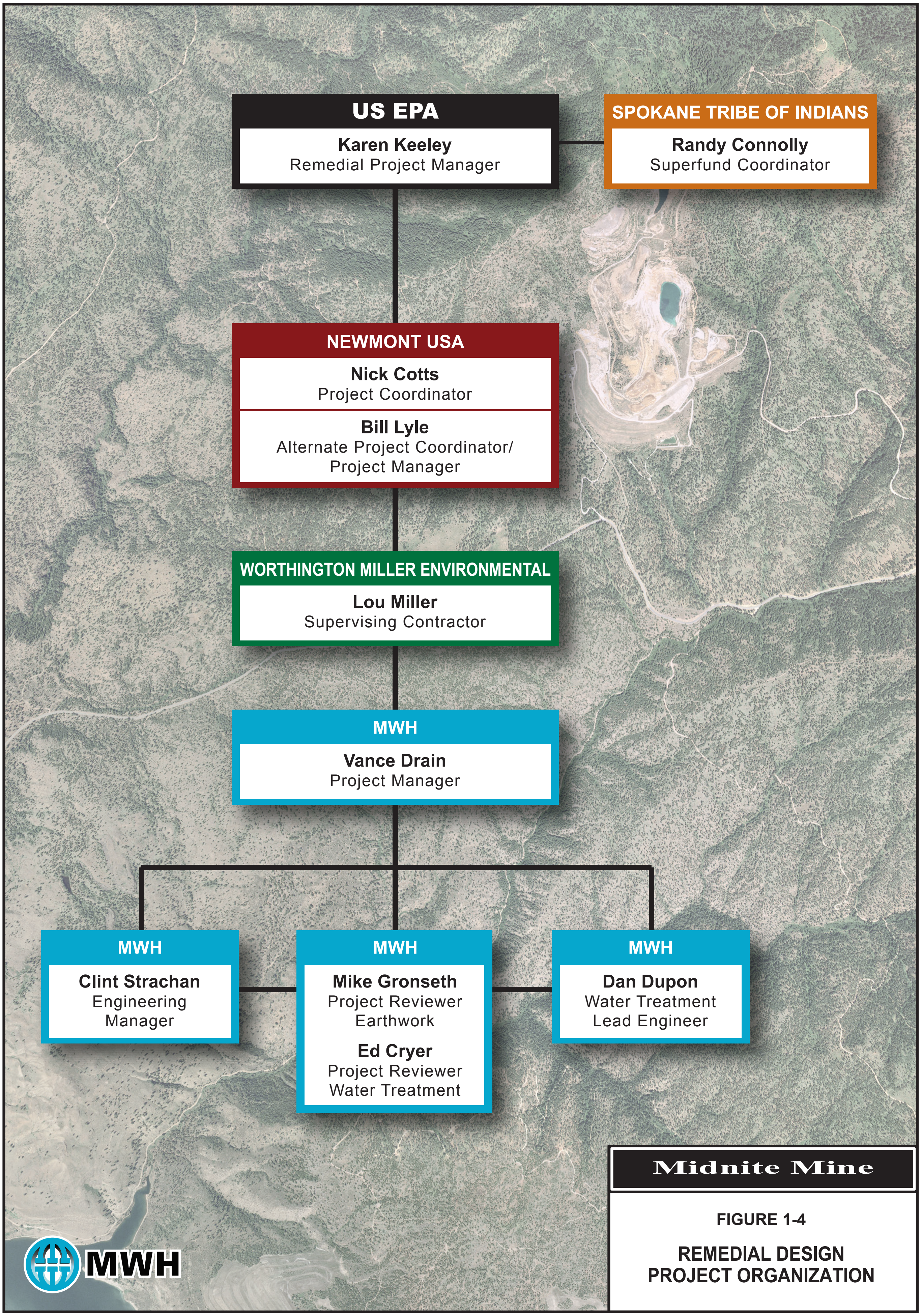


Midnite Mine

FIGURE 1-3

FEATURES OF MINED AREA

J:\Industrial Projects\MIDNITE MINE\Deliverables_Working Documents\Draft RD-RA WP\FIGURES\Fig 1-4_Remedial Design Project Org_11May2015.ai
11 May 2015
DRAWN BY D. Severson



