

Midnite Mine Superfund Site
Spokane Indian Reservation
Washington
Record of Decision

Prepared by

**Office of Environmental Cleanup
EPA Region 10**

September 2006

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AEA	Atomic Energy Act
AEC	United States Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
amsl	Above Mean Sea Level
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
ARD	Acid Rock Drainage
Background	Natural Conditions
BDAC	Biota Dose Assessment Committee
BERA	Baseline Ecological Risk Assessment
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
BPA	Backfilled Pit Area
BTAG	Biological Technical Assistance Group
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
COCs	Contaminants of Concern
COPCs	Contaminants of Potential Concern
CIP	Community Involvement Plan
CSFs	Cancer Slope Factors
CSMs	Conceptual Site Models
CTE	Central Tendency Exposure
CURE	Community Uranium, Radiation Education
CWA	Clean Water Act
cy	Cubic Yard
Dawn	Dawn Mining Company

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (Continued)

DOI	United States Department of the Interior
DOJ	Department of Justice
EIS	Environmental Impact Statement
ELG	Effluent Limit Guidelines
EPA	Environmental Protection Agency
EPC	Exposure Point Concentrations
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
ESI	Expanded Site Investigation
FML	Flexible Membrane Liner
FS	Feasibility Study
gpm	Gallons Per Minute
GW	Groundwater
HHRA	Human Health Risk Assessment Report
HI	Hazard Index
HQ	Hazard Quotient
HRS	Hazard Ranking System
HSCA	Spokane Tribe Hazardous Substances Control Act
IC	Institutional Controls
IRIS	Integrated Risk Information System
IRMP	Integrated Resource Management Plan
LOAEL	Lowest Observed Adverse Effect Level
MA	Mined Area
MAA	Mining Affected Area
MBTA	Migratory Bird Treaty Act
MCLs	Maximum Contaminant Levels
MOA	Memorandum of Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NCRP	National Council on Radiation Protection and Measurements

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (Continued)

NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
Newmont	Newmont Mining Company and its corporate successors
NHPA	National Historic Preservation Act
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NURE	National Uranium Resource Evaluation
O&M	Operation and Maintenance
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PCP	Pollution Control Pond
PRBs	Permeable Reactive Barriers
PRPs	Potentially Responsible Parties
PW	Present Worth
RA	Risk Assessment
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RfDs	Published Reference Doses
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
Roosevelt Lake	Franklin D. Roosevelt Lake
SDWA	Safe Drinking Water Act
SED	Sediment
SHAWL	Sovereignty Health Air Water Land
Site	Midnite Mine Superfund Site
SM	Surface Materials

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (Continued)

Spokane Arm	Spokane River Arm
SQG	Sediment Quality Guidelines
SW	Surface Water
T&E	Threatened or Endangered
TEDE	Total Effective Dose Equivalent
THPO	Tribal Historic Preservation Officer
TIR	Total Ionizing Radiation
TOSNAC	Technical Outreach Services for Native American Communities
Tribe	Spokane Tribe of Indians
TRV	Toxicity Reference Values
UCL	Upper Confidence Limit
UMTRCA	Uranium Mill Tailings Radiation Control Act
USFWS	United States Fish and Wildlife Service
UTL	Upper Tolerance Limit
WDOH	Washington Department of Health
WQS	Water Quality Standard
WTP	Water Treatment Plant

PART 1: THE DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

The Midnite Mine Superfund Site (Site) is located on the Spokane Indian Reservation in eastern Washington State, approximately 45 air miles northwest of Spokane. Midnite Mine is an inactive open-pit uranium mine.

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 Environmental Protection Agency (EPA) Identification Number is WA980978753.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the final Selected Remedy for the Midnite Mine Superfund Site. This Record of Decision (ROD) has been developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 USC §9601 et seq., as amended, and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. This decision is based on the Administrative Record for the Midnite Mine Site.

The remedy was selected by the U.S. Environmental Protection Agency. The Spokane Tribe concurs with the Selected Remedy contained in this ROD. In accordance with a 2000 Memorandum of Agreement (MOA) between EPA and Spokane Tribe, EPA provided the Tribe with an opportunity to review the draft ROD and consulted with the Tribe. The Spokane Tribe letter of concurrence is provided in Appendix A.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses all contaminated materials at the Site. This includes surface materials in the Mined Area and mining-affected groundwater, surface water, soils, and sediments.

The Selected Remedy 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 Backfilled Pit Area.
- 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 Backfilled Pit Area 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.
- Following containment, removal of water that enters Pit 3, Pit 4, and the Backfilled Pit Area 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.
- 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, revegetation, 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.

7. Long-Term Site Management:

- Long-term monitoring to assess the effectiveness of the remedy, including physical inspections, revegetation 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.
- Implementation of other enhancements to reduce acid rock drainage (ARD).

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment; complies with requirements that are applicable or relevant and appropriate to the remedial action, except as waived for interim water treatment discharge; is cost-effective; and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The source materials at the Midnite Mine Site are not a principal threat as defined in EPA guidance.

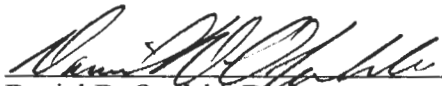
Because the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the ROD. Additional information can be found in the Administrative Record for the Midnite Mine Site.

- Contaminants of concern (COCs) are provided in Section 7.
- Baseline risk represented by the COCs is provided in Section 7.
- Cleanup levels for COCs and the basis for the levels are provided in Section 8.
- Current and future land and groundwater uses are provided in Section 6. Land and groundwater exposure assumptions used in the baseline risk assessment (RA) are provided in Section 7.
- Principal threat waste is discussed in Section 11.
- Estimated capital, annual operation and maintenance (O&M), and total present worth cost estimates, discount rate, and the number of years over which the remedy cost estimates are projected are provided in Section 12.
- Key factors that led to selecting the remedy are provided in Section 12.

AUTHORIZING SIGNATURE


Daniel D. Opalski, Director
Environmental Cleanup Office, Region 10
U.S. Environmental Protection Agency

9/29/2006
Date

PART 2: DECISION SUMMARY

SECTION 1 – SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Midnite Mine Superfund Site (Site) is located on the Spokane Indian Reservation in eastern Washington State, approximately 45 air miles northwest of Spokane (Figure 1-1, Site Location). The Site is located on lands owned by the federal government and held in trust for the Spokane Tribe of Indians (Tribe) and several individual tribal members.

The Environmental Protection Agency (EPA) Identification Number is WA980978753.

The Site includes an inactive open pit uranium mine and areas and media impacted by mine-related contamination. 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.

Remedial actions differ for the “Mined Area” (MA) and the “Mining Affected Area” (MAA). The Mined Area consists of approximately 350 acres of land physically disturbed by active mining which occurred for over 23 years beginning in 1954. The Mining Affected Area encompasses areas and media affected by Mined Area sources, including spilled ore along the haul route, gravel roads at and near the mine, and groundwater, surface water, sediments, and soils. Blue Creek sediments and surface water are part of the Mining Affected Area but are often discussed separately, as the current uses and levels of contamination differ. The MA and MAA areas are shown on Figure 1-2.

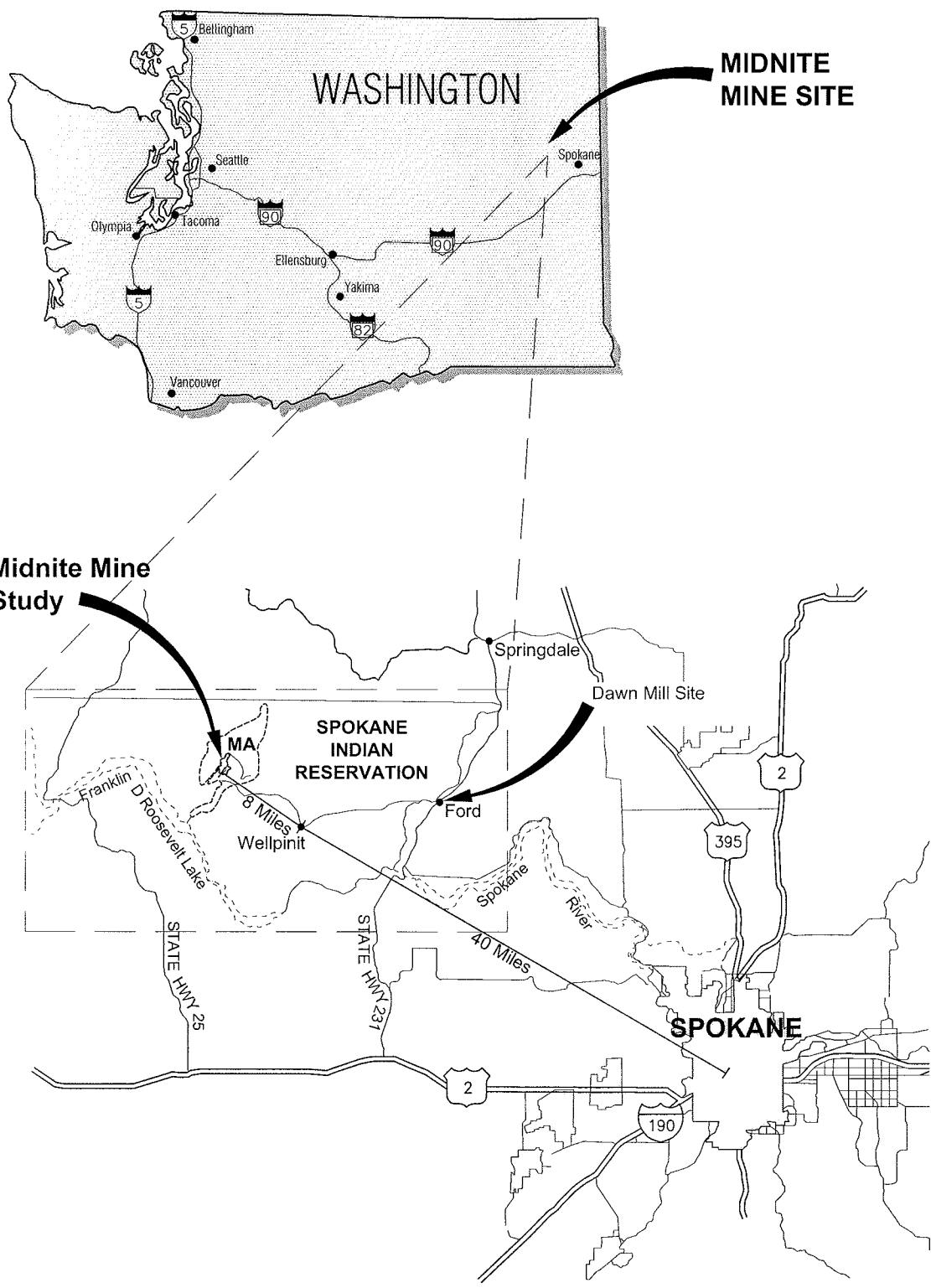
As shown on Figure 1-3, key features of the Mined Area include the following:

- Open mine pits, Pit 3 and Pit 4 (both partially filled with water).
- An area of interconnected pits filled with waste rock (the “Backfilled Pit Area” or BPA).
- Waste rock fill and waste rock piles (the South Spoils, Hillside Dump, and others).
- Seven or more piles of rock stockpiled as ore or “proto-ore” (near ore grade).
- A seep collection and pumpback system and water treatment plant (WTP).
- Mine roads and buildings.
- Surface water conveyances.

As shown on Figure 1-2 the Mining Affected Area includes the following:

- Natural drainages that receive surface water and groundwater flow from the Mined Area.
- Blue Creek, which receives water from the mine drainages and flows to the Spokane River Arm of Franklin D. Roosevelt Lake (the lake formed behind the Grand Coulee dam) (“Spokane Arm”).

EPA is the lead agency for the Site, and the Spokane Tribe of Indians participates as the support agency. The Remedial Investigation and Feasibility Study (RI/FS) and other CERCLA work leading to this ROD were conducted by EPA using federal funds. EPA has identified several Potentially Responsible Parties (PRPs) for the Site and intends to seek PRP performance of or funding for the cleanup.



**Midnite Mine
Study**

**MIDNITE
MINE SITE**

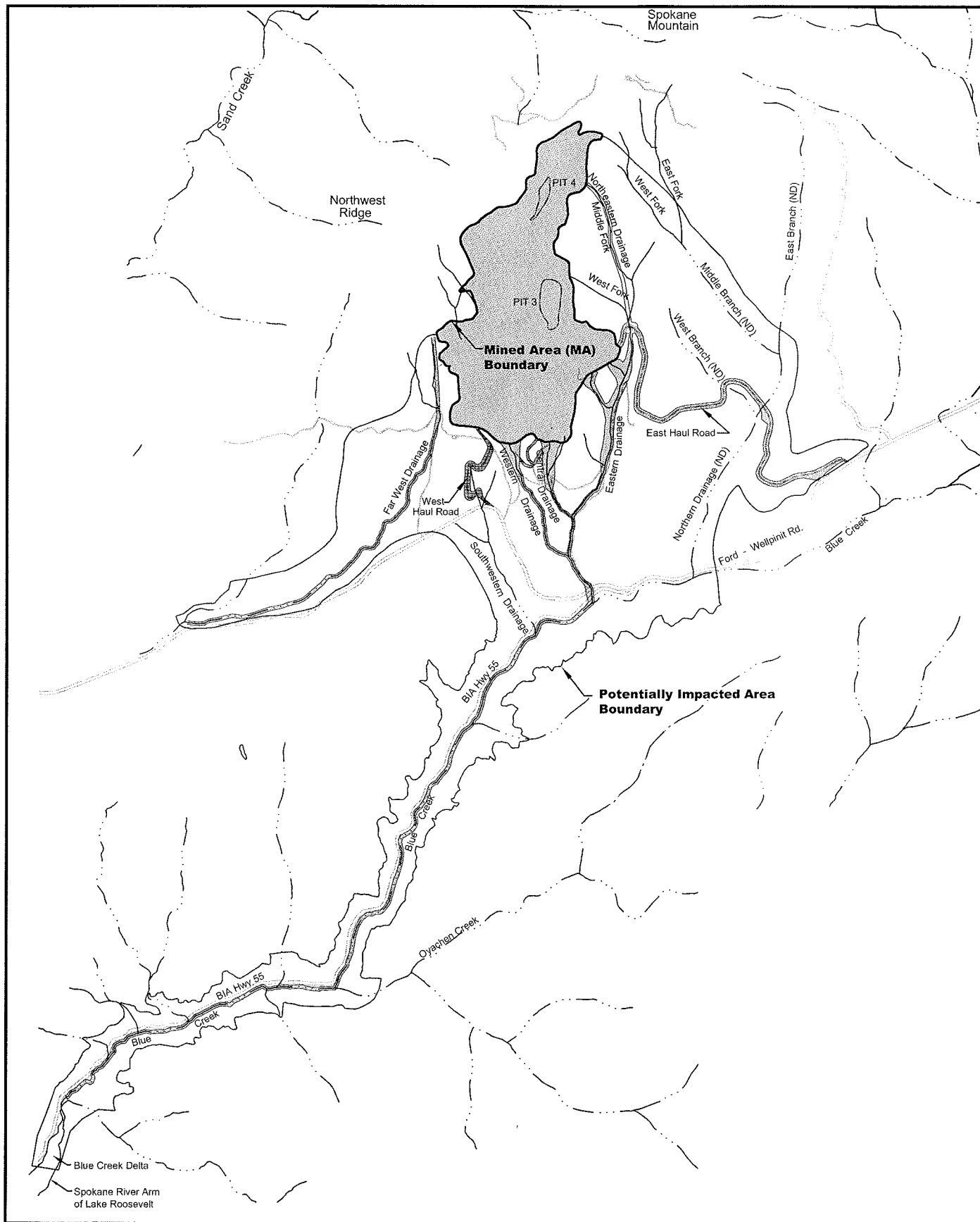
**SPOKANE
INDIAN
RESERVATION**

SPOKANE

DATE: Sep 27, 2006 FILE: PMXRegional Map



**Figure 1-1
Site Location**
Midnite Mine Record of Decision



DATE: Sep 25, 2006 FILE: PMXAaffected Areas

LEGEND

Mined Area Boundary

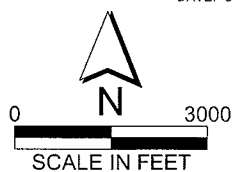
Potentially Impacted Area Boundary

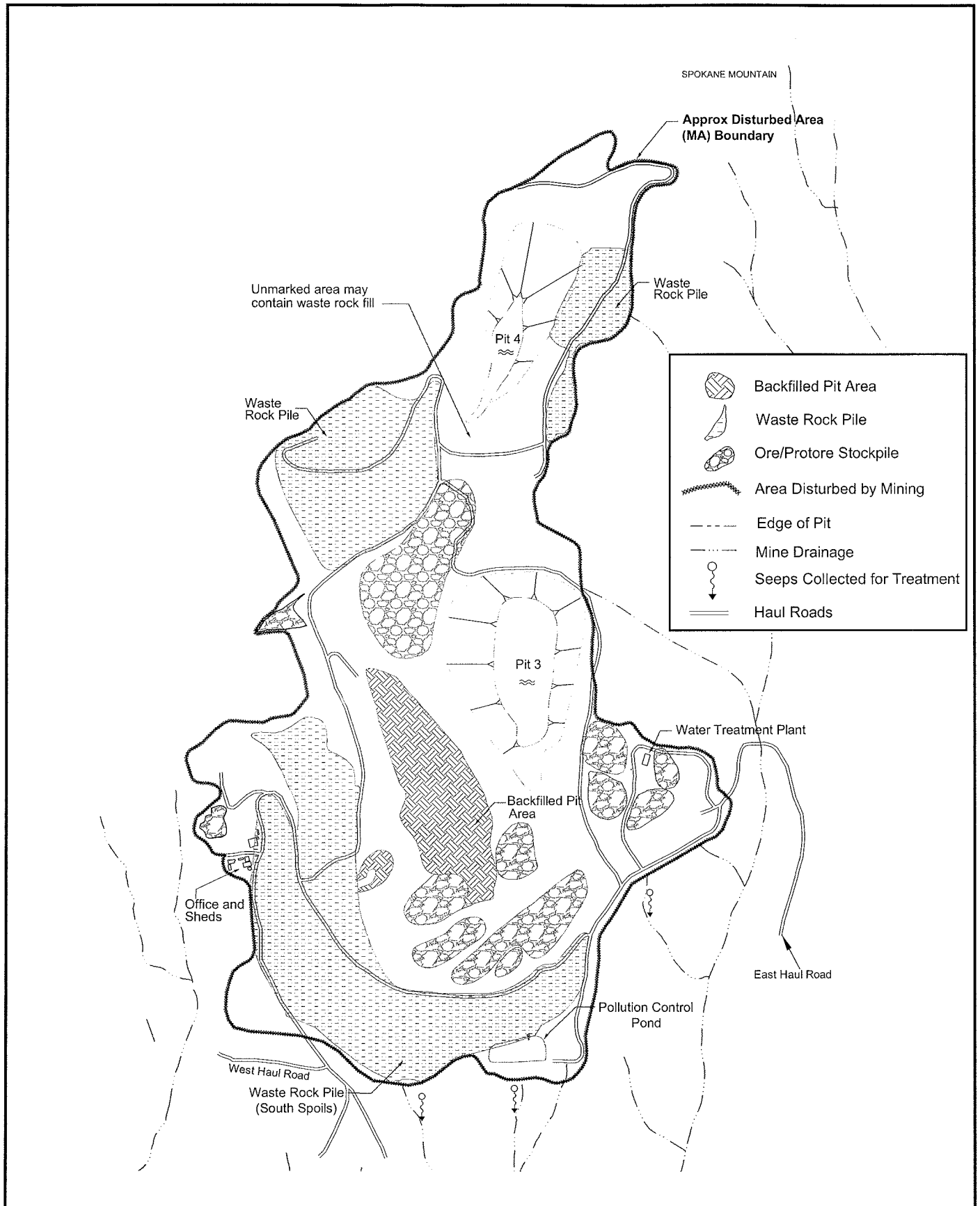
Shaded areas represent the Mined Area (MA) and Mining-Affected Areas (MAA) as defined by the remedial investigation.

Stream

Road

Figure 1-2
Locations of Mined Area
and Mining-Affected Area
 Midnite Mine Record of Decision





DATE: Sep 25, 2006 FILE: PMXMined_Area_Feature

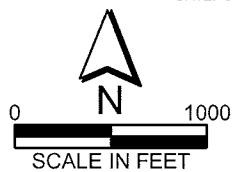


Figure 1-3
Features of the Mined Area
 Midnight Mine Record of Decision

SECTION 2 – SITE HISTORY AND ENFORCEMENT ACTIVITIES

In 1954, Spokane Tribe members and prospectors Jim and John LeBret found uranium in an area of the Spokane Reservation. The LeBret brothers and several other tribal members formed Midnite Mines, Inc. and secured mining leases at the Site. Midnite Mines, Inc. then joined with Newmont Mining Company (Newmont) to create the Dawn Mining Company (Dawn), 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 and continues to be the majority shareholder of Dawn. This ROD refers to Newmont Mining Company and its successors, collectively, as Newmont.