Midnite Mine

FIGURE 1-4

REMEDIAL DESIGN PROJECT ORGANIZATION

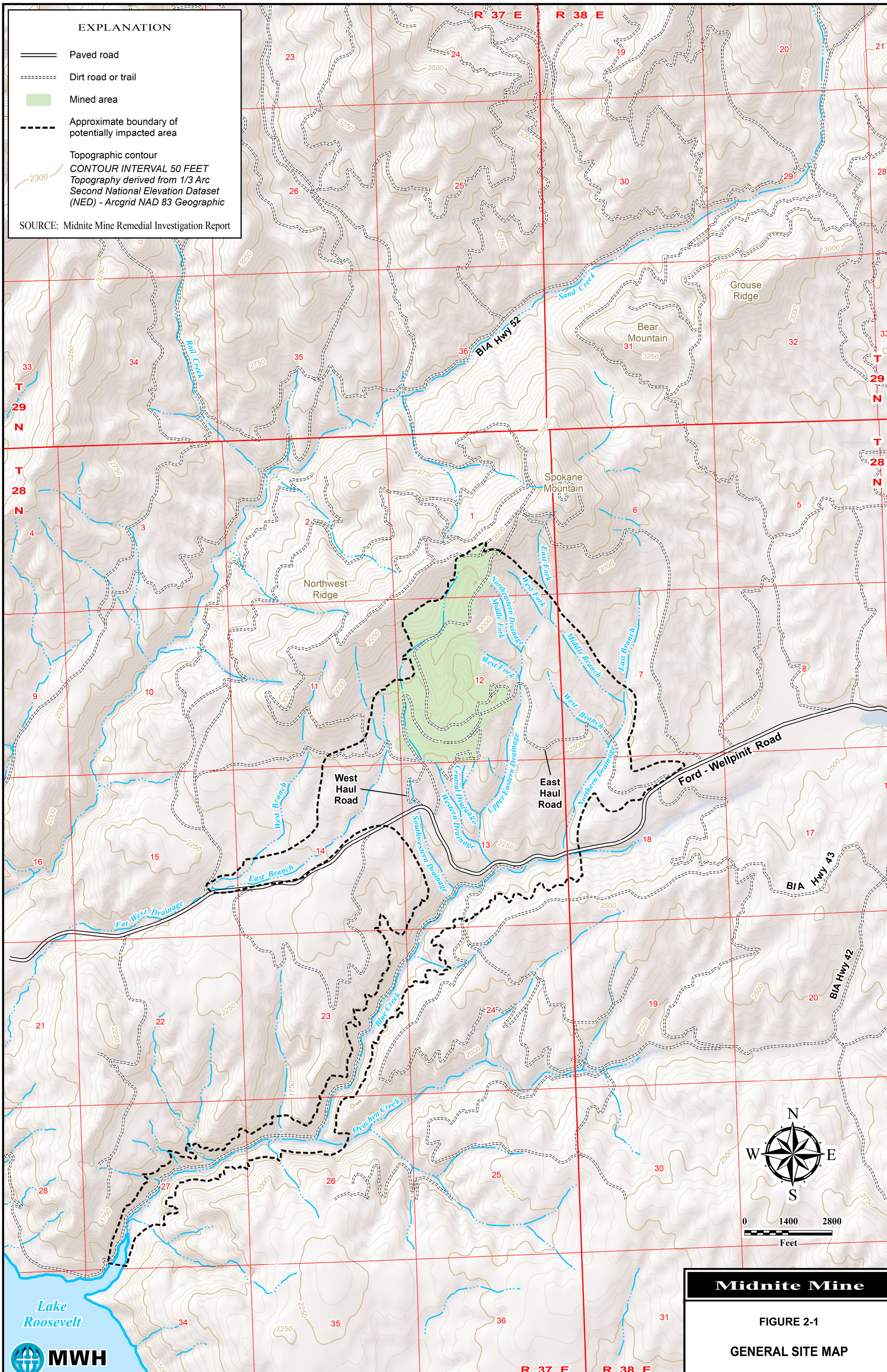
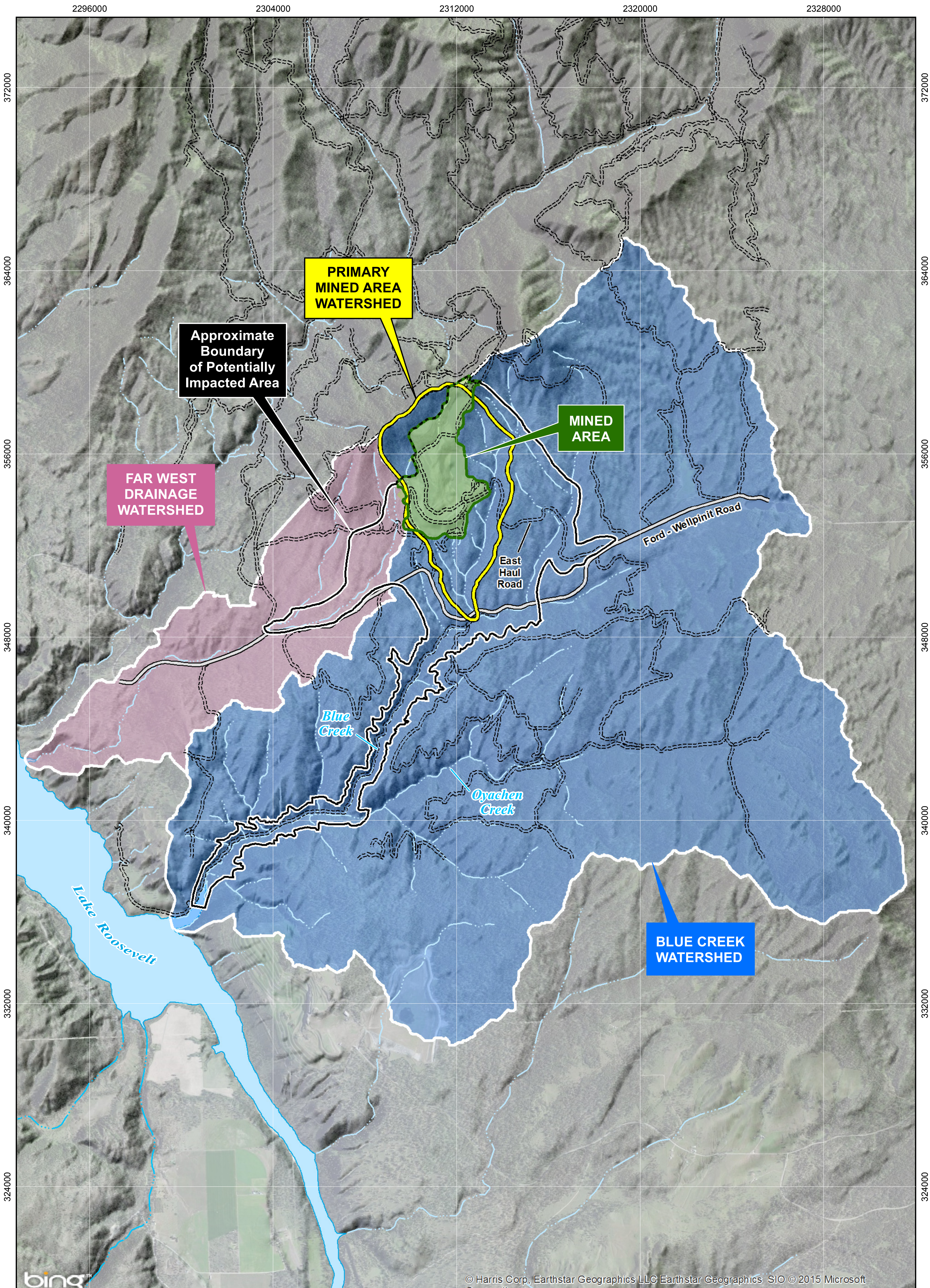