The mine was initially operated from 1954 until 1965, providing uranium under contracts with the United States Atomic Energy Commission (AEC). 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 regulated by a series of United States Department of the Interior (USDO) 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 Spokane Tribe and individual tribal allotment owners in matters related to leases and royalties.

It is reported that approximately 5.3 million tons of ore and proto-ore and 33 million tons of waste rock were removed from nine 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 dumped 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 Midnite Mine ore were hauled off Site and processed at the mill, producing approximately 11 million pounds of “yellowcake” (milled uranium oxide [U₃O₈]). The Dawn Mill is being closed under Washington Department of Health (WDOH) oversight, pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA).

In the late 1970s, contaminated seeps were observed at the toe of the largest waste rock piles at Midnite Mine. Pursuant to a BLM order, Dawn constructed an impoundment (the Pollution Control Pond, or PCP) in 1979 to capture the seeps for evaporation. Following the suspension of mining in 1981, Dawn 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, Dawn performed partial reclamation of the side slopes of the South Spoils (also called the Gully Waste Dump) with approximately eight inches of stockpiled topsoil, which was seeded with a mixture of grasses and planted with trees. Dawn 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; and installation of surface water controls such as a diversion trench, pipes, and runnels. Data collection was also required, and included monitoring of surface 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 keep cattle from contaminated areas.

In 1987, Dawn and EPA entered into a Compliance Order under the Clean Water Act (CWA) that required Dawn to eliminate discharges of pollutants to waters of the United States. In response, Dawn constructed a seep collection and pumpback system to collect water from the Western Drainage and Central Drainage 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 were also collected.

In 1988, Dawn constructed a water treatment plant (WTP) to treat the growing quantities of water in the open pits. A 1991 BLM order required Dawn to dewater the pits in compliance with a National Pollutant Discharge Elimination System (NPDES) permit issued by EPA in 1986 (Permit No. WA-002572-1). In 1992, the WTP began treating water using barium chloride and application of 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 (AEA) license requirements applied. WDOH, under the authority of the Nuclear Regulatory Commission (NRC) Agreement State Program, issued the license (Radioactive Materials License WN-I0390-1) in 1992.

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

In 1991, Dawn 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, Dawn 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 Dawn and Newmont for study and cleanup of the Site in compliance with CERCLA and NEPA requirements. In 1998, negotiations involving the DOI, EPA, and the U.S. Department of Justice (DOJ) led to an interim agreement between DOJ, DOI, Dawn, 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).

Dawn 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 Spokane Tribe support, proposed the Site for the NPL in February 1999.

Negotiations with Dawn in 1999 to conduct a Remedial Investigation/Feasibility Study (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 Dawn Mining for response costs incurred at the Site.

SECTION 3 – COMMUNITY PARTICIPATION

Throughout the RI/FS, EPA sought community participation with a focus on the tribal community. The community involvement plan (CIP), periodically updated, identified ways to reach out to the public. Written site updates were issued at least annually (twice yearly for the first several years), and public meetings occurred with a similar frequency. Meetings were held in Wellpinit, a community on the Spokane Reservation where most of the tribal government and federal agency offices, as well as schools and services, are located. Throughout the RI/FS, key reports were available to the public, both at EPA and the Spokane Tribe Department of Natural Resources.

EPA provided information for inclusion in the Rawhide Press, a monthly publication of the Spokane Tribe. To raise community awareness of Midnite Mine activities, EPA staff often combined trips to the reservation with visits to classrooms and meetings with community members and groups interested in the Site. EPA staff participated in a health fair attended by students, teachers, parents, and others. EPA staff also presented information at several meetings of the Sovereignty Health Air Water Land (SHAWL) Society and Community Uranium/Radiation Education (CURE) community groups.

Through the EPA-funded program for Technical Outreach Services for Native American Communities (TOSNAC), the community groups had access to technical support for reviewing and interpreting technical documents.

EPA issued the Proposed Plan on October 5, 2005. A notice of the availability of the Proposed Plan and Administrative Record was published on October 3, 2005, in the Spokesman Review newspaper. On this date, a complete copy of the Administrative Record was placed in the information repository at the Spokane Tribal College and Community Library on the Spokane Reservation in Wellpinit. A copy is also available at the Superfund Records Center in the EPA Region 10 office in Seattle.

EPA provided an initial 30-day comment period on the Proposed Plan. An extension to the public comment period was requested. In response, EPA extended the comment period by 30 days, to December 7, 2005. On November 2, 2005, several individuals and groups requested additional time for comment, and EPA further extended the comment period to January 18, 2006. Including extensions, the public comment period totaled 105 days.

Public meetings related to the Proposed Plan were held on October 19, 2005, November 2, 2005, and January 18, 2006. At the first meeting, EPA presented the Proposed Plan and informally answered community questions. The latter two meetings were formal hearings, with comments recorded by a court reporter for consideration by EPA. EPA's response to comments received during the public comment period is included in the Responsiveness Summary, which is part of this ROD.

The Selected Remedy in this ROD is based on the Administrative Record for the Midnite Mine Site. The Administrative Record file includes the Proposed Plan, comments and transcripts from formal public hearings, key reports and studies, correspondence, and guidance documents used to support the selection of a response action at the Site, and the ROD.

SECTION 4 – SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The Midnite Mine Superfund Site has two operable units.

- **Operable Unit 1** consists of the Mined Area (areas physically disturbed by mining) and the Mining Affected Area (gravel haul roads at and near the mine and areas of groundwater, surface water, sediments, and soil affected by the environmental transport of mine-related contaminants). EPA completed an RI/FS and Proposed Plan for these areas.
- **Operable Unit 2** (Midnite Mine Haul Route) consists of areas along the paved public road where ore or waste spilled in transit to the mill or was dumped, leading to levels of gamma radiation that posed a risk to human health. In 2004, Dawn performed a removal action under a CERCLA Administrative Order on Consent (AOC). The ore debris excavated by Dawn from areas of public access is staged in Operable Unit 1 with other Midnite Mine waste rock and will be addressed as part of this ROD.

This ROD documents the selection of a final remedy for both Operable Unit 1 and Operable Unit 2, and is the final action for the Midnite Mine Superfund Site.

The ROD addresses soils, groundwater, sediment, and surface water at Operable Unit 1. The Selected Remedy for Operable Unit 1 focuses first on control of contaminant sources, including waste rock, soil, gravel, and sediments in the Mined Area and Mining Affected Area. Access restrictions and continued capture and treatment of contaminated seeps are necessary as interim actions prior to containment of the wastes. Following waste containment, the Selected Remedy calls for monitoring to verify improvements in the quality of groundwater, surface water, and remaining sediments, with temporary institutional controls to protect human health until cleanup objectives are achieved in these areas. The Selected Remedy addresses the need for long-term actions, such as water management (collection and treatment of contaminated water and residuals management), maintenance of the waste containment areas, and permanent institutional controls to protect the integrity of the remedy. The Selected Remedy also identifies potential contingent actions and the circumstances that may trigger such actions.

The ROD addresses Operable Unit 2 soils by incorporating the removal action along the Haul Route by reference into the final remedial action for the Site. The Selected Remedy establishes institutional controls to ensure that future excavation or other ground disturbance along the paved road does not pose unacceptable human health or environmental risks.

In the event that additional areas are discovered that warrant CERCLA response action, EPA may amend the ROD or issue an Explanation of Significant Differences (ESD) to address such areas or may issue a new decision document to implement such actions.

SECTION 5 – SUMMARY OF SITE CHARACTERISTICS

This section provides an overview of the Site and a summary of information used in the RI/FS. This includes descriptions of the conceptual Site model, physical setting, and remedial investigation sampling results, including background levels of contamination. More detailed information is contained in the RI report, which is in the Administrative Record for the Site. See Section 3 for additional information on the Administrative Record.

5.1 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 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 pits, dumped in piles, or used for site grading and road construction.

Mining greatly 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 created ARD by increasing rock surface areas and exposing these surfaces to weathering. Uranium-bearing rock is exposed in open-pit walls and in ore, proto-ore, and waste rock on the ground surface and in previously mined 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.

In summary, the primary sources of contamination are exposed uranium-bearing rock, with the primary release mechanisms being ARD and radioactive decay. Contaminant migration pathways include surface water flow, groundwater flow, wind erosion and deposition, and sediment transport. Potential human 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.

5.2 PHYSICAL CHARACTERISTICS OF THE SITE

5.2.1 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 5-1). The Midnite Mine Superfund Site encompasses areas where physical disturbances caused by mining are apparent (the Mined Area) and areas where media are affected by contaminant transport (the Mining Affected Area).

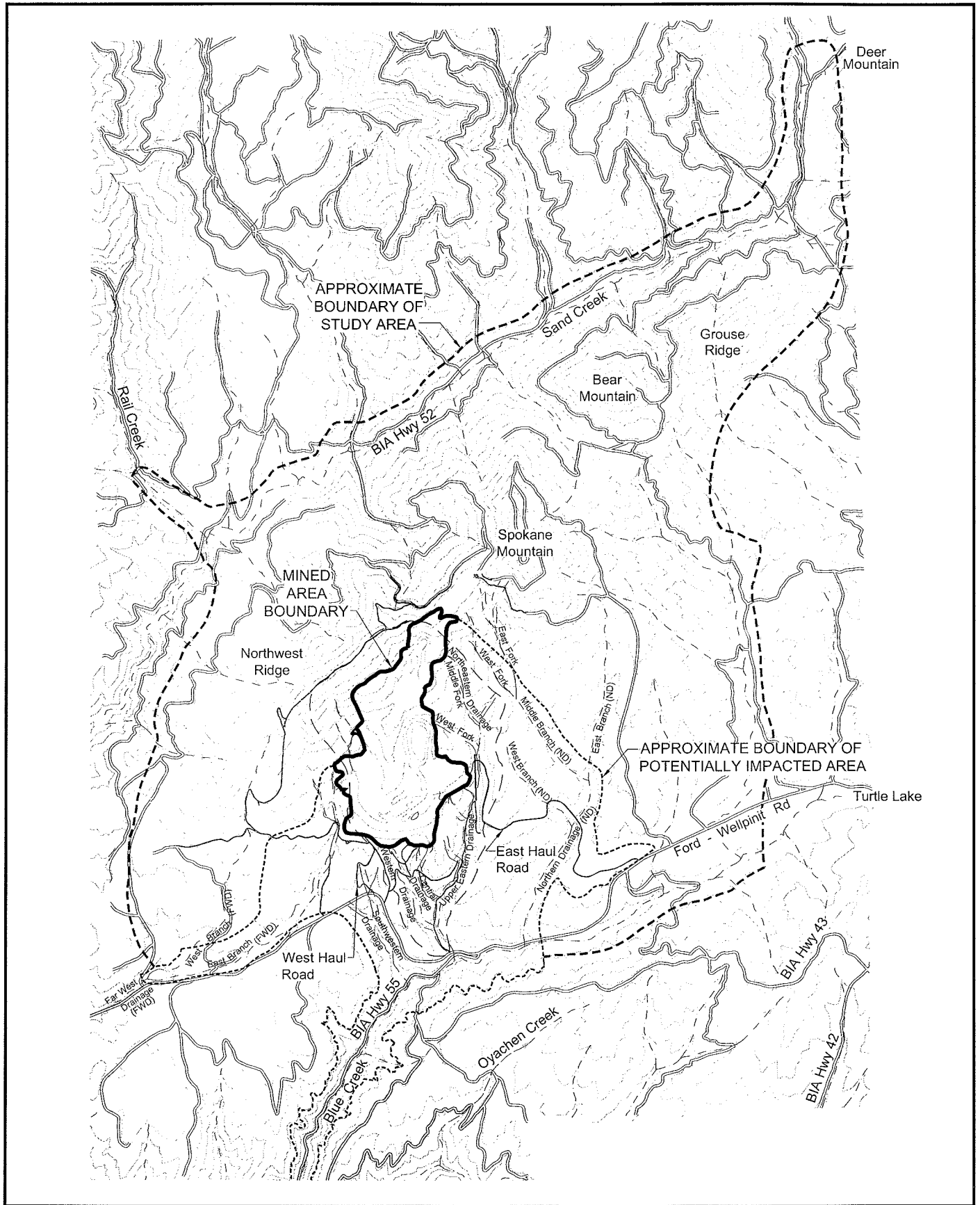
As shown on Figure 1-3, key site features include the following:

- Open mine pits, Pit 3 and Pit 4 (both partially filled with water).
- An area of interconnected pits filled with waste rock (the “Backfilled Pit Area” or BPA).
- Waste rock fill and waste rock piles (the South Spoils, Hillside Dump, and others).
- Seven or more piles of rock stockpiled as ore or “proto-ore” (near ore grade).
- A seep collection and pumpback system and water treatment plant (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 Mined Area.
- Blue Creek, which receives water from the mine drainages.

Waste rock from the mining process was deposited on the Site in piles; dumped into an area of older, interconnected pits (the Backfilled Pit Area); and used to contour the Site and to construct roads. The largest waste rock pile is the South Spoils, located downhill from the open pits (Pit 3 and Pit 4). Contaminated seeps occur at three primary locations at the toe of the South Spoils, where previous surface water drainages emerge from the waste rock fill. The quality of water in the Backfilled Pit Area is very 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.

Potentially ore grade or near-ore grade rocks were stockpiled during the course of mining, including ore-grade rocks that were too high in calc-silicate minerals to mill cost-effectively. Seven discrete stockpiles are located at the surface, and pockets of similar material are reportedly buried in waste rock, including the Backfilled Pit Area.

Two gravel haul roads lead from the Mined Area 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.



DATE: Sep 27, 2006 FILE: PMXLocation Fig5-1

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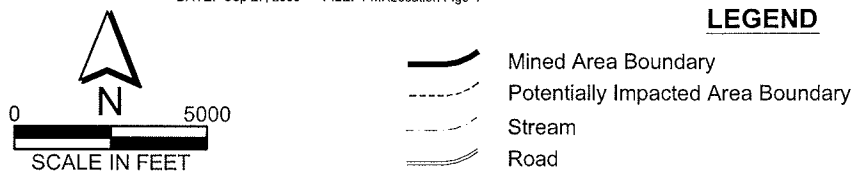


Figure 5-1
Site Setting
Midnite Mine Record of Decision

Three drainages carry surface water from the Mined Area 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 Lake (Roosevelt Lake), the reservoir formed by the Grand Coulee dam. From the point where the combined flow of the mine drainages enters Blue Creek to the Spokane Arm, the creek flows approximately 3.5 miles.

5.2.2 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 5-1). 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 (amsl). 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 Roosevelt Lake, dropping over 600 feet in elevation in this reach.

5.2.3 Meteorology

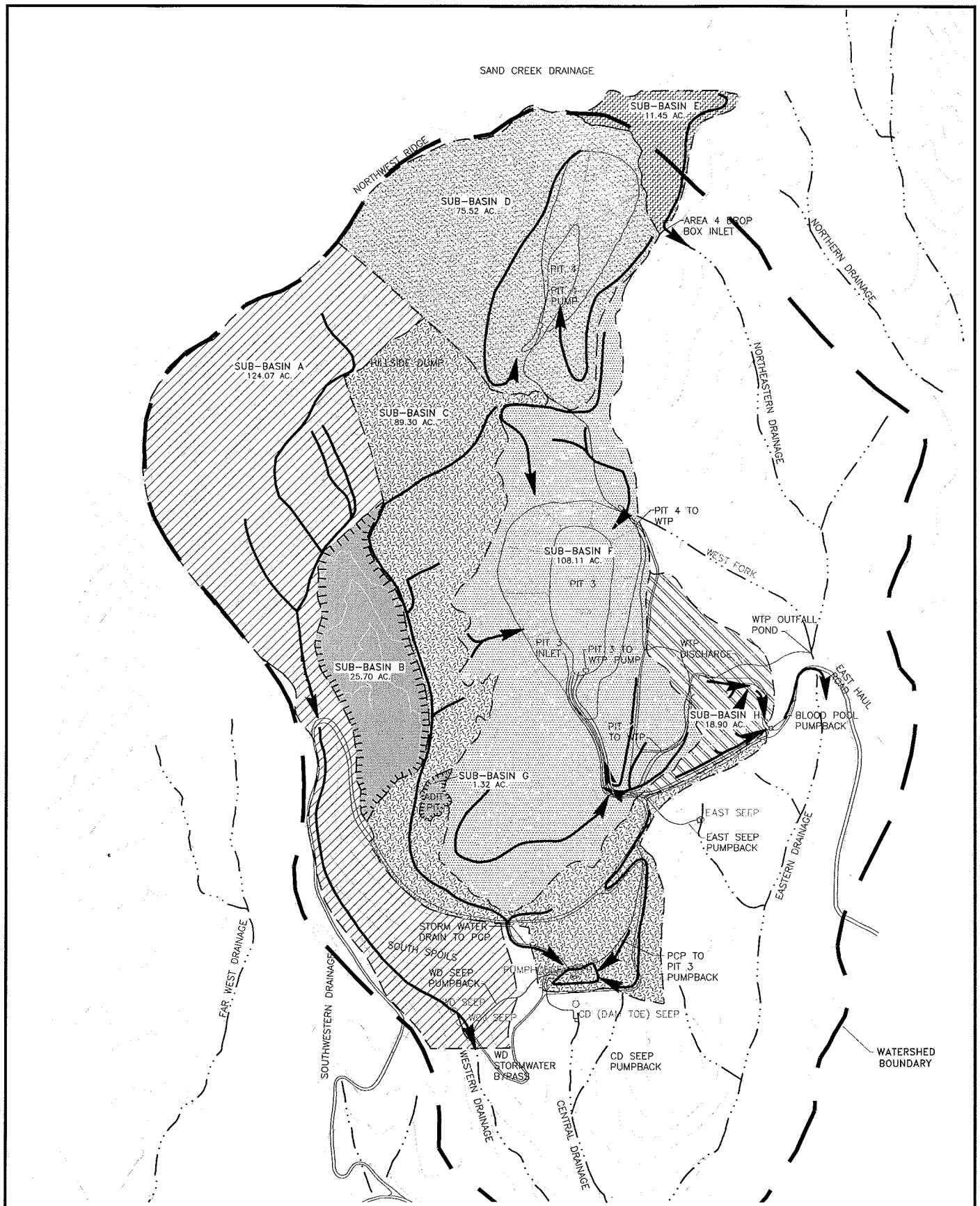
The climate is characterized by warm, dry summers and moderately moist, cold winters. The mean annual temperature is approximately 47 degrees F, with monthly average temperatures ranging from 29.2 degrees F in January to 71.0 degrees F in August.

Average annual precipitation at the Site based on a 9-year period is about 18.5 inches, and monthly average precipitation ranges from about 0.3 inch in August to 2.5 inches in December. Of the total annual precipitation, 40 percent falls in April through September. Average seasonal snowfall is 47 inches, with the highest average monthly snowfall in December (17.9 inches). In an average year, at least 1 inch of snow is on the ground for an average of 38 days. Maximum snow depth during the period of record is 34 inches.

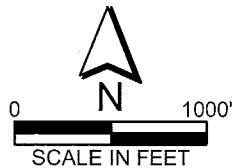
The primary prevailing wind direction at the Site is northeast, and the secondary direction is southwest. The average monthly wind speeds range from 3 to 4.9 mph, with average gust speeds from 8.5 mph (January) to 13.1 mph (July). Based on an on-site evaporation study performed by the mining companies, the estimated lake evaporation is approximately 28.5 inches per year.

5.2.4 Surface Water Hydrology

The watershed that includes the Mined Area currently has eight sub-basins, based on topography and diversion structures (see Figure 5-2). Surface water runoff from two of the sub-basins flows to the PCP and pits, while the other six drain to Blue Creek or (in the case of the Far West Drainage) flow directly to the Spokane Arm. Three primary drainages (Eastern, Western, and Central) drain the majority of the Mined Area. During water treatment plant operations, treated water is discharged to the East Drainage. Apart from this seasonal discharge, flow is minimal or absent during the dry summer months and in frozen periods during the winter. The highest surface flow rates occur in the spring during periods of increased rainfall and snowmelt.



Parametrix DATE: Sep 27, 2006 FILE: PMXHydrologic basins



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- 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

Figure 5-2
Hydrologic Basins
Midnite Mine Record of Decision

Mining operations have significantly altered local hydrology. Upper portions of the three primary drainages were excavated out 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 Mined Area. In other areas, unconsolidated, coarse-grained waste rock, ore, and proto-ore probably 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 pollution control pond (PCP), seep collection systems, pipes and culverts that route Mined Area surface water to the PCP and Pit 3, and ditches that divert upgradient surface water around the Mined Area.

Seeps occur where the Western, Central, and Eastern drainages emerge from the South Spoils waste rock pile. This water is currently captured and pumped back to the PCP and pits for treatment. Starting about 1,500 feet south of the Mined Area, 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. The East Drainage and Blue Creek flow during the dry season is dominated by discharge from the water treatment plant (which currently operates 4 days a week starting in the spring until the minimum allowable pit water elevation is attained). Blue Creek average daily flow measured upstream of the mine drainages ranges from 0.04 to 60 cubic feet per second (cfs) (United States Geological Survey [USGS], 1984–2002).