FIGURE 2-1

GENERAL SITE MAP



N
W E
S

0 2000 4000
Feet

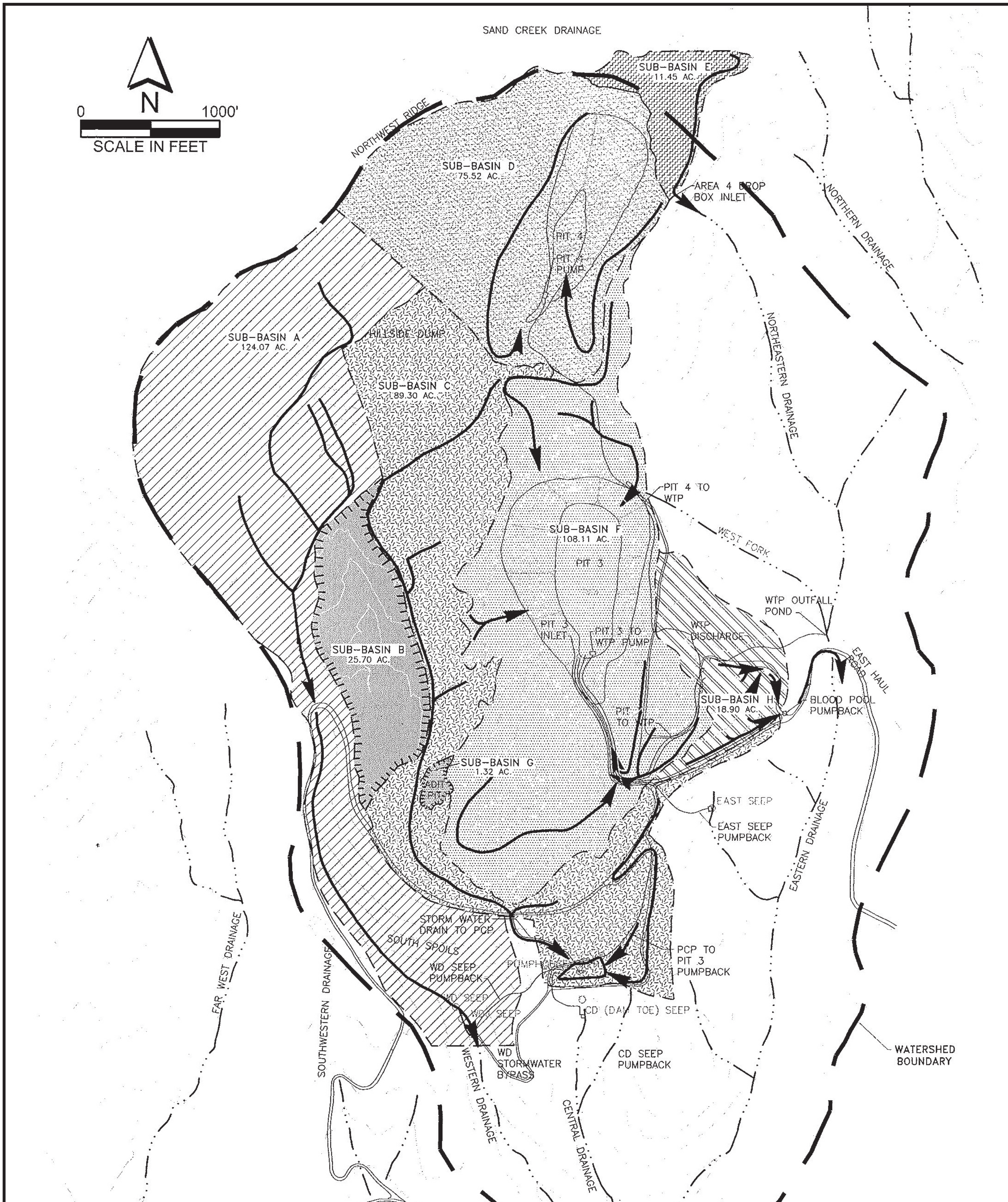
MWH

Paved road	
Dirt road or trail	
Existing drainage	

Midnite Mine

FIGURE 2-2

WATERSHED MAP



LEGEND

- SURFACE WATER SUB-BASIN BOUNDARY
- EXISTING SURFACE WATER CONVEYANCE, PIPELINE OR CAPTURE SYSTEM
- MA SURFACE WATER FLOW DIRECTION
- SURFACE WATER DRAINAGE OUTSIDE OF MA
- SEEPS

MWH

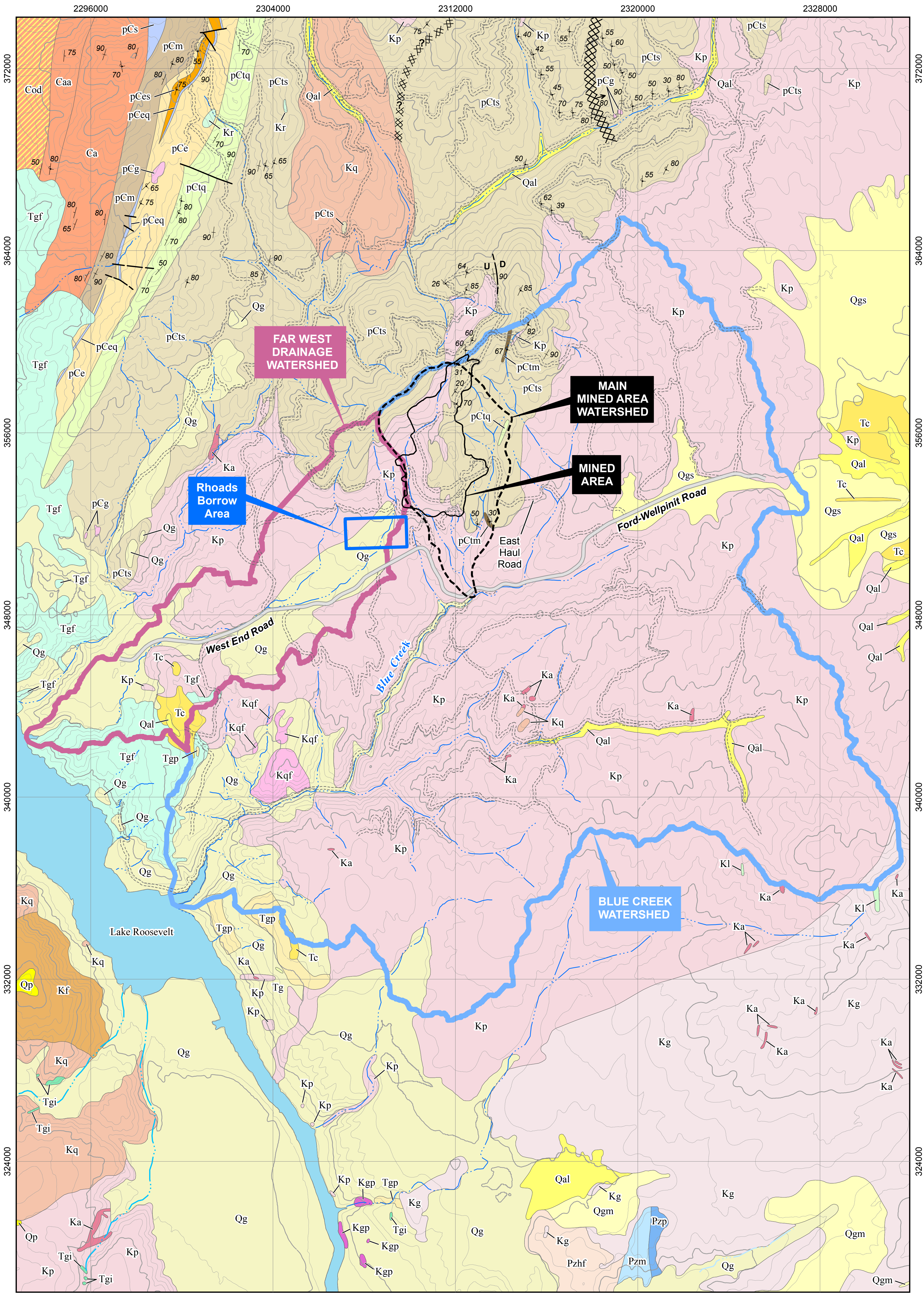
SOURCE: Midnite Mine Record of Decision

Midnite Mine

FIGURE 2-3

HYDROLOGIC BASINS

Fig 2-3_Hydrologic Basins.ai 6 Dec 2013



SOURCE:

USGS Bulletin 1131 Plate 1 - Geologic Map and Sections of the Turtle Lake Quadrangle, Lincoln and Stevens Counties, Washington

Geology by E.L. Boudette and P.L. Weis, 1955, and G.E. Becraft and P.L. Weis, 1956-57

MWH

N W E S

0 2000 4000

Feet

EXPLANATION

Paved road

Dirt road or trail

Existing drainage

See Figure 2-4b for Geologic Map Explanation

Midnite Mine

FIGURE 2-4a

GEOLOGY MAP

QUATERNARY

Recent

Qal — Alluvium

Pleistocene or Recent

Qgm — Glacial moraine
Principally unsorted and unstratified ground moraine; locally water-lain deposits

Qgs — Glacial lake silt

Qg — Glacial deposits undivided
Principally stratified deposits, but include moraine, reworked glacial material, and windblown sand

Pleistocene

Qp — Palouse formation
Grayish-brown to brown loess. Stippled where mixed with glacial gravel

TERTIARY

Miocene

Tc — Columbia River basalt
Black to dark-green or brownish-green fine-grained basalt flows

Oligocene