The 100-year floodplain is constrained by slopes on both sides of Blue Creek. The Mined Area is above the 100-year floodplain, as is the majority of the Mining Affected Area south of the mine. A gravel road along Blue Creek within the floodplain runs from where the mine drainages enter Blue Creek to where the creek enters the Spokane Arm, although a portion of the road is currently washed out.

5.2.5 Geology

The bedrock geologic setting of the Midnite Mine and surrounding area is dominated by once-molten granitic rock and the older metamorphosed sedimentary (meta-sedimentary) rock, known as the Togo Formation, which was intruded by the granitic quartz monzonite body. 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 quartz monzonite intrusion. Mineralized zones are characterized by an increase in grain size, foliation, and iron sulfide abundance. 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 Mined Area, the bedrock is predominantly quartz monzonite, while on the eastern side of the Mined Area, the bedrock consists mostly of Togo Formation rock.

Surficial deposits overlie the bedrock in some areas of the Site and at depths up to 10 feet. 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.

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 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 deeper below the surface.

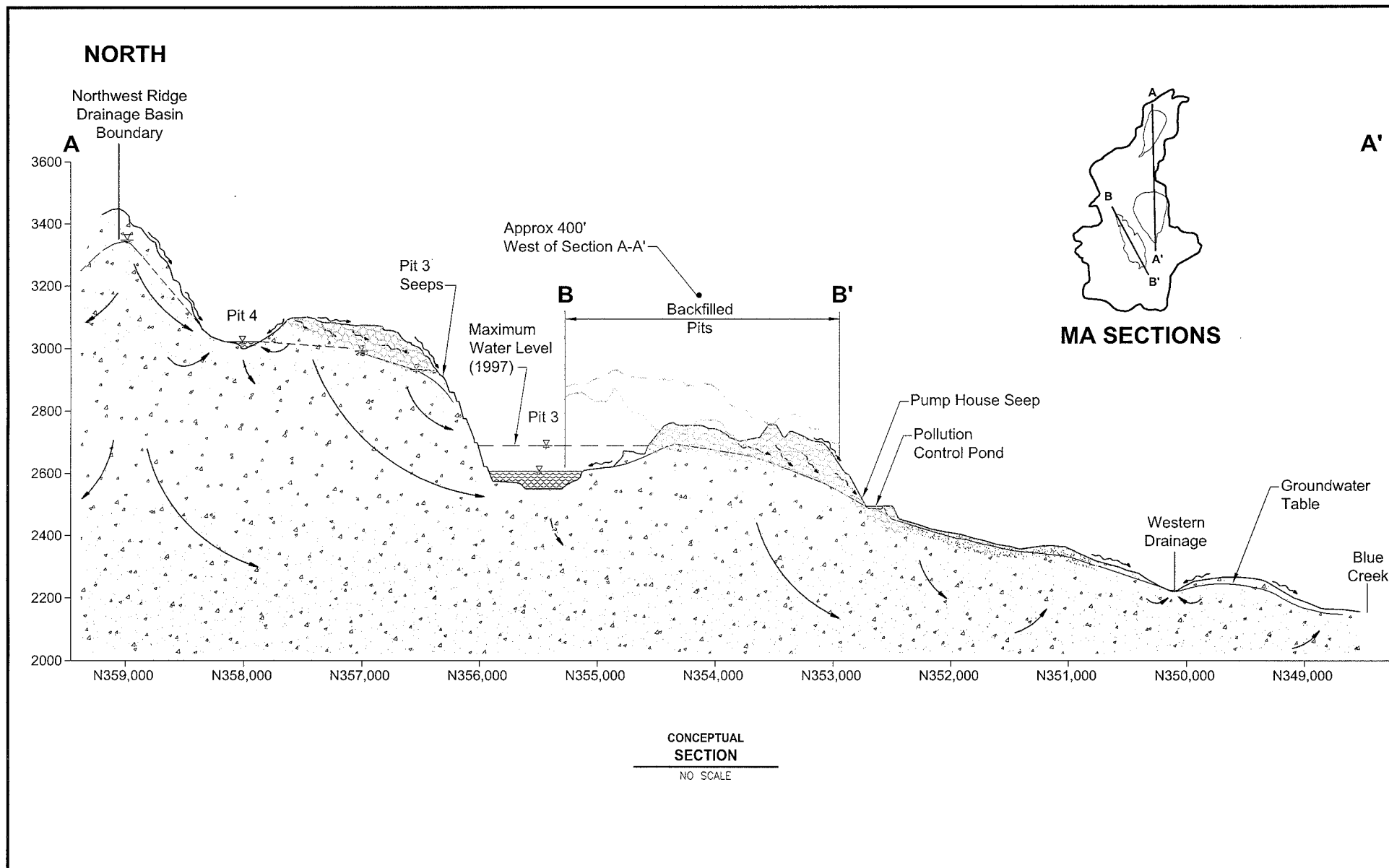
The 1981 National Uranium Resource Evaluation (NURE) identified numerous uranium and other metal anomalies in a study of Midnite Mine and surrounding areas. Some were known ore deposits and others were considered viable as possible areas for mineral exploration. The anomalies were found to occur in both 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. This mine and co-located mill have been closed and reclaimed.

5.2.6 Hydrogeology

Precipitation that does not leave the Site through evaporation, transpiration, or runoff enters the groundwater flow system. Outside the Mined Area, the amount of water entering the groundwater system is estimated at 10 percent of precipitation or less. Within the Mined Area, 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 2002a Phase 1 Hydrologic Modeling Technical Memorandum).

Figure 5-3, shows a conceptual model of the Site hydrology. 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. 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, which act as sinks when pit water levels are below bedrock groundwater elevations nearby.

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.



DATE: Sep 27, 2006 FILE: PMXHydro-Concept-Model

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- | | | | |
|---|--|---|----------------------------|
| --- Groundwater table,
dashed where inferred | ~ Schematic groundwater flow lines | Surface Water | Fractured Bedrock |
| ... Backfilled pit Subwaste boundary | ~ Schematic interflow and runoff paths | Mine Waste
(Ore, Proto-Ore,
Waste Rock) | Native Surficial Materials |
| ... Backfilled pit Surface boundary | — Existing Grade | | |

Figure 5-3
Site Hydrology-
Conceptual Model
Midnite Mine Record of Decision

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 downward and 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 Spoils 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 fractured and thus has higher hydraulic conductivity than the unweathered bedrock. Increased conductivity is also likely in the contact zone between the Togo Formation and 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 below the Central Drainage where it surfaces at the toe of the waste rock pile.

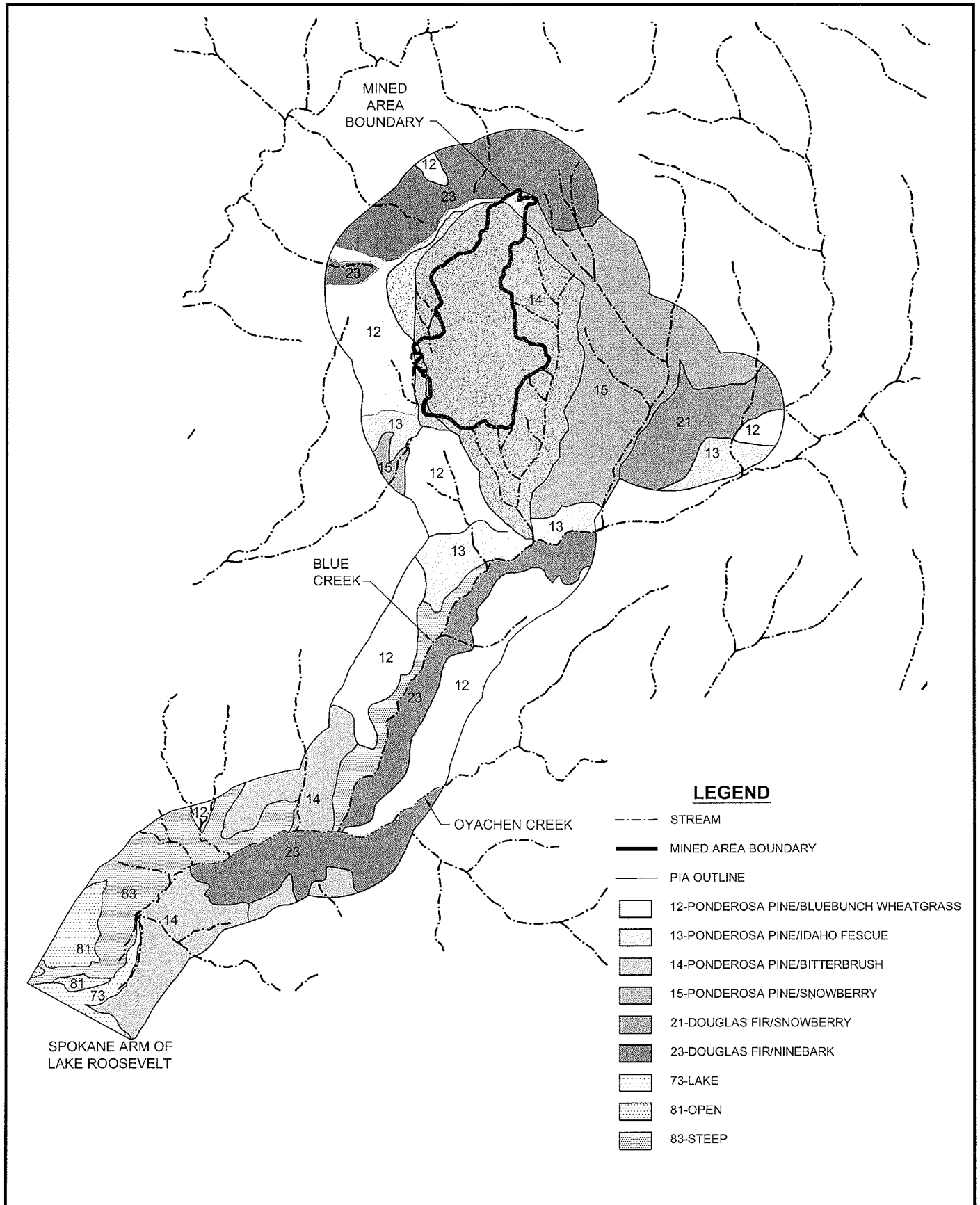
Average annual pit recharge from groundwater is estimated at 7.9 gallons per minute (gpm) for Pit 4 and 16.5 gallons per minute for Pit 3. Average water volumes entering the pits due to direct precipitation into the open pits are estimated at 22 million gallons per year for Pit 3 and 13 million gallons per year for Pit 4 (Phase I Hydrologic Modeling for Midnite Mine RI/FS, URS 2002).

5.2.7 Ecological Setting

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 5-4.

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 Mined Area 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.

Areas of riparian and wetland habitat are limited at the Site, occurring as a narrow band on the banks of Blue Creek and as small isolated areas associated with seeps within the mine drainage. These areas provide important habitat and environmental resources (food, cover, and water) to the area.



DATE: Sep 27, 2006 FILE: PMXHabitat Types

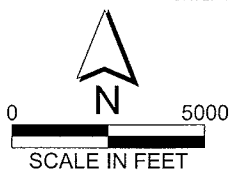


Figure 5-4
Habitat Areas
Midnite Mine Record of Decision

Aquatic habitat includes poor quality water in the open pits and other surface water impoundments in the Mined Area, as well as surface water in the mine drainages and Blue Creek. The banks and low-lying areas bordering the mine drainages and Blue Creek are riparian habitats which provide food, cover, and travel routes for a diversity of wildlife. An area along the East Drainage between the haul road crossing and Blue Creek is wetland habitat, characterized by saturated soils and the presence of grasses, cattail, bulrush, and dogwood species.

Much of the Blue Creek basin is a designated wildlife management area, and the Mined Area 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.

Existing or former habitat at the Site may be (or may have been) used by species which are listed as threatened or endangered (T&E) species or are candidates for listing under the Endangered Species Act. Threatened and endangered species potentially at the Site include the following: Bald eagle, grizzly bear, lynx, woodland caribou, gray wolf, bull trout, rainbow trout (steelhead), kokanee salmon (sockeye), and Ute ladies' tresses.

5.3 SUMMARY OF REMEDIAL INVESTIGATION

EPA initiated the Remedial Investigation and Feasibility Study (RI/FS) in February 1999. A number of plans, technical memoranda, and reports were developed during the RI/FS. The Midnite Mine Remedial Investigation Report (2005) provides greater detail on subjects summarized below.

EPA incorporated existing data and gathered additional data needed to support the RI/FS. Extensive post-mining data had already been obtained for the Mined Area and Blue Creek in previous studies and monitoring performed by the mining companies, the Department of Interior (BIA, BLM, BOM, and USGS), and EPA. Additional data were received as Dawn and Newmont reported the results of sampling under the 1998 Interim Agreement. EPA incorporated existing studies into the RI/FS as appropriate.

Midnite Mine is located in a mineralized region with a wide range of naturally occurring metals and radionuclide concentrations in rock and, consequently, in soils, sediments, and water. The local area was prospected and surveyed for uranium and other deposits, and several mines have been developed in the region. In the absence of data characterizing pre-mining site conditions, the determination of mine impacts was based on a comparison of media concentrations in areas potentially affected by Midnite Mine to those in similar but un-impacted nearby areas, or "background" (see Section 5.3.1 below).

The RI characterized the Mined Area and potentially impacted areas downstream, down-gradient, and downwind of the Mined Area, as well as background reference areas.

Media characterized include surface and subsurface materials (including soil and rock), surface water, sediment, and groundwater. These media were analyzed for concentrations of metals and radionuclides related to uranium mineralization (uranium-238, uranium-235, and thorium-232).

Groundwater analyses included organic compounds related to potential fuel spills. Measurements also included gamma radiation, airborne radon, radon flux, and slope stability.

Information developed in the RI was used to complete both human health and ecological risk assessments. The summaries of the risk assessments are included in Section 7 of this ROD. The sampling results for each of the media at the Site are summarized in the following sections.

5.3.1 Comparison to Background

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 upstream 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. For soils, radon, and gamma radiation, EPA sampled areas northeast of Midnite Mine, including an area of subsurface uranium deposits. Monitoring wells were installed in alluvium and bedrock to characterize background groundwater in these areas.

The basis for the use of these areas and the results of the statistical evaluations of the background data are provided in the RI/FS and technical memoranda, including the following:

- Statistical Approach for Discrimination of Background and Impacted Areas for Midnite Mine RI/FS (10/05/01).
- Draft Technical Memorandum for Suitability of Background Sampling Used to Establish Site Impacts (8/21/03).
- The Technical Memorandum – Evaluation of NURE Data with Respect to the Background Characterization Sampling Locations Selected for the Midnite Mine RI/FS (Remedial Investigation/Feasibility Study) Project (10/11/01).
- Draft Technical Memorandum: Background Statistical Analyses in Support of Nature and Extent of Contamination for the Midnite Mine RI/FS (8/16/02).

EPA used indicator contaminants for the statistical comparison to background (natural conditions). Indicators were selected based on existing site data, ARD chemistry, and correlations among the analytes. Ten indicators or more were selected by media and included indicator radionuclides, metals, and ARD products such as sulfate (see Table 5-1). The statistical comparison compared individual sample data to statistical background limits. Two statistical background limits were developed for this purpose, background limits and retest background limits (see Table 5-2 and Table 5-3). Based on a sample-by-sample comparison of indicator parameters, EPA identified areas affected by mining for purposes of the risk assessment. For each affected area, exposure point concentrations (see Section 7) were calculated.

Table 5-1. Indicator Parameters by Media

Analyte	Surface Water	Sediment	Groundwater	Surface Material
Aluminum			○	●
Arsenic				●
Antimony	○		○	
Cadmium	○	●		●
Chromium	○	●	○	●
Cobalt		●	○	
Copper				●
Iron			○	
Lead		●		●
Lead-210				●
Manganese		●	○	●
Nickel	○	●	○	
Polonium-210		●		
Radium-226	●	●		●
Selenium				●
Uranium-234			●	
Uranium-238	●	●		●
Vanadium	○			
Zinc	○		○	●
Nitrate	●			
Sulfate	●	●	●	

Notes: ○ = Analysis for dissolved analyte.

● = Analysis for total analyte.

Table 5-2. Background Limits and Retest Background Limits Summary Statistics for Surface Water and Groundwater

From May 2002 (Draft) Technical Memorandum, Background Statistics for Midnite Mine RI/FS

Round	Parameter	N ^a	ND ^b	Statistical Minimum	Report Minimum ^c	Report Maximum	Distribution	Background Limit ^d	Retest Background Limit ^e	Units	HHRA ^f 95% UTL ^g	Units
1	Dissolved Antimony	38	34	1.0 x 10 ⁻⁵	<0.1	1.4	LN ^h	6.1	0.6	µg/L ⁱ	2.3	µg/L
1	Dissolved Cadmium	38	35	7.7 x 10 ⁻⁸	<0.2	9.2	NP ^j	9.2	9.2	µg/L	0.50	µg/L
1	Dissolved Chromium	38	37	0.40	<0.4	0.63	NP	0.60	0.60	µg/L	0.63	µg/L
1	Dissolved Nickel	38	38	0.50	<0.5	5.0	NP	5.0	5.0	µg/L	1.4	mg/L
1	Dissolved Vanadium	38	33	0.014	<0.5	3.3	LN	3.7	1.4	µg/L	2.4	µg/L
1	Dissolved Zinc	38	28	0.026	<0.3	13.6	NP	14	14	µg/L	13	µg/L
1	Nitrate	38	23	2.0 x 10 ⁻⁴	0.020	2.98	LN	1.6	0.30	mg/L ^k	0.020	mg/L
1	Radium-226	18	0	0.094	0.094	1.81	NP	1.8	1.8	pCi/L	1.8	pCi/L
1	Sulfate	38	0	1.8	1.8	30	LN	38	22	µg/L	8.8	µg/L
1	Uranium-238	38	1	0.049	<0.049	5.5	LN	12	4.4	pCi/L	7.6	pCi/L
2	Dissolved Antimony	19	15	1.3	<2.7	5.8	LN	7.5	5.3	µg/L	2.3	µg/L
2	Dissolved Cadmium	19	19	0.50	<0.50	0.50	NP	0.5	0.50	µg/L	0.50	µg/L
2	Dissolved Chromium	19	12	0.19	<1.1	3.2	LN	5.1	2.8	µg/L	0.63	µg/L
2	Dissolved Nickel	19	17	0.84	<0.90	1.4	NP	1.4	1.4	µg/L	1.4	µg/L
2	Dissolved Vanadium	19	4	0.52	<1.0	7.6	LN	11	6.1	µg/L	2.4	µg/L
2	Dissolved Zinc	19	2	0.40	<0.40	8.6	LN	18	8.9	µg/L	13	µg/L
2	Nitrate	17	9	6.7 x 10 ⁻³	<0.030	0.094	LN	0.20	0.10	mg/L	0.020	mg/L
2	Radium-226	19	0	0.13	0.13	4.4	NP	4.4	4.4	pCi/L	1.8	pCi/L
2	Sulfate	19	0	2.4	2.4	8.4	LN	9.4	7.0	mg/L	8.8	mg/L
2	Uranium-238	19	0	0.056	0.056	2.8	LN	9.5	4.1	pCi/L	7.6	pCi/L

(Table Continues)

Table 5-2. Background Limits and Retest Background Limits Summary Statistics for Surface Water and Groundwater (Continued)

From May 2002 (Draft) Technical Memorandum, Background Statistics for Midnite Mine RI/FS

Round	Parameter	N ^a	ND ^b	Statistical Minimum	Report Minimum ^c	Report Maximum	Distribution	Background Limit ^d	Retest Background Limit ^e	Units	HHRA ^f 95% UTL ^g	Units
1	Dissolved Aluminum	56	25	0.097	<3.9	3,800	LN	15	2.76	µg/L	5,200	µg/L
1	Dissolved Antimony	56	40	1.8 x 10 ⁻³	<0.10	5.2	LN	8.3	2.0	µg/L	3.9	µg/L
1	Dissolved Chromium	56	29	0.062	<0.40	12	LN	20	7.8	µg/L	12	µg/L
1	Dissolved Cobalt	56	47	0.014	<0.50	7.2	LN	7.8	2.7	µg/L	4.5	µg/L
1	Dissolved Iron	56	15	0.49	<8.4	28,000	LN	170	20	µg/L	55,000	µg/L
1	Dissolved Manganese	56	0	1.0	1.0	1,900	NP	1.3	1,900	µg/L	1,900	µg/L
1	Dissolved Nickel	56	33	0.16	<0.50	14	NP	14	14	µg/L	14	µg/L
1	Dissolved Zinc	56	24	0.089	<0.30	180	NP	180	180	µg/L	180	µg/L
1	Sulfate	56	0	0.87	0.87	190	LN	190	77	mg/L	120	mg/L
1	Uranium-234	56	0	0.11	0.11	37	LN	66	21	pCi/L	37	pCi/L