Tgi — Intrusive rocks equivalent to Gerome andesite
Dominantly porphyritic rhyodacite (?) containing plagioclase phenocrysts in an aphanitic groundmass; locally even grained. Dark to light green; dense. Generally occur as dikes

Tgf — Flows of Gerome andesite
Dense fine-grained gray, greenish-gray, or black rhyodacite. Locally porphyritic, with hornblende or pyroxene phenocrysts

Tgp — Pyroclastic and sedimentary rocks of Gerome andesite
Tuff, crystal tuff, lapilli tuff, tuff-breccia. Local intercalated tuffaceous sandstone, carbonaceous beds; include sparse thin flows of ryodacite

Tg — Gerome andesite undivided

CRETACEOUS

Loon Lake granite

Kr — Intrusive rhyolite
Dense fine-grained white to light-yellowish-gray rock, with scattered, euhedral quartz phenocrysts

Ka — Alaskite, aplite, and pegmatite
Fine-grained light-colored alaskite and aplite dikes, and quartz-feldspar pegmatite dikes containing sparse muscovite or biotite

Kl — Lamprophyre
Fine-grained dark-greenish-gray dike rocks

Kgp — Granite porphyry dikes

Kg — Granodiorite
Massive medium-grained gray rock containing abundant biotite and horneblende