^a N = Number of samples

^b ND = Number of nondetects

^c < Indicates less than report minimum

^d Background Limit (99% upper tolerance limit)

^e Retest Background Limit (95% upper prediction limit)

^f HHRA = Human Health Risk Assessment Report

^g UTL = Upper Tolerance Limit

^h LN = Lognormal

ⁱ µg/L = Micrograms per liter

^j NP = Non Parametric

^k mg/L = Milligrams per liter

^l pCi/L = PicoCuries per liter

Table 5-3. Background Limits and Retest Background Limits Summary Statistics for Surface Material and Sediment

From May 2002 (Draft) Technical Memorandum, Background Statistics for Midnite Mine RI/FS

Matrix Type	Parameter	N ^c	ND ^d	Report Minimum ^e	Report Maximum	Distribution	Background Limit ^f	Retest Background Limit ^g	Units	HHRA ^h 95% UTL ⁱ	Units
SS	Aluminum	40	0	8,200	24,000	NP ^j	24,000	24,000	mg/kg ^k	18,000	mg/kg
SS	Arsenic	40	4	0.18	230	NP	230	230	mg/kg	86	mg/kg
SS	Cadmium	40	0	0.090	0.45	NO ^j	0.44	0.47	mg/kg	0.32	mg/kg
SS	Chromium	40	0	3.6	18	NO	18	19	mg/kg	18	mg/kg
SS	Copper	40	0	4.6	42	NP	42	42	mg/kg	42	mg/kg
SS	Lead	40	0	7.4	21	LN ^m	20	22	mg/kg	13	mg/kg
SS	Lead-210	40	0	1.1	11	LN	7.5	8.6	pCi/g ⁿ	7.7	pCi/g
SS	Manganese	40	0	250	1,600	NO	1,400	1,500	mg/kg	1,400	mg/kg
SS	Radium-226 Calculated	40	0	1.3	8.9	NP	8.9	8.9	pCi/g	4.7	pCi/g
SS	Selenium	40	37	0.043	0.52	NP	0.52	0.52	mg/kg	0.52	mg/kg
SS	Uranium-238	40	0	0.78	15	NP	15	15	pCi/g	43	mg/kg
SS	Zinc	40	0	17	62	NO	65	68	mg/kg	51	mg/kg
SB	Aluminum	16	0	7,700	17,000	NO	18,000	19,000	mg/kg	17,000	mg/kg
SB	Arsenic	16	0	0.78	86	NP	86	86	mg/kg	86	mg/kg
SB	Cadmium	16	16	0.030	0.32	NP	0.32	0.32	mg/kg	0.32	mg/kg
SB	Chromium	16	0	2.8	15	LN	21	23	mg/kg	16	mg/kg
SB	Copper	16	0	4.9	36	LN	56	61	mg/kg	36	mg/kg
SB	Lead	16	0	8.2	12	LN	13	13	mg/kg	12	mg/kg
SB	Lead-210	16	0	1.2	5.1	LN	7.7	8.2	pCi/g	5.7	pCi/g
SB	Manganese	16	0	380	1,300	LN	1,400	1,500	mg/kg	1,200	mg/kg
SB	Radium-226 Calculated	16	0	1.4	3.9	LN	4.7	4.9	pCi/g	3.8	pCi/g
SB	Selenium	16	13	0.22	0.56	NP	0.56	0.56	mg/kg	0.11	mg/kg
SB	Uranium-238	16	0	0.83	14	NP	14	14	pCi/g	43	mg/kg
SB	Zinc	16	0	27	45	NO	51	51	mg/kg	46	mg/kg

(Table Continues)

Table 5-3. Background Limits and Retest Background Limits Summary Statistics for Surface Material and Sediment (Continued)

From May 2002 (Draft) Technical Memorandum, Background Statistics for Midnite Mine RI/FS

Matrix Type	Parameter	N ^c	ND ^d	Report Minimum ^e	Report Maximum	Distribution	Background Limit ^f	Retest Background Limit ^g	Units	HHRA ^h 95% UTL ⁱ	Units
ES	Cadmium	22	2	<0.020	0.69	LN	1.0	1.2	mg/kg	1.0	mg/kg
ES	Chromium	22	0	1.1	23	NO	28	29	mg/kg	23	mg/kg
ES	Cobalt	22	0	0.92	14	LN	29	33	mg/kg	14	mg/kg
ES	Lead	22	0	2.9	20	NO	21	22	mg/kg	21	mg/kg
ES	Manganese	22	0	98	1,400	LN	1,700	2,000	mg/kg	1,200	mg/kg
ES	Nickel	22	0	0.72	26	NO	27	28	mg/kg	23	mg/kg
ES	Polonium-210	22	0	0.60	10	LN	18	21	pCi/g	17	pCi/g
ES	Radium-226	22	0	0.95	8.5	LN	21	23	pCi/g	13	pCi/g
ES	Sulfate	22	0	0.66	190	LN	330	480	mg/kg	290	mg/kg
ES	Uranium-238	22	0	0.98		LN	56	71	pCi/g	93	mg/kg
CS	Cadmium	22	3	<0.020	0.68	LN	1.0	1.2	mg/kg	1.0	mg/kg
CS	Chromium	22	0	1.4	22	NO	23	24	mg/kg	23	mg/kg
CS	Cobalt	22	0	0.91	13	NO	14	15	mg/kg	14	mg/kg
CS	Lead	22	0	4.0	21	LN	25	27	mg/kg	21	mg/kg
CS	Manganese	22	0	89	870	LN	1,200	1,300	mg/kg	1,200	mg/kg
CS	Nickel	22	0	0.89	24	NO	23	25	mg/kg	23	mg/kg
CS	Polonium-210	22	0	0.70	18	LN	17	21	pCi/g	17	pCi/g
CS	Radium-226	22	0	1.4	8.2	LN	13	15	pCi/g	13	pCi/g
CS	Sulfate	22	0	1.1	170	LN	290	400	mg/kg	290	mg/kg
CS	Uranium-238	22	0	0.79	22	LN	31	38	pCi/g	93	mg/kg

^a SB = 5–20 centimeter sample interval.

^b SS = 0–5 centimeter sample interval.

^c N = Number of samples.

^d ND = Number of nondetects.

^e < indicates less than report minimum.

^f Background Limit (99% upper tolerance limit).

^g Retest Background Limit (95% upper prediction limit).

^h HHRA = Human Health Risk Assessment Report.

ⁱ UTL = Upper Tolerance Limit.

^j NP = Non Parametric.

^k mg/kg = Milligrams per kilogram.

^l NO = Normal.

^m LN = Lognormal.

ⁿ pCi/g = PicoCuries per kilogram.

^o CS = Composite Sample.

^p ES = Grab Sample.

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% upper tolerance limit (UTL) of background, a value used as a threshold for selection of contaminants to evaluate in the human health risk assessment. The 95% 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% UTL is frequently used as a background level for purposes of site cleanup. The 95% 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. The 95% UTL background levels of radiation and radon gas are 22.3 $\mu\text{R/hr}$ and 14 pCi/L , respectively (Human Health Risk Assessment 2005).

5.3.1.1 Uncertainties in Background

Quantitative data regarding the spatial distribution of naturally-occurring metals and radionuclides in surface water, groundwater, sediments, surface materials, plants, and air were not obtained at Midnite Mine or nearby areas before mining began. Consequently, for remedial decision-making purposes, conditions in comparable reference areas (“background”) are used to estimate pre-mining conditions at and near Midnite Mine.

Background levels were used to delineate the nature and extent of contamination, identify contaminants of potential concern for a site, define exposure areas for risk assessment, and in some cases to estimate areas and cleanup levels for remediation. Estimates of background are of particular importance at mining sites, where constituents present in rock at the site prior to mining are mobilized, concentrated, and redistributed due to mining activities and subsequent release and transport mechanisms.

Sample data can only approximate the actual distribution of COC concentrations in site and background media. Where concentrations are naturally variable, the distribution of concentrations in the sample data may not encompass the true range of conditions.

Selection of different areas to represent background conditions or collection of additional or different samples in the selected area could have resulted in different estimates of background. However, the effect of such differences would most likely affect only areas where contaminant concentrations are near background levels rather than the more highly contaminated areas of the Site. As required by CERCLA, EPA is focusing on areas where, despite natural variability, the data demonstrate that mining impacts have occurred and that the associated risks to human health and the environment warrant response actions.

5.3.2 Nature and Extent of Contamination

The following section presents the range of concentrations for key indicator contaminants in different areas and media.

5.3.2.1 Surface Materials

The waste rock, ore, and proto-ore piles are of variable size and, particularly for the waste, contain a mixture of rock type. Although shallow trenching indicates that near-surface materials are oxidized, waste pile seeps with low pH, high sulfates, and elevated contaminant levels indicate ongoing ARD in the Mined Area.

Table 5-4 shows the range of concentrations of contaminants of concern measured in the Mined Area and along the haul roads. Uranium concentrations of up to 482 mg/kg were measured in the Mined Area, as compared to a 95% 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 piles under current conditions, although the analyses indicated the potential for shallow slope failures in limited areas (such as above the pollution control pond), particularly following heavy rains or seismic events.

Table 5-4. Concentrations of COCs in Surface Materials and the 95% UTL Background Level					
Constituent	Units	95% UTL Background	Range of COC Concentrations		
			Mined Area	East and West Haul Roads	Areas Adjacent to East and West Haul Roads
Total Inorganics					
Uranium	mg/kg	43	12.6–482	72.7–262	6.98–93
Radionuclides					
Lead-210	pCi/g	7.5	20–260	10.6–70	<1.2–41.9
Radium-226	pCi/g	4.7	0.074–880	15.4–35.4	11.5–59
Notes: Bolded values indicate maximum value exceeds background as determined in the RI.					

5.3.2.2 Sediments

Samples were taken of sediments in Pit 3 and Pit 4, the PCP and other impoundments, and from drainage and stream channels and banks. Sediment concentrations ranged widely, but the highest concentrations of contaminants of concern in sediments were measured in the open pits, PCP, and mine drainages, with generally lower concentrations in Blue Creek. Table 5-5 shows the range of concentrations of contaminants of concern measured in various areas of sediment.

RI sediment data for the delta where Blue Creek joins the Spokane Arm are limited to two samples. Sediment concentrations in these samples are not above background. However, the sample locations may not reflect conditions throughout the Blue Creek delta. Since it is likely that Blue Creek carried mine-affected sediments downstream, additional characterization of this area is necessary to determine the need for remediation.

5.3.2.3 Surface Water

Surface water quality at the Site reflects the impacts of ARD, with elevated sulfate, radionuclides, and metals concentrations. Concentrations of COCs in surface water (excluding seeps) are shown in summary form in Table 5-6 (page 34) and Table 5-7 (page 35). COC concentrations are generally highest in the Mined Area impoundments and in drainages to the south of the Mined Area, and then the concentrations decrease due to dilution in Blue Creek. For example, measured concentrations of (metallic) uranium in Mined Area surface water ranged from 1,320 to 30,000 µg/L, while Blue Creek downgradient 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 mg/L in pits and seeps to 1,500 mg/L in Lower Blue Creek. The maximum sulfate concentration measured in background area surface water was 30 mg/L.

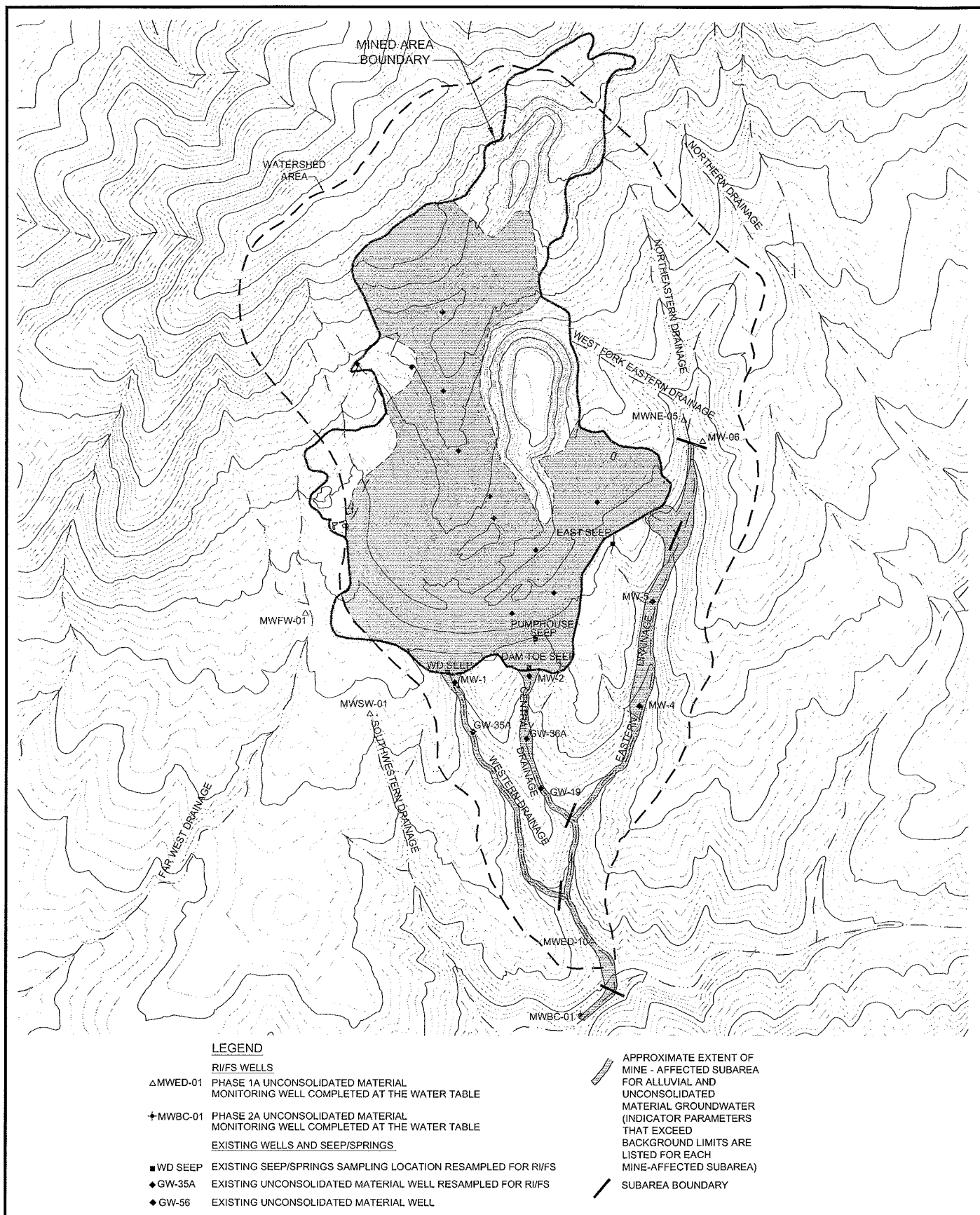
5.3.2.4 Groundwater

Groundwater quality at the Site is affected by acid mine drainage processes, as demonstrated by concentrations of metals, radionuclides, and sulfate. Figure 5-5 and Figure 5-6 show the approximate extent of contamination in alluvial and bedrock groundwater, respectively.

Table 5-8 shows the range of concentrations measured in groundwater in the alluvial groundwater in the mine drainage area and adjacent to Blue Creek. For example, concentrations of total uranium in unconsolidated groundwater ranged from 3,900 to 54,000 µg/L in the Mined Area, and in the Western Drainage measured from 78 to 2,980 µg/L, as compared to the upper 95% tolerance limit of background of 88 µg/L. Bedrock groundwater concentrations of total uranium (metallic) ranged from 0.14 to 419,000 µg/L. Maximum sulfate concentrations in Mined Area wells ranged up to 3,000 mg/L, compared to a maximum background concentration in groundwater of 187 mg/L.

5.3.2.5 Gamma Radiation and Radon

Gamma radiation and radon gas levels are elevated at the Site, as indicated by radon flux data, airborne radon measurements, and gamma survey information. Radiation surveys indicate overall elevation of gamma radiation levels throughout the Mined Area, 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 materials used in road construction and particulate transport from the road in dust and surface water runoff.



DATE: Sep 28, 2006 FILE: PMXmine affected groundwater5-5

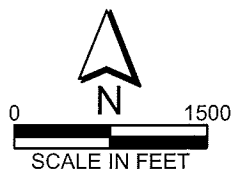
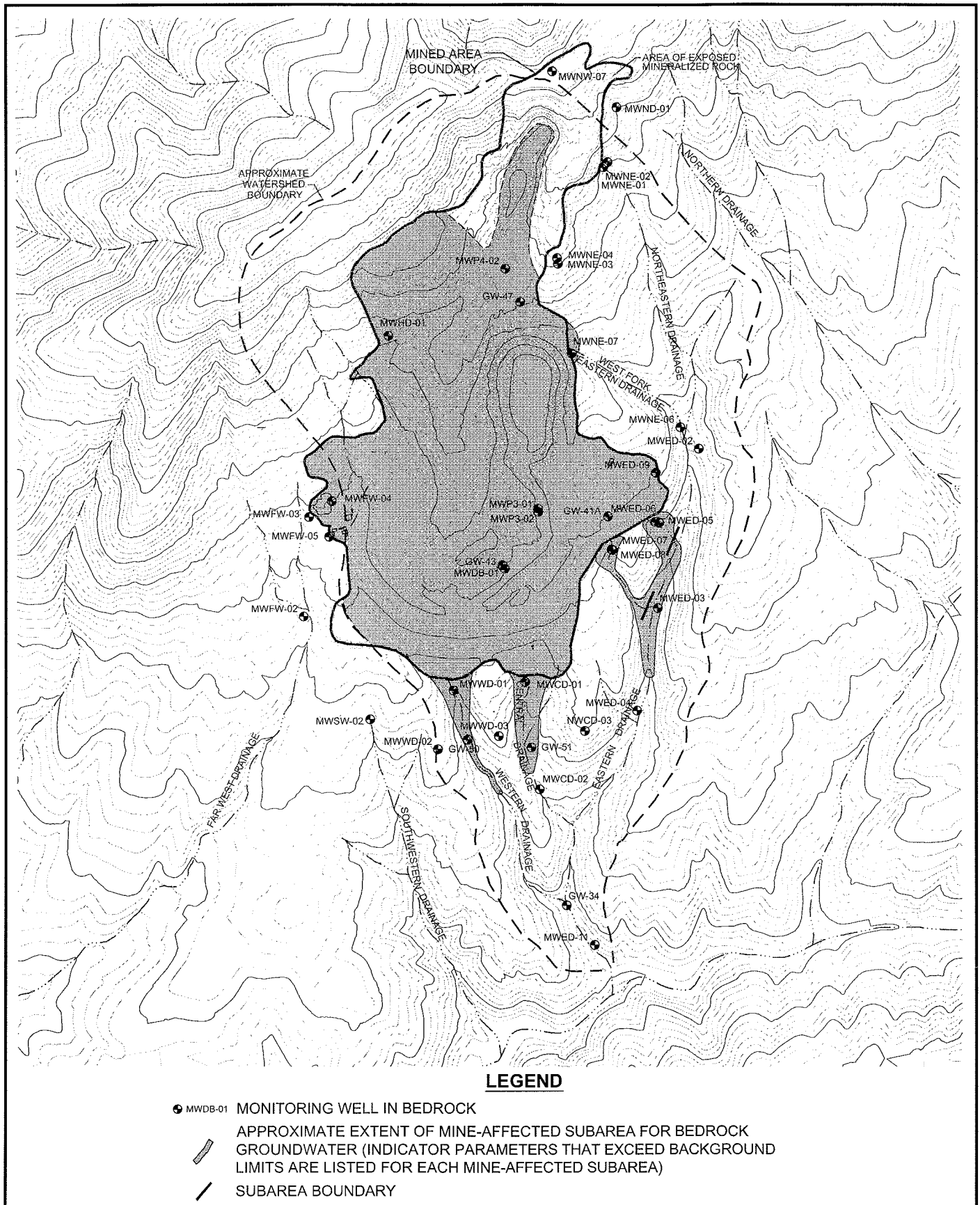


Figure 5-5
Summary of Mine Affected
Groundwater in Alluvial,
Unconsolidated Material
 Midnite Mine Record of Decision



DATE: Sep 28, 2006 FILE: PMXmine affected groundwater

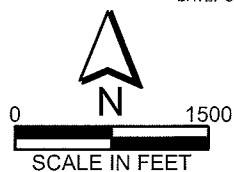


Figure 5-6
Summary of Mine Affected
Groundwater in Bedrock
 Midnite Mine Record of Decision

Gamma radiation surveys in the Mined Area indicated a range of 13.1 to 398 $\mu\text{R/hr}$. By contrast, the highest reading in the background area was 19.2 $\mu\text{R/hr}$.

Radon measurements in the Mined Area ranged from 1.3 to 372 pCi/m²-s, with a mean of 140 pCi/m²-s at the stockpiles. By comparison, the maximum background measurement was 11.8 pCi/m²-s.