Kp — Porphyritic quartz monzonite
Medium- to coarse-grained gray to pinkish-gray rock with abundant 1- to 2-inch phenocrysts of potassium feldspar; locally, plagioclase and quartz phenocrysts; contains 3 to 5 percent biotite

Kq — Equigranular quartz monzonite
Coarse- to medium-grained, light-gray to light-yellowish gray rock containing 1 to 5 percent biotite

Kf — Fine-grained equigranular quartz monzonite
Light-gray to yellowish-gray rock; contains crystals commonly less than 2 millimeters in size. Biotite commonly less than 6 percent

Kqf — Fine-grained quartz monzonite rich in mafic minerals
Fine-grained gray rocks containing about 15 percent mafic minerals

NORTHERN SECTION

CAMBRIAN

Lower Cambrian

Cod — Old Dominion limestone of Weaver (1920)
White to dark-gray fine-grained limestone; locally recrystallized to coarse, white to gray marble

Cap / Caa / Ca — Addy quartzite

Ca	*massive dense well-cemented white, tan, or reddish quartzite. Generally well sorted, well bedded*
Caa	*light-tan to brown thin-bedded argillite; in zones 75 to 300 feet thick, interlayered with Addy quartzite, locally phyllite; contains thin quartzite layers in places*
Cap	*phyllite, slightly metamorphosed facies of argillitic layers*

UNCONFORMITY

PRECAMBRIAN

pCg — Greenstone
Small dikes and sills of medium-grained dark-greenish-gray altered mafic igneous rocks

Belt Series (?)

pCs — Stensgar dolomite
Predominantly white to light-gray thin-bedded fine- to medium-grained dolomite; contains layers of thin-bedded green or tan calcarious argillite

pCm — McHale slate
Tan, greenish-tan, brown, and gray fine-grained thin-bedded rock, with moderately to well-developed slaty cleavage

pCes / pCe / pCeq — Edna dolomite

pCe	*light-yellow, tan, locally very dark gray ferruginous and calcareous dolomite; commonly fine grained, poorly bedded*
pCes	*dark-gray to black fine-grained thin-bedded to massive argillaceous rock having moderately well developed slaty cleavage, in discontinuousd lensess*
pCeq	*massive medium-grained well-cemented poorly bedded white to gray quartzite, in discontinuous lenses*

pCtq / pCtm / pCts — Togo formation

pCtq	*uppermost part, a persistent gray medium-grained well-centered quartzite layer*
pCts	*dominantly dark-gray thin-bedded slaty argillite and phyllite; locally, spotted phyllite and schist*
pCtm	*local discontinuous lenses of dolomitic marble*
pCtq	*local discontinuous lenses of quartzite*

SOUTHERN SECTION

CAMBRIAN

Pzmp / Pzm / Pzp — Marble and phyllite

Pzmp	*undivided*
Pzm	*gray to white thin-bedded fine- to medium-grained marble*
Pzp	*gray thin-bedded phyllite*

Pzhf — Hornfels
Well-banded green to reddish-brown fine-grained

Pzq — Quartzite
Gray to brown, commonly thin bedded

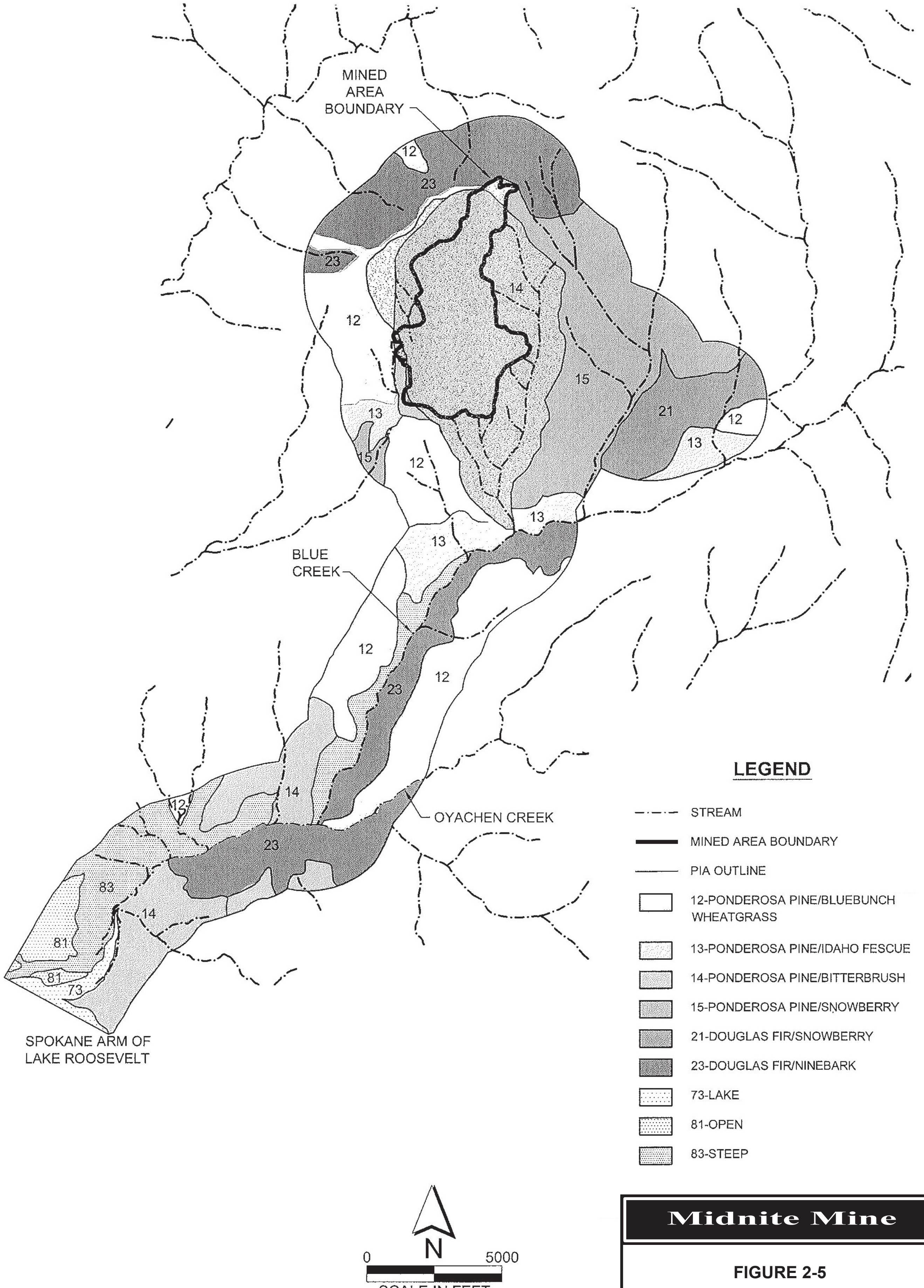
Symbol	Explanation
45	Strike and dip of beds
70	Strike and dip of overturned beds
90	Strike of vertical beds
	Contact
	Fault
	Fault zone
? ?	Probable fault zone

SOURCE:
USGS Bulletin 1131 Plate 1 - Geologic Map and Sections of the Turtle Lake Quadrangle, Lincoln and Stevens Counties, Washington
Geology by E.L. Boudette and P.L. Weis, 1955, and G.E. Becraft and P.L. Weis, 1956-57

Midnite Mine

FIGURE 2-4b

GEOLOGY MAP EXPLANATION



SOURCE: *Midnite Mine Record of Decision*

MWH

Midnite Mine

FIGURE 2-5

HABITAT AREAS