5.3.3 Fate and Transport

Contaminant migration has likely been reduced due to the cessation of blasting, dumping, and hauling; the revegetation of areas of waste rock; and water management measures such as seep collection, surface water diversion, and reduced accumulation of water in the pits.

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 drainages and Blue Creek.
- Migration of COCs in groundwater flowing downgradient towards Blue Creek.
- Erosion and deposition of COCs in particulates in the drainages and Blue Creek.

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

Groundwater impacts in bedrock appear less extensive than impacts to alluvial groundwater at this time. Dilution and changes in pH as water moves through the system may be mitigating the impacts of ARD. Ongoing loading could in time increase the area of bedrock groundwater contamination.

Table 5-5. Concentrations of COCs in Sediment and 95% UTL Background Level									
Constituent	Units	95% UTL Background	Range of COC Concentrations						
			Open Pits	Middle Blue Creek	Lower Blue Creek	Upper Eastern Drainage	Lower Eastern Drainage	Central Drainage	Western Drainage
Total Inorganics									
Manganese	mg/kg	1,179	629–2,160	560–63,300	414–3,670	199–2,490	6,040–33,600	983–6,910	72.3–12,900
Uranium	mg/kg	93	179–917	3.59–89.9	4.23–28.6	5.4–57.5	17.1–138	144–4,140	27.2–293
Radionuclides									
Lead-210	pCi/g	20	62–130	2.2–6.3	1.1–2.4	5.1–12.0	3.3–9.0	2.3–23	3.2–13
Radium-226	pCi/g	13	<0.912–122	<0.395–7.25	<0.41–1.95	<0.751–12.9	<0.123–20	<0.545–263	<0.453–16.1
Uranium-238	pCi/g	31	92–305	1.2–30	<0.648–8.26	1.8–19.7	5.7–45.7	40.1–1,550	6.4–110
Notes: Bolded values indicate maximum value exceeds background as determined in the RI.									

Table 5-6. Concentrations of COCs in Surface Water Compared to the 95% UTL Background Level								
Constituent	Units	95% UTL Background	Middle Blue Creek	Lower Blue Creek	Upper Eastern Drainage	Lower Eastern Drainage	Central Drainage	Western Drainage
Manganese	µg/L	72	9–1,070	26.2–90.3	4.3–15,900	346–5,840	40,100–91,200	99–15,900
Uranium	µg/L	20	7–100	7–27	30–130	32.9–81	5–727	97–103
Lead-210	pCi/L	2.5	-5.4– 17^a	-0.50–<2.3	-3.4– 14^a	-15	0.0–62 ^a	0.16–0.16
Uranium-234	pCi/L	8.8	1.4–46	3.0–9.7	7.2–64	9.7–73	1.54–360	2.5–38.1
Uranium-238	pCi/L	7.6	2.42–32	2.3–8.8	6.5–58	8.9–72	<0.735–360	1.6–34.4
Notes: Bolded values indicate maximum value exceeds background as determined in the RI and the lowest numerical standard.								
^a The maximum concentration or activity is reported from SMI samples.								

Table 5-7. Concentrations of Selected Metals in Surface Water and 95% UTL Background Level								
Constituent	Units	95% UTL Background	Range of Concentrations of Risk Drivers in Mining Affected Area					
			Middle Blue Creek	Lower Blue Creek	Upper Eastern Drainage	Lower Eastern Drainage	Central Drainage	Western Drainage
Aluminum	µg/L	9,073	50–6,740	<63.6–3,980	<30–2,150	<60–1,780	830–1,720	170–4,130
Cadmium	µg/L	0.5	<0.20–<1.0	<0.20–<0.50	<0.20– 4.0^a	<0.2–4.0	28–54	0.99–5.2
Copper	µg/L	2.6	<0.50– 37^a	<0.40–<4.8	<0.50– 50^a	<0.50– 50^a	1.3–47	<0.9–80
Lead	µg/L	1.2	<0.20–1.1	<0.90–1.1	<0.20–3.2	<0.20–<2.0	0.20–0.20	<0.2–<10
Nickel	µg/L	1.4	3.3–30	<3.4–4.4	0.74–340	7.1–190	730–1,400	<20–380
Silver	µg/L	0.9	<0.7– 20^a	<0.70–<0.80	<0.7–30	<0.7–30^a	<0.7–12	<0.8–7
Zinc	µg/L	14	<3.0–40	<2.3–6.5	<0.40– 370^a	<4–115	740–1,480	30–460
Notes: Aluminum had a 95% UTL of 9,073 due to a small number of high concentration samples. Most site samples and discharge pond samples were less than 500. Bolded values indicate maximum value exceeds background as determined in the RI. ^a The maximum concentration or activity is reported from SMI samples.								

Table 5-8. Concentrations of Selected Contaminants in Groundwater and 95% UTL Background Level						
Constituent	Units	95% UTL Background	Range of COC Concentrations in Mining Affected Area Alluvium			
			Middle Blue Creek	Eastern Drainage	Central Drainage	Western Drainage
Metals						
Manganese	µg/L	1,990	166	0.47– 3,720^a	1,060–34,700	15,400–40,200
Uranium (total)	µg/L	88	38	2–41	1,020–1,020	78–2,980
Radionuclides						
Uranium-234	pCi/L	37	14.4	0.60–15.2	41.3–970	28.7–1,210
Uranium-238	pCi/L	35	12.6	0.30–13.7	39.4–957	25.8–1,016
Notes: Bolded values indicate maximum value exceeds background as determined in the RI. ^a The maximum concentration or activity exceeding the background limit is reported from E&E samples.						

SECTION 6 – CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section discusses the current and reasonably anticipated future land uses and current and potential beneficial groundwater uses at the Midnite Mine Site. It also discusses the basis for future use assumptions.

6.1 CURRENT LAND USE

The Midnite Mine has not been actively mined since 1981. The BIA terminated the mining leases held by Dawn Mining Company in 1991. The closest town, Wellpinit, is approximately 8 miles from the Mined Area. Tribal government offices, schools, and federal services are located in Wellpinit. The closest permanent residence is approximately 3 miles from the mine. Access to the Mined Area is limited to some extent by gates on the two primary access roads. However, the Mined Area is not fenced, has several other access roads, and can be accessed by motorized vehicles, bikes, horseback, and foot.

The Mined Area and Mining Affected Areas are located within a portion of the Spokane Reservation currently used for wildlife management, cattle grazing, forestry, and recreational and cultural activities, such as hunting, fishing, plant gathering, and youth education. West of Midnite Mine is a wildlife management area that encompasses most of Blue Creek down-gradient of the mine drainage. A gravel road parallels Blue Creek, and a tribal youth camp and picnic facilities are located on land adjacent to the confluence of Blue Creek and the Spokane River.

Land in the Mined Area is held in trust by the federal government for the Spokane Tribe and for individual tribal members. Tribal trust lands also predominate in the surrounding area, with limited fee land and individual allotments (see Figure 6-1).

6.2 FUTURE LAND USE

The reasonably anticipated future uses of the Mined Area are as open space for wildlife, hunting, skiing, backpacking, and a hunting lodge. Given the proximity of the Mined Area to wildlife management areas, in 2005, the Spokane Tribal Council passed a resolution (Resolution No. 2005-180) stating the Tribe's intention to use the land for Tribal commercial enterprises consistent with the Blue Creek Basin's designated uses, including a hunting/cross-country ski lodge and support facilities, such as corrals, pastures, and caretaker and ranger housing. Those portions of the Mined Area where mine waste materials are contained will require restrictions on certain uses in order to ensure protection and/or to maintain the effectiveness of the remedy.

The reasonably anticipated future uses of the Mining Affected Area south of the mine and along Blue Creek include traditional subsistence and residential uses and wildlife management. To ensure protection of human health, some of these uses may need to be temporarily restricted until groundwater, sediment, and surface water cleanup levels are achieved.

6.3 CURRENT GROUNDWATER USE

Groundwater is not currently in use for domestic purposes in the Mined Area, the Mining Affected Area drainages, and Blue Creek area. A well that once supplied water for mine workers is located in the Mined Area, and a well remains open on a former homestead on allotment land west of the Mining Affected Area.

6.4 FUTURE GROUNDWATER USE

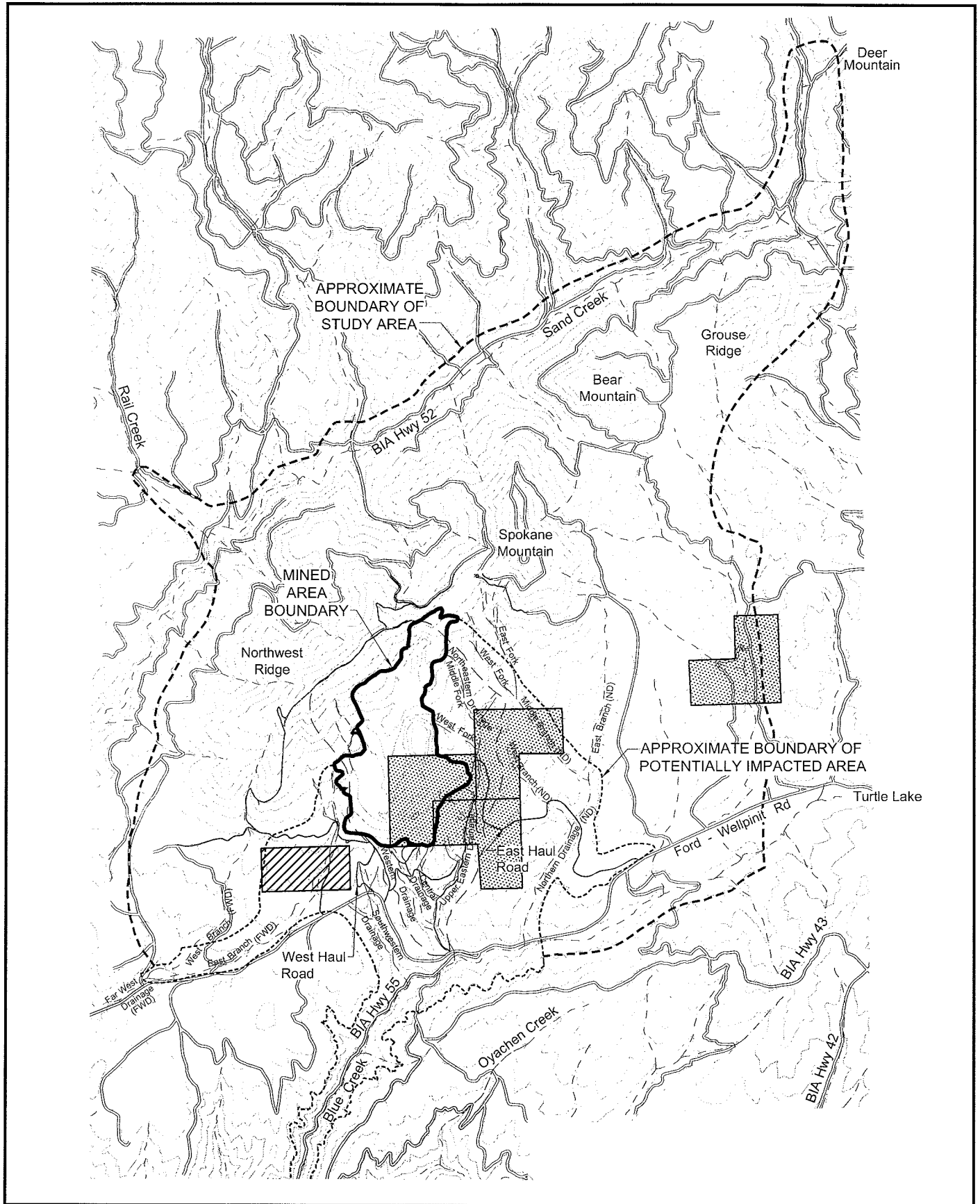
The Tribe's future land use plan includes a private well or wells for use at the hunting lodge (drinking, irrigation, etc.) and for the caretaker and ranger residences in the Mined Area. If residential development occurs in the Mining Affected Area drainages or Blue Creek area, groundwater use would be from private residential wells.

6.5 SURFACE WATER USE

In the Mined Area, surface water is not currently in use for domestic supply purposes. In the Mining Affected Area, the drainages and Blue Creek are accessible for use by workers in the area and recreational or subsistence visitors. Blue Creek is designated as Class AA in the Spokane Tribe Surface Water Quality Standards. Designated uses of Class AA waters include, but are not limited to, primary contact ceremonial and spiritual uses, cultural uses, water supply, stock watering, fish and shellfish, primary contact recreation, and commerce and navigation.

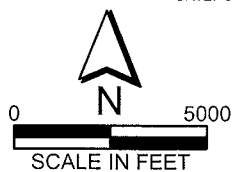
6.6 OTHER RESOURCE USES

Current and future uses of the Mined Area and Mining Affected Area include harvest and consumption of plants, fish, and wildlife as part of the subsistence diet.



DATE: Sep 25, 2006 FILE: PMXLocation Fig1-1

LEGEND



- | | | | |
|--|------------------------------------|--|---------------------------|
| | Mined Area Boundary | | Estimated Allotment Areas |
| | Potentially Impacted Area Boundary | | Estimated Fee Land Area |
| | Stream | | |
| | Road | | |

Figure 6-1
Map of Allotments and Fee Areas

Midnite Mine Record of Decision

SECTION 7 – SUMMARY OF SITE RISKS

This section summarizes the baseline human health risk assessment (URS 2005) and ecological risk assessment (EPA 2005) performed in the RI/FS. These reports are included in the Administrative Record for the Site.

7.1 HUMAN HEALTH RISK ASSESSMENT

Because the Site is within the boundaries of the Spokane Indian Reservation and is on land held in trust for the Spokane Tribe of Indians and individual tribal members, the human health risk assessment focuses on risk to tribal members. Exposure assumptions were developed in consultation with the Spokane Tribe. Residential land use was assumed, as well as exposures related to subsistence activities and diet (using plant and animal resources from the Site) and traditional sweat lodge practices. A nonresidential subsistence exposure scenario was also considered, as well as a scenario for recreational activities in the Mined Area. Risks from these uses of the Site are quantified as Reasonable Maximum Exposure (RME) risks.

As a basis for comparison to the tribal subsistence risks in the human health risk assessment, risks associated with standard EPA default residential and occupational exposure scenarios (U.S. Environmental Protection Agency 1991; U.S. Environmental Protection Agency 1993) are presented in Section 7.1.8 (Risks for Default Exposure Scenarios). For the standard default residential scenarios, both an average level of exposure (Central Tendency Exposure, or CTE) and an RME are presented.

7.1.1 Identification of Contaminants of Concern

There are four primary tasks in a baseline risk assessment: 1) identification of contaminants of potential concern; 2) exposure assessment; 3) toxicity assessment; and 4) risk characterization.

Risk characterization integrates information from the preceding components of the risk assessment and synthesizes an overall conclusion about risk that is transparent, clear, reasonable, consistent, and useful for decision-makers. The risk characterization process allows the identification of contaminants which contribute significantly to site-related risks and hazards. These key contaminants are called Contaminants of Concern, or COCs, and are the focus of this risk summary.

The COCs for exposure media identified by the risk assessment are:

- Surface Water: Uranium, manganese, lead-210, uranium-238, and uranium-234.
- Surface and Subsurface Materials: Uranium, lead-210, radium-226, and external radiation.
- Sediment: Uranium, manganese, lead-210, uranium-238, uranium-234, and radium-226.
- Groundwater: Uranium, manganese, uranium-238, and uranium-234.

- Air: Radon.
- Plants: Uranium, manganese, lead-210, radium-226, uranium-238, and uranium-234.
- Meat: Arsenic, selenium, thallium, uranium, lead-210, and radium-226.

7.1.2 Conceptual Exposure Model

A conceptual exposure model was developed for the risk assessment to assess affected media, land uses, and potential exposure pathways. The receptors chosen for evaluation are based on current and projected future use scenarios for the Site. The media chosen for consideration are those impacted by historical mining activities for which there is a potential for human exposure, specifically soil, groundwater, surface water, sediment, and air. Plant and animal tissue were also considered as exposure media potentially affected by site contamination. Some of the pathways were excluded from quantitative evaluation based on qualitative and/or quantitative reasoning.

The assumed future use of both the Mined Area and the Mining Affected Area was residential. Future site residents were assumed to live either in the Mined Area or in the Mining Affected Area and were assumed to rely on foods from the Site. Thus, the risk assessment considered exposure pathways typically associated with residential scenarios, such as water and soil ingestion, indoor air inhalation (radon), and direct radiation exposure. In addition, tribal subsistence activities were reviewed and exposure assumptions modified. For example, soil ingestion rates were increased to reflect higher contact with soils in subsistence gathering and other traditional activities, and water ingestion rates were increased due to the high activity level of the subsistence lifestyle. Also, inhalation of water vapor in traditional sweat lodges was added, as well as ingestion of plants and animals from the Site for subsistence.

A complete summary of all the scenarios and pathways considered in the risk assessment are set forth in the baseline Human Health Risk Assessment (HHRA) (EPA 2005).

7.1.3 Exposure Assessment

The objectives of the exposure assessment are to identify potential exposure scenarios by which contaminants of concern in site media could contact humans and to quantify the intensity and extent of that exposure.

Four exposure scenarios were evaluated:

- A resident of the Mined Area.
- A resident of the Mining Affected Area adjacent to the Mined Area.
- A nonresident who used the Mining Affected Area of the Site for traditional and subsistence activities.
- A recreational visitor to the Mined Area.

The subsistence visitor was assumed to drink surface water, use the sweat lodge, and subsist entirely on wild plants, game, and fish from the Site. These subsistence assumptions also applied to residents of the Site. In addition, site residents had residential exposure pathways, such as drinking water from private wells and being exposed to radiation and radon exposure in and near the residences.

Residents and visitors were assumed to be exposed for 70 years, with residents spending 24 hours a day every day at the Site. Visitors were assumed to use the gravel haul roads and use water and harvest food along the Blue Creek corridor, but were not assessed for radiation exposure or radon inhalation. For residents, radiation exposure was estimated for 24 hours a day, but the outdoor levels of gamma radiation were adjusted downward for the 12.5 hours assumed to be spent indoors, using a shielding factor of 0.4. Similarly, radon inhalation was assumed to occur for twenty-four hours, with indoor radon concentrations based on concentrations of radium-226 in the soil.

Risks associated with standard EPA default RME and CTE residential and occupational scenarios are presented in Section 7.1.9, Uncertainties. While EPA remedial decisions for the Site are based on the Tribal exposure scenarios, the risks from default exposure assumptions provide an estimate of risks independent of uncertainties in the Tribal exposure assumptions. The risks also provide information for other potential land uses. Additionally, risk estimates based on standard EPA default exposure scenarios are useful to compare levels of risk at Midnite Mine to risks encountered at other hazardous waste sites.

Resident/Subsistence User of the Mined Area

A resident of the Mined Area was assumed to live year-round in a house in the Mined Area for 70 years. Water for domestic use would be provided by a well at the Site. Time spent outside the house would include traditional and subsistence activities, including hunting, fishing, and plant harvesting. During these activities, the resident would drink surface water from the mine drainages and Blue Creek. Two hours a day would be spent in a traditional sweat lodge at the residence.

Resident/Subsistence User of the Mining Affected Area

A resident of the Mining Affected Area would have the same exposure assumptions as the resident of the Mined Area. However, exposure areas and concentrations were modified to reflect the location of the residence in an area where soils are affected by the adjacent gravel haul road.

Recreational Visitor to the Mined Area

Recreational use of the Mined Area was assumed to take place for 112 hours a year. Visitors were assumed to visit the Site, where radiation exposure and radon inhalation would occur, and to swim in the open pits.

Subsistence Visitor to the Mining Affected Area

The subsistence visitor was assumed to be a tribal member with the same diet of local plants and animals as residents of the Mined Area and Mining Affected Area. Surface water ingestion and sweat lodge use assumptions were also the same, except that the source of water was Blue Creek. See Table 7-1, Table 7-2, and Table 7-3 for a summary of the exposure parameters used in the risk assessment for soil and sediment, surface water and groundwater ingestion, and vapor inhalation (during sweat lodge use).

7.1.4 Exposure Point Concentrations

Exposure Point Concentrations (EPCs) were calculated for geographical areas, called “exposure areas,” that could be contacted by the residents and visitors of the Site. For a given exposure area, EPCs were generally calculated as the 95% upper confidence limit (95% UCL) on the mean (U.S. Environmental Protection Agency 2002). The 95% UCL for soil was also used for the basis of modeled concentrations in plant and animal tissue. For areas represented by fewer than ten samples, the maximum concentration in an exposure area was used as the estimate of the EPC for that area.

The Exposure Areas included the following:

- Mined Area: Pits, waste rock, ore, and proto-ore.
- Mining Affected Area next to the Mined Area: Drainages, haul roads, and affected soils.
- Blue Creek: Surface water and sediments.

Table 7-1. Spokane Tribe Subsistence Exposure Factors for Soil and Sediment

Parameter	Definition	Infant Value	Child Value	Adult Value	Units	Source
IR	Ingestion Rate	200	300	300	mg/day	Contact-intensive for child/adult (U.S. Environmental Protection Agency Region 10 2001); infant value is child default (U.S. Environmental Protection Agency 1991)
SA	Surface Area	1,800	2,800	5,700	cm ² /day	(U.S. Environmental Protection Agency 2004)
AF	Soil to Skin Adherence Factor	0.2	0.2	0.2	mg/cm ²	(U.S. Environmental Protection Agency 2004)
ABS	Absorption Factor	Chemical Specific	Chemical Specific	Chemical Specific	unitless	(U.S. Environmental Protection Agency 2004)
FC	Fraction of Day for Dermal Exposure	1	1	1	unitless	Spokane Tribe (Harper, Flett et al. 2002)
EF	Exposure Frequency	365	365	365	days/year	Spokane Tribe (Harper, Flett et al. 2002)
ED	Exposure Duration	2	4	64	year	Spokane Tribe (Harper, Flett et al. 2002)
BW	Body Weight	9.1	17.2	70	kg	(U.S. Environmental Protection Agency 1991; U.S. Environmental Protection Agency 1997)
ATnc	Averaging Time for Noncarcinogenic Effects	ED x 365	ED x 365	ED x 365	days	(U.S. Environmental Protection Agency 1991)
ATc	Averaging Time for Carcinogenic Effects	25,550	25,550	25,550	days	(U.S. Environmental Protection Agency 1991)
Notes: cm – centimeter mg – milligram kg – kilogram						

Table 7-2. Spokane Tribe Subsistence Exposure Factors for Surface Water and Groundwater

Parameter	Definition	Infant Value	Child Value	Adult Value	Units	Source
IR	Ingestion Rate	0.9	2	4	L/day	Spokane Tribe (Harper, Flett et al. 2002)
EF	Exposure Frequency	365	365	365	days/year	Spokane Tribe (Harper, Flett et al. 2002)
ED	Exposure Duration	2	4	64	year	Spokane Tribe (Harper, Flett et al. 2002)
BW	Body Weight	9.1	17.2	70	kg	(U.S. Environmental Protection Agency 1991; U.S. Environmental Protection Agency 1997)
ATnc	Averaging Time for Noncarcinogenic Effects	ED x 365	ED x 365	ED x 365	days	(U.S. Environmental Protection Agency 1991)
ATc	Averaging Time for Carcinogenic Effects	25,550	25,550	25,550	days	(U.S. Environmental Protection Agency 1991)

Table 7-3. Spokane Tribe Subsistence Exposure Factors for Sweat Lodge

Parameter	Definition	Child Value	Adult Value	Units	Source
InhR	Inhalation Rate	0.42	0.83	m ³ /hour	Child 10 m ³ /day (U.S. Environmental Protection Agency 1997) Adult 20 m ³ /day (U.S. Environmental Protection Agency 1991)
VF	Volatilization Factor for Water	0.15	0.15	L/m ³	Water vapor saturation at 150 degrees F sweat lodge temperature (Harris and Harper 1997)
EF	Exposure Frequency	365	365	days/year	Spokane Tribe (Harper, Flett et al. 2002)
ET	Exposure Time	0.25	2	hours/day	Spokane Tribe (Harper, Flett et al. 2002)
ED	Exposure Duration	4	64	years	Spokane Tribe (Harper, Flett et al. 2002)
BW	Body Weight	17.2	70	kg	(U.S. Environmental Protection Agency 1991; U.S. Environmental Protection Agency 1997)
ATnc	Averaging Time for Noncarcinogenic Effects	ED x 365	ED x 365	days	(U.S. Environmental Protection Agency 1991)
ATc	Averaging Time for Carcinogenic Effects	25,550	25,550	days	(U.S. Environmental Protection Agency 1991)

Notes: cm – centimeter
mg – milligram
kg – kilogram

EPCs were developed for each exposure medium for calculating risk to the four exposure scenarios, as described below.

- **Soils:** Separate EPCs were calculated for the Mined Area soils and Mining Affected Area soils adjacent to the haul roads.
- **Surface Water:** For ingestion and use of surface water in sweat lodges, EPCs were calculated for the mine drainages and Blue Creek separately. The mine drainage exposure point concentration included samples from the drainages, as well as concentrations measured in seeps which are currently collected and treated. For recreational exposure to surface water in the Mined Area, data for the two open pits were combined.
- **Sediments:** Sediment EPCs were calculated for the same exposure areas as surface water.
- **Groundwater:** Several individual wells were selected and used to represent a range of carcinogenic and noncarcinogenic EPCs for a residential well at the Site. EPCs for groundwater used in sweat lodges (for the residential scenario) were determined similarly.
- **Plants:** Existing plant root data were used where available. EPCs were calculated separately for aquatic and riparian plants. EPCs for plants sampled near Blue Creek were calculated separately from those sampled in and near the mine drainages. EPCs for terrestrial plants were calculated for the Mined Area. Where soil contaminants of potential concern did not have corresponding plant tissue data, concentrations were estimated using plant uptake models.
- **Meat:** EPCs for contaminants of concern in meat were calculated using a model developed for cattle, using median soil and surface water concentrations.
- **Radon:** EPCs for outdoor radon were based on measurements taken in the Mined Area. For the hours spent indoors, the radon values were adjusted with a factor that reflects radon buildup in houses. Radon values were at background levels away from the areas of disturbed or mine-affected soil, so radon was not a contaminant of concern along Blue Creek.
- **Radiation:** The risk assessment used EPCs for direct radiation exposure calculated in two different ways, using direct gamma radiation measurements and using estimated gamma radiation levels extrapolated from radionuclide concentrations in soils. The risk assessment relies primarily on risk estimates based on the latter method but provides results for both.

7.1.5 Toxicity Assessment

The human health toxicity assessment quantified the relationship between estimated exposure (dose) to a contaminant of concern and the increased likelihood of adverse effects. Potential cancer and noncancer effects are characterized differently. Risks of contracting cancer due to site exposures are evaluated based on toxicity factors (cancer slope factors [CSFs]) published by EPA. Quantification of noncancer hazards relies on published reference doses (RfDs).

CSFs are used to estimate the probability that a person would develop cancer given exposure to site-specific contamination. This site-specific risk is in addition to the risk of developing cancer due to other causes over a lifetime. Consequently, the risk estimates generated in the risk assessment are frequently referred to as “excess lifetime” cancer risks.

RfDs are threshold values which represent a daily contaminant intake below which no adverse human health effects are expected to occur. To evaluate noncarcinogenic health effects, the human health impact of contaminants is approximated using a hazard quotient (HQ). Hazard quotients are calculated by comparing the estimates to site-specific human exposure doses with RfDs. HQs less than one are safe.

CSFs and RfDs for nonradionuclides were primarily from EPA’s online database, Integrated Risk Information System (IRIS) (Cook 2003; U.S. Environmental Protection Agency 2005). The criteria for radionuclides were from “CSFs for Environmental Exposure to Radionuclides” (U.S. Environmental Protection Agency Office of Radiation and Indoor Air 1999; U.S. Environmental Protection Agency Office of Radiation and Indoor Air 2002).

EPA has classified all radionuclides as known human carcinogens, based on epidemiological studies of radiogenic cancers in humans. Many of the radionuclides of concern are members of naturally-occurring decay chains (e.g., radium-226 series, thorium-228 series). For these radionuclides, risks were calculated based on CSFs that represent the entire decay series (identified with “+D” designation), based on an assumption of equilibrium between parent radionuclides and decay members (secular equilibrium). EPA’s evaluation of site data indicates that the assumption of secular equilibrium for the uranium decay sub-chains is not likely to significantly underestimate or overestimate concentrations of decay products.

7.1.6 Risk Characterization

CERCLA risk estimates are used as a consistent measure of risks for decision making and to prioritize risks. CERCLA risk estimates are not predictive of health effects to a particular individual.

Cancer Risk

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. This “excess lifetime cancer risk” is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{CSF}$$

Where: Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = Chronic Daily Intake averaged over 70 years (mg/kg-day)
CSF = Cancer Slope Factor, expressed as (mg/kg-day)⁻¹

Cancer risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} equates to a 1 in 1,000,000 chance of developing a cancer attributable to exposure at a site. This is referred to as an “excess lifetime cancer risk” because it would be in addition to the “normal risk” of contracting cancer (in the absence of site exposures). EPA’s risk range for exposures at a site is 10^{-4} to 10^{-6} .

Noncancer Health Effects

The potential for noncancer health effects is evaluated by comparing an exposure level over a specified time period with the RfD derived for the same exposure period. The RfD is a dose that an individual may be exposed to of a given chemical that is safe. The ratio of the exposure to the RfD is a hazard quotient (HQ). An HQ less than one means the dose is less than the RfD and adverse health effects are unlikely to occur. Alternatively, an HQ of 1 or more means the dose exceeds the RfD and adverse health effects are possible. A hazard index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., the liver) or that act through the same mechanism of action within a medium or across all media. Similarly, an HI less than one indicates that adverse health effects from exposure to multiple contaminants are unlikely.

The HQ is calculated as follows:

$$HQ = CDI/RfD$$

Where: CDI = Chronic Daily Intake (mg/kg-day)
RfD = Reference Dose (mg/kg-day)

Background Considerations

EPA calculates risks using concentrations of contaminants measured at the Site. For naturally occurring metals, these concentrations include a portion attributable to background. At many sites, background levels are low or do not contribute more than a small percentage to the overall risks at a site. However, for Midnite Mine, background levels of certain radionuclides and metals contribute risks greater than EPA's target risk range. For this reason, the Midnite Mine risk assessment also presented risk estimates calculated using background data, where possible. CERCLA response actions are intended to reduce risks at a site, but they do not generally address background conditions. To provide information to support risk management, this section presents total risk estimates (inclusive of background) but also presents information about risks incremental to background risks, referred to as "site-related risks" in this ROD.

7.1.7 Summary of Human Health Risks

The following estimated risks and hazards for the four RME scenarios are for total risk and include a component of risk attributable to background concentrations of metals and radionuclides:

- Potential future residents of the Mined Area (cancer risk = 1; hazard index = 28 to 179,190).
- Potential future residents of the Mining Affected Area (cancer risk = 8×10^{-1} to 1; hazard = 52 to 149,879).
- Recreational visitors to the Mined Area (cancer risk = 2×10^{-3} ; hazard = 15 to 62).
- Nonresidential users of the Mining Affected Area, including Blue Creek, for traditional and subsistence purposes (for Blue Creek exposures, cancer risk = 2×10^{-1} ; hazard = 493 to 2,318).

The biggest contributions to site risks are from the use of surface water and groundwater in sweat lodges, consumption of plants, inhalation of indoor radon, consumption of livestock, and use of surface water and groundwater as drinking water.

Total risks and hazards for the Mined Area and Mining Affected Area subsistence residential use scenarios are summarized in Table 7-4. Total risks and hazards for recreational use of the Mined Area and for subsistence use of the Mining Affected Area and Blue Creek are shown in Table 7-5.

The methods used in CERCLA risk assessments generally work most effectively with risks less than one. For residential/subsistence exposures in the Mined Area, however, the total cancer risk (inclusive of risk due to background concentrations) is estimated to be very high (as much as one). The practical interpretation of these very high risk estimates is that the risks are large when compared either to background or to CERCLA risk-based action levels.

As noted above, calculating risks for the same exposure assumptions using background data indicates that the background risks for some pathways and scenarios exceed the upper end of the CERCLA target risk range. However, site concentrations of radionuclides are high enough that background radionuclide concentrations contribute less than 25 percent of the risk for any individual pathway and total exposure contributes significantly less. For example, background risk for external radiation is 1×10^{-3} . Total risk from this pathway (based on total site concentrations, which include the background contribution) is 3×10^{-2} . After subtracting background risk, the site-related risk remains the same at 3×10^{-2} .

Much of the human health risk at the Site is driven by radiation exposure and radon in the Mined Area. This is particularly critical for residents of the Mined Area and adjacent Mining Affected Area, who are assumed to spend 24 hours a day at the Site for 70 years.

While the highest risks are associated with residential uses of the Mined Area and Mining Affected Area, cultural and subsistence uses of Blue Creek also contribute significant risks. Site-related risks from a lifetime of daily sweat lodge use and water ingestion using Blue Creek surface water total approximately 10^{-3} , with sediment ingestion at 10^{-4} .

Other metals, such as cobalt, arsenic, thallium, uranium, vanadium, and zinc had hazard quotients in the tens and hundreds for meat consumption (based on modeled beef tissue concentrations). Plant ingestion HIs ranged from approximately 100 (for Blue Creek riparian plants) to greater than 70,000 (for Mining Affected Area riparian plants) and were strongly driven by uranium, with cadmium, cobalt, and nickel generally adding HQs in the tens and arsenic and manganese in the hundreds.

Table 7-4. Summary of Total Risks and Hazards for Subsistence Residential^a Exposures

Area Exposure Point		Nonradionuclides				Radionuclides (Rad) Cancer Risk	Combined Rad and Nonrad Cancer Risk
		Hazard Index			Cancer Risk		
		Infant	Child	Adult			
Mined Area	Soil (Mined Area)	28	22	6	4E-04	3E-03	3E-03
	Groundwater (Drinking Water) ^b	0.087–26,749	0.1–31,449	0.05–15,455	N/A	2E-04 - 3E-01	2E-04–3E-01
	Groundwater (Sweat Lodge) ^b	–	39–38,087	150–147,956	2E-04–2E-01	2E-03–1E+00 ^e	2E-03–1E+00 ^e
	External Radiation (Outdoors)	N/A	N/A	N/A	N/A	2E-02	2E-02
	External Radiation (Indoors)	N/A	N/A	N/A	N/A	1E-02	1E-02
	Plants (Mined Area terrestrial)	–	28,686	15,664	5E-02	5E-01	6E-01
	Meat	–	221	109	7E-03	2E-01	2E-01
	Radon (Outdoor Air)	N/A	N/A	N/A	N/A	6E-03	6E-03
	Radon (Indoor Air)	N/A	N/A	N/A	N/A	2E-01	2E-01
	Total: ^c	28–26,777	28,968–98,465	15,929–179,190	6E-02–3E-01	9E-01–1E+00 ^e	1E+00 ^e
Mining Affected Area	Soil Adjacent to Haul Roads (Ingestion) ^d	5	4	0.9	N/A	6E-04	6E-04
	Surface Water in Drainages (Drinking Water) ^d	83	98	48	N/A	1E-01	1E-01
	Surface Water in Drainages (Sweat Lodge) ^d	–	2,514	9,767	1E-02	8E-01	8E-01
	Groundwater (Drinking Water) ^b	47–3,453	55–4,060	27–1,995	N/A	1E-03–2E-02	1E-03–2E-02
	Groundwater (Sweat Lodge) ^b	–	2–3,941	8–15,309	3E-05–9E-03	8E-03–1E-01	8E-03–1E-01
	Mine Drainages (Sediment Ingestion) ^d	–	31	8	N/A	9E-04	9E-04
	External Radiation (Outdoors)	N/A	N/A	N/A	N/A	5E-03	5E-03
	External Radiation (Indoors)	N/A	N/A	N/A	N/A	2E-03	2E-03
	Plants (Drainages, Aquatic/Riparian)	–	40,230–141,653	21,967–77,347	N/A	2E-01–7E-01	2E-01–7E-01
	Meat	–	221	109	7E-03	2E-01	2E-01
	Radon (Outdoor Air)	N/A	N/A	N/A	N/A	6E-03	6E-03
	Radon (Indoor Air)	N/A	N/A	N/A	N/A	2E-01	2E-01
	Total: ^c	52–3,458	40,512–149,879	22,112–94,761	7E-03–2E-02	8E-01–1E+00 ^e	8E-01–1E+00 ^e

Notes: Cancer risk notation explanation: 1E-02 equals a cancer risk of 1 x 10⁻².

– Infants were not evaluated for these pathways.

N/A –COPCs in area/media not applicable for indicated effect (cancer or noncancer) for this pathway.

^a All dietary needs met on site; plants are gathered in the exposure area where the residence is located; protein sources are represented by beef with tissue COPC concentrations modeled from site soil data.

^b Risks from exposure to groundwater reflect a range of concentrations in wells in the Mined Area, or Mining Affected Area as applicable.

^c Totals are presented as a range to reflect the range of contaminant concentrations in groundwater and plants.

^d Soil adjacent to the haul roads is used for residential exposures. Haul road soil ingestion is assessed under the nonresidential scenario. Risks and hazards for exposure to sediment from the mine drainages address the same pathway and are not included in the total.

^e Although summing the individual pathways may lead to a total greater than 1, total risk cannot exceed 1.

Table 7-5. Risks and Hazards for Nonresidential Recreational and Subsistence Exposures

Table 7-5. Risks and Hazards for Nonresidential Recreational and Subsistence Exposures					
Area	Exposure Point	Nonradionuclides		Cancer Risk	Radionuclides Cancer Risk
		Hazard Index			
		Child	Adult		
Mined Area Swimmer	Pit Surface Water ^a (Ingestion)	37	9	N/A	2E-04
	Pit Sediment ^a (Ingestion)	25	6	N/A	1E-03
	Outdoor Radon (Inhalation) ^a	N/A	N/A	N/A	2E-04
	External Radiation ^a	N/A	N/A	N/A	6E-04
	Totals:	62	15	–	2E-03
Mining Affected Area Subsistence User ^b	Haul Road Soil (Ingestion) ^c	23	6	N/A	2E-03
	Blue Creek Water (Vapor Inhalation)	61	236	N/A	2E-03
	Blue Creek Water (Ingestion)	22	11	N/A	8E-04
	Blue Creek Sediment (Ingestion) ^c	2	0.6	N/A	N/A
	Blue Creek Plants (Ingestion) ^d	239–1,989	130–1,086	N/A	N/A
	Meat (Ingestion) ^e	221	109	7E-03	2E-01
	Totals: ^c	568–2,318	493–1,449	7E-03	2E-01

Notes: N/A – COPCs in area/media not applicable for indicated effect (cancer or noncancer) for this pathway.

^a Assumed that 1 hour per day for 112 days per year is spent at Pits 3 and 4.

^b Subsistence user may be exposed to sediments, surface water, and plants in the Mining Affected Area drainages. See summary risk table for residential exposures.

^c Risks and hazards for sediment ingestion are for the same pathway as haul road soil ingestion. The risks and hazards should not be added together. Shaded values are not included in total.

^d Calculated hazard or risk differs for aquatic and riparian plants in Blue Creek.

^e Risks related to meat consumption are based on modeled COPC uptake from soil values and are the same for all subsistence scenarios.

7.1.8 Uncertainties

The risks and hazards estimated in the HHRA have a high degree of uncertainty, given the large number of pathways evaluated and uncertainties associated with land use and exposure assumptions.

Uncertainties in risk estimates specific to tribal subsistence activities are listed below:

- Ingestion rates for tribal subsistence users of the Site are estimated based on total caloric need (surveyed ingestion rates for the Spokane Tribe subsistence diet are not available).
- All dietary needs are assumed to be met by plants and animals obtained exclusively from the Mined Area and Mining Affected Area.
- Plant data used to calculate EPCs were from randomly selected plant samples that do not reflect dietary preferences.
- The contaminants that contribute the most risk to the plant ingestion pathway were not analyzed in plant tissue samples but were modeled from soil concentrations.
- Animal tissue concentrations are estimated based on a model developed for cattle, not wildlife such as deer and elk, which forage differently.
- Modeling animal tissue concentrations from site soil data assumes that the animals forage exclusively in the Mined Area and Mining Affected Area.
- Sweat lodge exposure assumptions and exposure point concentrations are based on a series of protective assumptions because measured values are not available. This uncertainty is compounded because site COCs are not volatile and COC behavior in the sweat lodge is largely unknown.

For the sweat lodge vapor inhalation pathway, HIs for adults range from approximately 2,000 to more than 100,000. The hazards were caused by manganese and reflect high uncertainties associated with exposure and toxicity assumptions. The manganese inhalation RfD is based on occupational exposure to metal workers and welders, not water vapor inhalation.

There is relatively little uncertainty in estimates of cancer risk from radionuclide exposure. Cancer risks are extremely high, even if risks specific to subsistence and cultural activities are excluded. For example, cancer risks from radon, external radiation, and soil ingestion in the Mined Area are on the order of 10^{-1} , 10^{-1} , and 10^{-3} , respectively. Estimates of cancer risk due to ingestion of radionuclides in the Mined Area groundwater differ from well to well. The risks ranged from 10^{-4} to 10^{-1} . Risks for this pathway are lower by about an order of magnitude in the Mining Affected Area.

Table 7-6 shows total and site-related cancer risks from inhalation of radon and exposure to external radiation.

Table 7-6. Risks Due to External Radiation and Radon for Residential and Non-Residential Scenarios

				Cancer Risk								
				Residential Scenarios			Nonresidential Scenarios					
							Subsistence Visitor ^a			Recreational Visitor ^a		
				Total Risk	Background Risk	Excess Risk ^b	Total Risk	Background Risk ^b	Excess Risk	Total Risk	Background Risk	Excess Risk ^b
Mined Area												
External Radiation	pCi/g	4.7	2.3	3.4×10^{-2}	9.5×10^{-4}	3.3×10^{-2}	1.2×10^{-2}	3.2×10^{-4}	1.2×10^{-2}	6.4×10^{-4}	1.8×10^{-5}	6.2×10^{-4}
Mining Affected Area												
External Radiation	pCi/g	4.7	2.3	1.3×10^{-2}	9.5×10^{-4}	1.2×10^{-2}	4.5×10^{-3}	3.2×10^{-4}	4.2×10^{-3}	NA	NA	NA
Mined Area and Mining Affected Area Combined												
Radon (outdoor)	pCi/L	2.0	1.1	6.3×10^{-3}	7.8×10^{-4}	5.5×10^{-3}	3.0×10^{-3}	3.7×10^{-4}	2.6×10^{-3}	1.7×10^{-4}	2.1×10^{-5}	1.5×10^{-4}
Radon (indoor)	pCi/L	NE	2.9	2.2×10^{-1}	5.3×10^{-3}	2.1×10^{-1}	NA	NA	NA	NA	NA	NA
<p>Notes: EPC = Exposure Point Concentration NA = Not Applicable NE = Not Established pCi/g = pico curies per gram pCi/L = pico curies per liter UCL = Upper Confidence Limit of the Mean UTL = Upper Tolerance Limit (Background Threshold)</p> <p>^a Subsistence visitor assumes 2,000 hours/year (50 weeks at 40 hours/week, a typical worker scenario) outdoors in either the mined area or mining affected area; Recreational Visitor assumes 112 hours/year in the mined area.</p> <p>^b Excess risks are equal to total risks minus the risk present at background (pre-mining) levels of COPCs.</p>												

7.1.9 Risks for Standard EPA Default Exposure Scenarios

Because future land use and the risk scenarios associated with land use were identified as a significant source of uncertainty in the risk assessment, EPA evaluated the effect of this uncertainty by examining risks under residential and occupational exposure scenarios based on EPA standard default exposure factors using RME and CTE measures of exposure. The exposure factors for these scenarios are presented in Table 7-7.

Table 7-7. EPA Standard Default Exposure Factors for Residential and Occupational Scenarios							
Parameter	Definition	Occupational	Residential				Units
		Adult	Child Value		Adult Value		
		RME	RME	CTE	RME	CTE	
IR	Soil Ingestion Rate	100	200	100	100	50	mg/day
SA	Surface Area Exposed to Soil	3,300	2,800	2,800	5,700	5,700	cm ² /day
AF	Soil to Skin Adherence Factor	0.2	0.2	0.2	0.07	0.07	mg/cm ²
EF	Exposure Frequency	250	350	234	350	234	days/year
IRW	Ingestion of Drinking Water	1	1	1	2	1.4	L/day
ED	Exposure Duration	25	6	2	24	7	year
BW	Body Weight	70	15		70		kg
ATnc	Averaging Time for Noncarcinogenic Effects	ED x 365					days
ATc	Averaging Time for Carcinogenic Effects	25,550					days

Notes: RME exposure factors are from Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Emergency and Remedial Response: Washington, DC. <http://www.hanford.gov/dqo/project/level5/hhems.pdf>. (U.S. Environmental Protection Agency 1991).

CTE are from Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors for central Tendency and Reasonable Maximum Exposure Draft. Office of Emergency and Remedial Response: Washington, DC. <http://www.hanford.gov/dqo/project/level5/hhems.pdf>. (U.S. Environmental Protection Agency 1993).

The standard EPA default exposure scenarios do not include subsistence or cultural practices associated with the tribal lifestyle. Rather than the 70 years at the residence for reservation residents, the default residential scenarios assume 9 years and 30 years at the residence for the central tendency and reasonable maximum exposures, respectively, rather than 70 years.

Table 7-8 shows the risks and noncancer hazards estimated for the default RME residential exposure scenario. The HI is in the hundreds in the mine drainages area and in the thousands in the Mined Area, mostly due to groundwater ingestion. Cancer risks are in the range of 10^{-2} in the mine drainages area and 10^{-3} in the Mined Area, driven by radon and radiation exposures, as well as groundwater ingestion. Risk estimates for the default CTE residential scenario (Table 7-9) are somewhat lower, but still well above EPA's target risk range.

Risk estimates for the EPA standard default scenario for occupational exposures are similar in magnitude and also exceed EPA target cancer risks and noncancer hazards, as shown in Table 7-10. Depending on the well used for drinking water, the noncancer hazard index is up to 350 in the mine drainage area and up to 2,648 in the Mined Area. Cancer risks are driven by radon inhalation, radiation exposure, and drinking water ingestion. Depending on the drinking water source, the risks are estimated at over 10^{-2} both in the mine drainages area and in the Mined Area.

Table 7-8. Summary of Site Risks Under a Default RME Residential Exposure Scenario

Area	Exposure Media	Nonradioactive Metals			Radionuclides
		Child HI RME	Adult HI RME	Cancer Risk RME	Cancer Risk Lifetime
Mined Area	Yard Soil	15	2	5E-05	3E-04
	Groundwater (Drinking Water) ^a	0.04–15,598	0.02–7,410	NC	4E-05–5E-02
	External Radiation (Outdoors)	N/A	N/A	N/A	1E-03
	External Radiation (Indoors)	N/A	N/A	N/A	6E-04
	Radon (Outdoor Air)	N/A	N/A	N/A	2E-03
	Radon (Indoor Air)	N/A	N/A	N/A	8E-02
	Total:^b	15–15,613	2–7,412	5E-05	8E-02–1E-01
Mining Affected Area	Yard Soil (Adjacent to Haul Roads)	3	0.3	NC	7E-05
	Drainages (Drinking Water)	48	23	NC	2E-02
	Groundwater (Drinking Water) ^c	27–2,014	13–957	NC	2E-04–4E-03
	External Radiation (Outdoors)	N/A	N/A	N/A	2E-03
	External Radiation (Indoors)	N/A	N/A	N/A	8E-04
	Radon (Outdoor Air)	N/A	N/A	N/A	2E-03
	Radon (Indoor Air)	N/A	N/A	N/A	8E-02
	Total:^b	30–2,017	13–980	–	8E-02–1E-01
<p>Notes: NC = Not Calculated. N/A = Contaminants not associated with noncancer effects. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Emergency and Remedial Response: Washington, DC. http://www.hanford.gov/dgo/project/level5/hhems.pdf. U.S. (U.S. Environmental Protection Agency 1991)</p> <p>^a Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations. The results are reported as a range of risks and hazards calculated from Wells GW-53, BOM-17, and MWP3-01.</p> <p>^b Totals are presented as a range to include the low and high groundwater values.</p> <p>^c Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations in the PIA. The results are reported as a range of risks and hazards calculated from Wells MW-1, MW-2, GW-19, MWCD-01, GW-50, and MWED-06.</p>					

Table 7-9. Summary of Site Risks Under a Default Central Tendency Residential Exposure Scenario

Area	Exposure Media	Nonradioactive Metals			Radionuclides
		Child HI CTE	Adult HI CTE	Cancer Risk RME	Cancer Risk Lifetime
Mined Area	Yard Soil	5	1	5E-06	3E-05
	Groundwater (Drinking Water) ^a	0.03–10,429	0.01–3,468	NC	5E-06–7E-03
	External Radiation (Outdoors)	N/A	N/A	N/A	3E-04
	External Radiation (Indoors)	N/A	N/A	N/A	1E-04
	Radon (Outdoor Air)	N/A	N/A	N/A	4E-04
	Radon (Indoor Air)	N/A	N/A	N/A	2E-02
	Total:^b	5–10,433	1–3,468	5E-06	2E-02–2E-02
Mining Affected Area	Yard Soil (Adjacent to Haul Roads)	1	0.1	NC	7E-06
	Drainages (Drinking Water)	32	11		3E-03
	Groundwater (Drinking Water) ^c	18–1,346	6–448	NC	2E-05–5E-04
	External Radiation (Outdoors)	N/A	N/A	N/A	4E-04
	External Radiation (Indoors)	N/A	N/A	N/A	2E-04
	Radon (Outdoor Air)	N/A	N/A	N/A	4E-04
	Radon (Indoor Air)	N/A	N/A	N/A	2E-02
	Total:^b	19–1,347	6–448		2E-02–2E-02
<p>Notes: NC = Not Calculated. N/A = Contaminants not associated with noncancer effects. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Emergency and Remedial Response: Washington, DC. http://www.hanford.gov/dqo/project/level5/hhems.pdf. U.S. (U.S. Environmental Protection Agency 1991)</p> <p>^a Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations. The results are reported as a range of risks and hazards calculated from Wells GW-53, BOM-17, and MWP3-01.</p> <p>^b Totals are presented as a range to include the low and high groundwater values.</p> <p>^c Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations in the PIA. The results are reported as a range of risks and hazards calculated from Wells MW-1, MW-2, GW-19, MWCD-01, GW-50, and MWED-06.</p>					

Table 7-10. Summary of Site Risks Under a Default RME Occupational Exposure Scenario

Area	Exposure Media	Nonradioactive Metals		Radionuclides
		Hazard Index RME	Cancer Risk RME	Cancer Risk
Mined Area	Yard Soil	1	4E-05	2E-04
	Groundwater (Drinking Water) ^a	0.01–2,646	NC	1E-05–2E-02
	External Radiation (Outdoors)	N/A	N/A	1E-03
	External Radiation (Indoors)	N/A	N/A	5E-04
	Radon (Outdoor Air)	N/A	N/A	6E-04
	Radon (Indoor Air)	N/A	N/A	2E-02
	Total:^b	1–2,648	4E-05	2E-02–4E-02
Mining Affected Area	Yard Soil (Adjacent to Haul Roads)	0.2	NC	6E-05
	Drainages (Drinking Water)	8		9E-03
	Groundwater (Drinking Water) ^c	5–342	NC	1E-05–7E03
	External Radiation (Outdoors)	N/A	N/A	1E-03
	External Radiation (Indoors)	N/A	N/A	6E-04
	Radon (Outdoor Air)	N/A	N/A	2E-03
	Radon (Indoor Air)	N/A	N/A	6E-02
	Total:^b	13–350		1E-02–7E02
<p>Notes: NC = Not Calculated. N/A = Contaminants not associated with noncancer effects. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Emergency and Remedial Response: Washington, DC. http://www.hanford.gov/dqo/project/level5/hhems.pdf. U.S. (U.S. Environmental Protection Agency 1991)</p> <p>^a Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations. The results are reported as a range of risks and hazards calculated from Wells GW-53, BOM-17, and MWP3-01.</p> <p>^b Totals are presented as a range to include the low and high groundwater values.</p> <p>^c Risks from exposure to groundwater were evaluated on a well-by-well basis representing a range of concentrations in the PIA. The results are reported as a range of risks and hazards calculated from Wells MW-1, MW-2, GW-19, MWCD-01, GW-50, and MWED-06.</p>				

Risks and hazards estimated for these standard EPA default scenarios exceed CERCLA goals for both cancer and noncancer effects and support the conclusion that remedial action is needed to address sources of radon and radiation, as well as sources of COCs in groundwater.

7.2 BASELINE ECOLOGICAL RISK ASSESSMENT

The Baseline Ecological Risk Assessment (BERA) was prepared by EPA in coordination with a Biological Technical Assistance Group (BTAG).

The BERA did not directly evaluate risks to Threatened and Endangered species which may occur at the site; however, these species fall within the assessment endpoints evaluated (for example, the endpoint of carnivorous mammals includes lynx and gray wolf), and species used in models to represent the endpoint were selected to ensure that risk conclusions would be protective of Threatened and Endangered species.

7.2.1 Identification of Contaminants of Concern

Following the risk characterization, contaminants that contributed most to site risks were identified based on consideration of background levels and the magnitude of the hazard quotients. These COCs include the following:

- **Surface Water:** Aluminum, barium, beryllium, cobalt, copper, lead, manganese, nickel, silver, uranium, and zinc.
- **Surface Materials:** Cadmium, lead, and uranium.
- **Sediments:** Chromium, manganese, selenium, uranium, and vanadium.

7.2.2 Exposure Assessment

The BERA evaluated endpoints selected to represent ecological communities in the aquatic and terrestrial ecosystems at the Site, as follows:

- Aquatic periphyton, benthic macroinvertebrate, and fish communities.
- Terrestrial soil and plant communities.
- Mammals: Herbivorous, carnivorous, omnivorous, piscivorous, and soil invertebrate-feeding mammal communities.
- Birds: Insectivorous, omnivorous, soil invertebrate-feeding, carnivorous, herbivorous, and piscivorous avian communities.
- Amphibian communities.
- Wetland plant and invertebrate communities.

Risk to aquatic, riparian, and terrestrial animals and to terrestrial plants from ionizing radiation exposure was evaluated in accordance with Department of Energy Biota Dose Assessment Committee (BDAC) Technical Standards. For total ionizing radiation (TIR) exposure, Department of Energy risk assessment methods were used, based on risk thresholds of 1 rad/day for aquatic animals and terrestrial plants and 0.1 rad/day for riparian and terrestrial animals.

Terrestrial exposure areas included the Mined Area, haul roads, downwind soil areas, and background areas. Aquatic exposure areas included water bodies in the Mined Area (the pit lakes, PCP, and WTP outfall pond), each mine drainage, and two affected segments of Blue Creek. Riparian sediments were also evaluated for the mine drainages and Blue Creek. Surface water and sediments in Blue Creek upstream of the mine drainage, in background areas, and in the Spokane Arm were also evaluated to support a comparison to site conditions.

7.2.3 Identification of Receptors

Table 7-11 illustrates potential pathways for receptors to be exposed to contaminants in surface water, soil, and sediments at the Site. The specific endpoints focus on trophic levels and communities, such as producers, detritivores, or consumers, further sorted as herbivores, insectivores, carnivores, or piscivores.

Pathways evaluated include direct contact/uptake, food chain exposure, inhalation, and external radiation. Pathways were not evaluated quantitatively if the pathways were not complete or were unlikely to pose significant risk.

7.2.4 Exposure Point Concentrations

Maximum contaminant concentrations for a given exposure area were used as exposure point concentrations for contaminants of potential concern in almost all cases. Central tendency values were used only to estimate direct media exposure in two of four dietary models.

A sum of fractions approach was used to estimate total ionizing radiation exposure due to radionuclides in water and sediments, for comparison to risk thresholds. The sum of fractions was calculated using central tendency values.

7.2.5 Ecological Effects Assessment

For nonradionuclides, the focus of the effects assessment was to identify appropriate effect doses (toxicity reference values [TRV] and life history profiles relevant to dose) for bird and mammal receptors and to identify available effect doses (media based benchmarks) for the remaining assessment endpoints (terrestrial plants, wetland plants, aquatic biota).

For aquatic receptors, terrestrial soil microorganisms and plants, amphibians, and wetland plants and invertebrates, hazard quotients were calculated based on toxicity reference values or benchmarks. Maximum site metal concentrations for a given exposure area were compared to media-based benchmarks.

Table 7-11. Ecological Exposure Pathways

Exposure Media	Exposure Routes	Terrestrial Receptors															
		Soil Organisms			Wildlife (terrestrial/riparian ecosystem consumers)												
		Plants ^{b2}	Micro-organisms	Invertebrates	Mammals						Birds						
					Herbivore	Herbivore	Invertivore	Omnivore	Carnivore	Carnivore	Herbivore	Herbivore	Invertivore	Omnivore	Carnivore	Carnivore	
					Meadow Vole	White-Tailed Deer	Masked Shrew	Deer Mouse	Coyote	Bobcat	Spruce Grouse	Song Sparrow	Cliff Swallow	American Robin	Great Horned Owl	American Kestrel	
Stream/Pit Surface Water	Radiation	—	—	—	2	2	2	2	2	2	2	2	2	2	2	2	2
	Direct Contact	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Ingestion	—	—	—	*	*	*	*	*	*	*	*	*	*	*	*	*
Stream/Pit Sediment	Radiation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Direct Contact	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Ingestion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Surface Material ^c	Radiation	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Direct Contact	*	*	*	o	o	o	o	o	o	o	o	o	o	o	o	o
	Ingestion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pit Wall Material	Radiation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Direct Contact	o	o	o	—	—	—	—	—	—	—	—	—	—	—	—	—
	Ingestion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Haul Road	Radiation	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Direct Contact	*	*	*	—	—	—	—	—	—	—	—	—	—	—	—	—
	Ingestion	—	—	—	*	*	*	*	*	*	*	*	*	*	*	*	*
Exposure Media	Exposure Routes	Aquatic Receptors			Terrestrial/Riparian Receptors												
		Plants ²	Invertebrates	Fish	Wildlife (terrestrial/riparian ecosystem consumers)												
					Amphibian	Mammals			Birds								
					Invertivore	Herbivore	Omnivore	Piscivore	Herbivore	Invertivore	Piscivore	Piscivore					
						Muskrat	Raccoon	Mink	Coyote	Bobcat	Spruce Grouse	Song Sparrow					
Stream/Pit Surface Water	Radiation	1	3	3	2	2	2	2	2	2	2	2	2				
	Direct Contact	*	*	*	*	o	o	o	o	o	o	o	o				
	Ingestion	—	o	o	o	*	*	*	*	*	*	*	*				
Stream/Pit Sediment	Radiation	1	3	3	2	2	2	2	2	2	2	2	2				
	Direct Contact	o	*	o	o	o	o	o	o	o	o	o	o				
	Ingestion	—	o	o	o	*	*	*	*	*	*	*	*				
Surface Material ^d	Radiation	—	—	—	2	2	2	2	2	2	2	2	2				
	Direct Contact	—	—	—	o	x	x	x	x	x	x	x	o				
	Ingestion	—	—	—	o	x	x	x	x	x	x	x	o				
Haul Road	Radiation	—	—	—	2	—	—	—	—	—	—	—	—				
	Direct Contact	—	—	—	—	—	—	—	—	—	—	—	—				
	Ingestion	—	—	—	—	—	—	—	—	—	—	—	—				
Radiation = Evaluated using the DOE's <i>A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota</i> USDOE (U.S. Department of Energy) 2002. A Graded Approach for Evaluating Radiation Doses to Aquatic, Riparian, and Terrestrial Biota. DOE-STD-1153-2002. July. (described in Section 2.3.2.3) See Footnotes 1, 2, and 3. Direct Contact = Uptake by plants, invertebrates, fish, and amphibians through direct contact with soil, water, or sediment. Ingestion = Direct ingestion of food and water and incidental ingestion of soil/sediment. — = Pathway incomplete or not applicable; quantitative evaluation not performed. * = Pathway potentially complete and selected for quantitative evaluation. o = Pathway potentially complete but not selected for quantitative evaluation as data or methods are lacking. x = Pathway relatively unimportant for risk management decisions. ^a Tables adapted/modified from URS (URS Corporation) 2001b. Terrestrial Ecological Risk Assessment Approach for Midnite Mine RI/FS. Draft Technical Memorandum prepared for USEPA Region 10. October. ^b Terrestrial Plants includes riparian plants or upland plants depending on habitat/location. ^c For the purpose of this exposure table, Surface Material includes surface material in the Mined Area (waste ore/protore stockpiles/backfilled pits), soils downwind in the Potentially Impacted Area (PIA), and riparian sediments. ^d For the purpose of this exposure table, Surface Material includes surface material in the Mined Area (waste ore/protore stockpiles/backfilled pits), and soils downwind in the Potentially Impacted Area (PIA). ¹ Radiation exposure compared with 1 rad/day for plants. ² Radiation exposure compared with 0.1 rad/day for terrestrial animals. ³ Radiation exposure compared with 1 rad/day for aquatic and riparian animals.																	

For the ten mammalian and avian endpoints, models were used to evaluate risks from the dietary pathway in combination with direct soil and/or water pathways. The models were calculated using four sets of inputs to evaluate the effect of the input assumptions on the risk estimates. Inputs which were varied included media concentrations (maximum or central tendency) and life history and exposure assumptions (conservative and representative body weights and ingestion rates). The TRVs used are shown in Table 7-12.

Table 7-12. Toxicity Reference Values for Birds and Mammals				
Analyte	Mammals		Birds	
	NOAEL^a (mg/kgBW/day)	LOAEL^b (mg/kgBW/day)	NOAEL (mg/kgBW/day)	LOAEL (mg/kgBW/day)
Aluminum	NA ^c	NA	NA	NA
Barium	5.1	51	210	420
Beryllium	0.62	6.2	NS ^e	NS
Cadmium	0.23	2.3	0.85	3.4
Chromium	5.7	57	1.0	5.0
Cobalt	5.0	20	23	44
Copper	24	35	27	33
Lead	8.0	80	1.5	15
Manganese	83	270	980	9,800
Nickel	23	42	57	79
Selenium	0.025	0.25	0.40	0.80
Silver	0.27	2.7	4.0	40
Uranium	0.50	5.0	160	1,600
Vanadium	0.21	2.1	11	110
Zinc	23	230	11	220
^a NOAEL = No Observed Adverse Effect Level. ^b LOAEL = Lowest Observed Adverse Effect Level. ^c NA = Not Analyzed as a Contaminant of Potential Concern. ^d mg/kg BW = Milligram per Kilogram Body Weight. ^e NS = No Studies Available.				

Media based benchmarks are shown in Table 7-13. Benchmarks for water and sediments were generally obtained from the most current EPA criteria, guidance, or technical data available. Soil benchmarks were obtained from guidance provided by the Oak Ridge National Laboratory (ORNL). The benchmarks for all media were generally based on chronic NOAEL levels. For radionuclides, effect doses were derived from U.S. Department of Energy guidance.

Table 7-13. Benchmarks Values for Soil, Sediment, and Surface Water			
Analyte	Soil ^a (mg/kg) DW	Sediment ^b (mg/kg) ^e DW	Surface Water (µg/L) ^f
Aluminum	50	9,400	87
Barium	500	500	3.9
Beryllium	10	0.70	0.53
Cadmium	3.0	0.99	0.12 ^c
Chromium	0.40	43	NB ^d
Cobalt	20	20	3.0
Copper	50	32	3.2 ^c
Lead	50	36	0.70 ^c
Manganese	100	740	80
Nickel	30	23	19 ^c
Selenium	1.0	0.10	5.0
Silver	2.0	0.50	0.080
Uranium	5.0	17	2.6
Vanadium	2.0	NB	19
Zinc	50	120	41 ^c
^a Soil Benchmarks from the Oak Ridge database (based on lowest value for earthworms, microorganisms or plants). ^b Sediment Benchmarks derived from the consensus-based threshold effect concentration (TEC) database where available. The lowest Sediment Quality Guidelines (SQGs) were used when consensus-based TEC values were not available. ^c Based on water hardness of 30 ppm and dissolved metal concentrations. Calculated using US EPA 2002, National Recommended Water Quality Criteria. ^d NB = No benchmark available. ^e mg/kg = milligrams per kilogram. ^f µg/L = microgram per liter.			

In addition to site chemical data, available biological data were used, including previous benthic studies of Blue Creek. These data were supplemented by limited macroinvertebrate tissue sampling, habitat assessment data, and macroinvertebrate surveys in the Eastern Drainage and Blue Creek.

7.2.6 Risk Characterization

For nonradionuclides, hazard quotients were developed for each assessment endpoint by exposure area. The resulting hazard quotients varied widely, but no exposure area had values less than one for all receptors and contaminants. Some contaminants exceeded ecological risk thresholds in background areas. Metals generally drove the ecological risk, although the risk drivers differed for different media and receptors. Riparian and aquatic risks in Blue Creek were lower than risks in the mine drainages, and terrestrial risks were highest in areas with mine waste at the surface, such as the Mined Area and gravel haul roads.

Results of the dietary modeling for mammals and birds similarly indicated that, even using the less protective assumptions, site risks were very high in some areas, and in no area was it possible to state that there were no ecological risks.

Areas exceeding either the 1.0 rad/day or 0.1 rad/day risk thresholds for ionizing radiation were generally limited to the Mined Area pits and impoundments and the Central and Upper Eastern drainages.

7.2.7 Uncertainties

The ecological risk assessment was based on conservative exposure assumptions and toxicological data from laboratory studies, with limited site-specific biological data. Several key uncertainties are listed below, and a more detailed discussion is provided in the BERA (2005):

- EPCs were used to represent the entire forage area, which assumes that an animal forages only in that area of the Site (likely to overestimate risk).
- The exposure point concentration used was generally the maximum concentration for the area (likely to overestimate risk).
- The exposure point concentration includes a component attributable to natural background (likely to overestimate site-related risk).
- Some exposure pathways could not be evaluated with existing methods and data. These include dermal exposure, inhalation exposure, and the ingestion by wildlife of salt deposits potentially contaminated with COCs at the edges of the pits and other wet areas (likely to underestimate risk).
- Receptor life history data were based on the scientific literature, often developed for different species, the same species from a different region, or under conditions that differ from site conditions (could overestimate or underestimate risk).
- The effect of potential interactions (synergy, antagonism) between multiple contaminants is difficult to estimate (could overestimate or underestimate risk).
- For aquatic exposures, benchmarks for hardness-dependent metals were compared to site data adjusted to a hardness of 30 mg/L as CaCO₃. (Since water hardness levels at most of the aquatic areas evaluated are generally above this hardness, the benchmarks could overestimate risk).

7.2.8 Summary of Ecological Risks

Based on multiple lines of evidence, the BERA concludes that site contamination poses risk in the three ecosystems at the Site: aquatic, riparian/wetland, and terrestrial. The specific contaminants contributing to the ecological risk and the magnitude of the contribution vary greatly among areas of the Site.

Aquatic and terrestrial risks were greatest in the Mined Area and the mine drainages south of the Mined Area. Concentrations of COCs in sediments and water are lower in Blue Creek than in the Mined Area and mine drainages. Given the contribution of background to the total risk, site-related risks in Blue Creek are moderate to low. Benthic community data show moderate impacts in the mine drainages and Blue Creek, but variable stream flow rates and other confounding factors may contribute to these results.

A number of metals were identified as risk drivers due to high HQs. Some of these metals exceed ecological benchmarks in background, but were significantly higher than background at the Site. These ecological risk drivers are identified in Table 7-14.

Table 7-14. Risk Drivers for Protection of Ecological Receptors			
Contaminant	Surface Water	Sediment	Surface and Stockpile Material
Aluminum	X		
Barium	X		
Beryllium	X		
Cadmium	X		X
Chromium		X	
Cobalt	X		
Copper	X		
Lead	X		X
Manganese	X	X	
Nickel	X		
Selenium		X	
Silver	X		
Uranium	X	X	X
Vanadium		X	
Zinc	X		

7.3 BASIS FOR ACTION

Contaminants in surface water, groundwater, surface materials, and air represent a threat to human and ecological receptors. The chance of an individual developing cancer or noncarcinogenic effects related to exposure to site media exceeds the acceptable risk range identified in the NCP. Site concentrations of toxic contaminants are above levels that the human population, including sensitive subpopulations, can safely be exposed to, incorporating an adequate margin of safety. Aquatic and terrestrial ecological receptors may also be harmed by exposure to surface water, sediments, and surface materials.

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment.

SECTION 8 – REMEDIAL ACTION OBJECTIVES AND CLEANUP LEVELS

Remedial Action Objectives (RAOs) are medium-specific or location-specific goals for protecting human health and the environment. This section presents the RAOs for surface materials, surface water, sediments, groundwater, and air. It also presents cleanup levels for these media, based on site risks and regulatory requirements, including potentially applicable or relevant and appropriate requirements (ARARs). A description of the key ARARs and regulatory requirements is provided in Section 14. These RAOs and cleanup levels provide the basis for developing and evaluating the protectiveness of cleanup alternatives presented in Section 9.

8.1 NEED FOR REMEDIAL ACTION

The uranium mining operations at Midnite Mine have resulted in widespread distribution of contaminated surface materials in and near the Mined Area, as well as impacts to surface water, sediments, groundwater, and air. Conditions at the Site pose human health and ecological risks which warrant remedial action.

Section 6 discusses land uses at the Midnite Mine Site. Human health remediation goals are based on the reasonably anticipated future land use at the Site. In the absence of remedial action, site conditions pose risks substantially greater than EPA's risk range for the future land uses assumed in the risk assessment and for land uses currently contemplated for the Site. Site risks are also unacceptable for industrial/commercial land uses (as demonstrated in Section 7.1.8, Uncertainties).

In the absence of remedial action, Site conditions would result in risks greater than 10^{-4} for tribal subsistence uses of the site by nonresidents of the Site and for residential and recreational uses of the site, and would also result in unacceptable risks for default residential and occupational scenarios (See Section 7.1.9)

Key COCs for protection of human health at the mine are radioactive isotopes of uranium (U-234, U-238) and their decay products, such as radium-226, radon gas (radon-222), lead-210, and others. Manganese is a COC for both human and ecological health, and a number of other metals are COCs for ecological health, most notably in surface water, with a shorter list of COCs in sediment and surface material.

Based on the results of the Human Health Risk Assessment and the Baseline Ecological Risk Assessment, the response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances into the environment.

8.2 REMEDIAL ACTION OBJECTIVES

The RAOs for contaminated media at the Site are presented in the following sections.

8.2.1 Surface Material and Sediments

Surface material includes soil, ore, proto-ore, waste rock, overburden, and materials used in haul road construction. Sediments include sediments in pits, 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 Mined Area to areas outside of the Mined Area. Prevent people from removing mining-affected surface material.

8.2.2 Surface Water

Surface water includes seeps and water in pits, ponds, and other surface impoundments, and in creeks and drainages. RAOs 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.

8.2.3 Groundwater

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.

8.2.4 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.

8.3 CLEANUP LEVELS

This section describes the basis for cleanup levels for surface water, groundwater, surface material, sediment, and air for protection of human health and the environment.

Under the NCP, EPA is expected to select a remedy that achieves an excess human health cancer risk of between 10^{-4} and 10^{-6} . For the Midnite Mine Site, the cleanup levels are generally based on background levels rather than on concentrations based on risks, because most of the regulatory standards and risk-based concentrations for the Site are below background levels. Environmental media in un-impacted areas near the site contain naturally elevated levels of certain metals and radionuclides. Generally, under CERCLA, cleanup levels are not set at concentrations below natural background levels. (See Section 104[a][3][A] of CERCLA.) In some instances, such as the Spokane Tribe water quality standards, the regulatory standard itself allows for the use of background, as described below.

Due to the known carcinogenic potency of radionuclides, fractional increases in concentrations of radionuclides can lead to a significant increase in risk. By setting background as the cleanup level, this remedy will reduce site-related risks to levels associated with natural conditions.

While regulatory standards and risk-based concentrations must be considered in the development of cleanup levels, EPA guidance and policy do not recommend that cleanup levels be established at levels below background, even if the background level exceeds an ARAR or risk-based concentration. Where a regulatory standard or risk-based concentration is greater than the background level, the standard or risk-based concentration is used as the cleanup level.

Background levels were determined for the Site during the RI/FS. The background levels are concentrations of COCs in environmental media, determined from a distribution of measured values using statistical parameters (specifically, the 95% upper tolerance [95% UTL] of background data) or, in limited cases, the maximum measured value from the background area.

Since there is uncertainty in any determination of background (see Section 5.3.1.1), surface water, groundwater, and sediment cleanup levels which are based on background may be revised during remedial design if EPA determines that new information warrants such revision. Changes in a cleanup level would require an Explanation of Significant Differences or a ROD amendment.

8.3.1 Cleanup Levels for Surface Water

Cleanup levels for surface water are set forth in Table 8-1. For several contaminants of concern in surface water, the cleanup levels are based on background levels. This means that the surface water will be returned to natural conditions for these contaminants of concern rather than to more stringent levels established in other laws, guidances, or the baseline risk assessments. The cleanup to background concentrations in circumstances of elevated background concentrations is consistent with Section 104(a)(3)(A) of CERCLA. It is also specifically authorized by the Spokane Tribe Surface Water Quality Standards if natural conditions exceed a specific standard.

Table 8-1. Cleanup Levels for Midnite Mine Surface Water			
COC	Cleanup Level	Driver of Risk	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
Notes: µg/L = micrograms per liter pCi/L = picoCuries per liter ^a Criteria are hardness dependent. Cleanup level calculated at a hardness of 100 mg/L as CaCO ₃ . Actual ARARs are equations used to derive the values.			

For the remaining contaminants of concern, it is not necessary to clean up to background since a protective concentration is available based on laws, guidances, or risk assessments, including ecological benchmarks developed by EPA.

Surface water cleanup levels are to be achieved at the completion of the remedy. At Midnite Mine, most of the potential remedies include source control actions followed by a period of natural contaminant attenuation in surface water and groundwater. During this period, which varies among alternatives, some COCs in surface water would be expected to exceed cleanup levels.

The cleanup levels apply to point discharges to surface water. Such discharges are also subject to substantive requirements of the Clean Water Act (CWA) NPDES program, specifically discharge limits that address pollutants or contaminants likely to lead to an exceedance of applicable water quality standards in the receiving water. For off-site discharge, such limits would be established by EPA through issuance of a NPDES permit.

8.3.2 Cleanup Levels for Groundwater

Cleanup levels for groundwater are set forth in Table 8-2. Cleanup levels for contaminants of concern in groundwater are based on background levels. This means that the groundwater will be returned to natural conditions for these contaminants of concern rather than to more stringent levels established in other laws, guidances, or the baseline risk assessments. The cleanup to background concentrations in circumstances of elevated background concentrations is consistent with Section 104(a)(3)(A) of CERCLA. It is also specifically authorized by the Spokane Tribe Hazardous Substances Control Act (HSCA) if natural conditions exceed a specific standard.

Table 8-2. Cleanup Levels for Midnite Mine Groundwater			
COC	Cleanup Level	Driver of Risk	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
Notes: µg/L = micrograms per liter pCi/L = picoCuries per liter			

CERCLA and the NCP provide that groundwater should be returned to its beneficial uses within a reasonable timeframe wherever practicable. When restoration of groundwater is not practicable, then it is necessary to prevent further migration of the plume and to prevent exposure to the contaminated groundwater (40 CFR 300.430[a][1][ii][F]). The NCP provides that groundwater cleanup levels should generally be attained throughout the contaminated plume. However, the NCP recognizes that groundwater may remain contaminated at and beyond the edge of the waste management area when waste is left in place (55 Federal Register 8713, 8753, March 8, 1990). Waste management areas at this site differ for the different cleanup alternatives and consist of areas where waste rock would be contained under a soil cover for purposes of controlling ARD sources and protecting groundwater.

Cleanup levels for groundwater must protect surface water. For this reason, surface water cleanup levels are applicable to groundwater at the point where groundwater discharges to surface water.

Groundwater cleanup levels are to be achieved at the completion of the remedy. As with surface water, the potential remedies evaluated include a period of groundwater contaminant attenuation following source control. During this period, which varies among alternatives, some COCs in groundwater would be expected to exceed cleanup levels.

8.3.3 Cleanup Levels for Surface Material

Cleanup levels for surface material are set forth in Table 8-3. Cleanup levels for several contaminants of concern in surface material are based on background levels. This means that the surface material will be returned to natural conditions (i.e., conditions prior to mining) for these contaminants of concern rather than to more stringent levels established in other laws, guidances, or the baseline risk assessments. The cleanup to background concentrations in circumstances of elevated background concentrations is consistent with Section 104(a)(3)(A) of CERCLA. It is also specifically authorized by the Spokane Tribe Hazardous Substances Control Act (HSCA) if natural conditions exceed a specific standard. Cleanup to background concentrations of radionuclides addresses site-related risks from external radiation exposure related to surface material.

Table 8-3. Cleanup Levels for Midnite Mine Surface Material			
COC	Cleanup Level	Driver of Risk	Basis of Cleanup Level
Uranium (Total)	43 mg/kg	Human Health and Ecological	Background
Lead-210	7.5 pCi/kg	Human Health	Background
Radium-226	4.7 pCi/g	Human Health	Background
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. pCi/g = picoCuries per gram mg/kg = micrograms per kilogram			

8.3.4 Cleanup Levels for Sediments

Cleanup levels for sediments are set forth in Table 8-4. Cleanup levels for several contaminants of concern in sediments are based on background levels. This means that the sediment will be returned to natural conditions for these contaminants of concern rather than to more stringent levels established in other laws, guidances, or the baseline risk assessments. The cleanup to background concentrations in circumstances of elevated background concentrations is consistent with Section 104(a)(3)(A) of CERCLA. It is also specifically authorized by the Spokane Tribe HSCA if natural conditions exceed a specific standard.

For the remaining contaminants of concern (chromium), it is not necessary to clean up to background since a protective concentration is available based on laws, guidances, or risk assessments, including ecological benchmarks developed by EPA.

Table 8-4. Cleanup Levels for Midnite Mine Sediments			
COC	Cleanup Level	Driver of Risk	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
Notes: pCi/g = picoCuries per gram mg/kg = micrograms per kilogram			

8.3.5 Cleanup Levels for Air

For air, the cleanup level for radon-222 is based on the EPA standard for radon release rates (20 picoCuries per square meter per second) at inactive uranium mill tailings sites closed under 40 CFR 192.02(b)(1) and 40 CFR 61.222(a). This ARAR is based on restricted land uses in areas where waste is contained under a soil cover. 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.

8.4 ESTIMATED AREAS AND VOLUMES OF WASTE, AND ESTIMATED PIT CAPACITIES

Remedial alternatives were developed in the FS to meet the remedial action objectives and cleanup levels. Detailed information used to support the development of the alternatives and to estimate costs are provided in the FS.

Figure 1-2 shows the approximate areas where site environmental media exceed cleanup standards (i.e., MA and MAA areas). The area where either alluvial or bedrock groundwater, or both, exceed background is approximately 380 acres.

Waste footprints and volumes, including 19,000,000 cubic yards of waste rock, ore, and protore, are shown on Table 8-5. A summary of physical characteristics of the pits, including backfill capacity, is provided in Table 8-6.

Table 8-5. Volumes of Waste Rock, Ore, and Protore			
Waste Type	Stockpile or Area	Estimated Footprint Area (acres)	Estimated Volume (cubic yards)
Ore and Proto-Ore	Various Stockpiles	40	1,500,000
Waste Rock Piles	South Spoils, East Dump, Hillside Dump, Others	197	14,800,000
Waste Rock in Backfilled Pits	Boyd Pit, Pit 2, Pit 2 West, Adit Pit	17.5	2,200,000
Soil Excavated from Haul Roads	East Haul Road, West Haul Road, Others	9	56,000
Contaminated Sediments from Drainages and Open Pit	Eastern, Western, Central Drainages; Pits 3 and 4.	38	27,000
Over-Excavation ^a	Mined Area	260	420,000
Total Waste Volume:			19,000,000
Total Waste Volume Minus Backfilled Pits:			16,800,000
^a Overexcavation of 1 foot of intermixed waste rock and native soil.			

Table 8-6. Summary of Physical Characteristics of the Open Pits and Backfilled Pits						
Pit	Estimated Footprint Area (acres)^a	Estimated Total Volume (cubic yards)^b	Side Slope Range (horizontal: vertical)^c	Maximum Width East-West (ft)	Maximum Width North-South (ft)	Maximum Depth (ft)^d
Pit 3	49	16,000,000	0.3:1 to 0.8:1	1,200	2,300	457
Pit 4	30	4,800,000	0.4:1 to 0.7:1	730	2,040	297
Backfilled Pits	17.5	2,200,000	1:1 to 7:1	600	1,300	165
^a Based on fill prism footprint area for Pit 3 and Pit 4 (FS, Appendix E). Backfilled Pit Area based on estimates in Table 4-3 of the RI.						
^b Based on total fill prism volume capacity for Pit 3 and Pit 4 (FS, Appendix E).						
^c The side slopes are based on slopes measured between benches and access roads when applicable.						
^d Estimated from high point on highwall to pit bottom.						

SECTION 9 – DESCRIPTION OF ALTERNATIVES

Eight alternatives were retained for detailed analysis in the Feasibility Study (FS). The alternatives differ largely in how effectively the alternatives reduce the generation of ARD through containment of the mine waste and how the alternatives treat the ARD that is generated. Containment in every case includes grading of the waste and placement of a vegetated soil cover to reduce infiltration and meet soil and radon cleanup levels. Water treatment methods also vary and include treatment of water in situ (i.e., where it is underground) and treatment in an ex situ system using the same process as the existing water treatment plant.

Alternatives 1 and 2 do not include containment of mine waste:

- **Alternative 1:** No Action.
- **Alternative 2b:** Institutional Controls (IC), Monitoring, and Continued Existing Water Treatment.

Alternative 3 includes above-grade containment of most mine waste, with variations in water treatment:

- **Alternative 3c:** Above-Grade Consolidation and Containment of Surface Materials and Expanded Water Collection and Ex Situ Treatment.
- **Alternative 3d:** Above-Grade Consolidation and Containment of Surface Materials and *In situ* Groundwater and Pit Water Treatment.

Alternative 4 includes containment of some mine waste in pits, with variations in water treatment:

- **Alternative 4d:** Amendment and Consolidation of Surface Materials in Pits (Partial Backfill) and Water Treatment in Pit 3.
- **Alternative 4e:** Consolidation of Surface Materials in Pits (Partial Backfill) with Pit Drains and Ex Situ Water Treatment.

Alternative 5 with containment of all mine waste in pits, with variations in water treatment:

- **Alternative 5a:** Complete Backfill of Open Pits with Above-Grade Surface Materials in Pits with Pit Drains and Ex Situ Water Treatment.
- **Alternative 5c:** Excavation of Backfilled Pit Area, Complete Backfill of All Surface Materials in Pits with Pit Drains, and Ex Situ Water Treatment.

Alternatives 2b, 3c, 4e, 5a, and 5c include only treatment at an ex situ water treatment plant, using the existing chemical precipitation process. Alternatives 3d and 4d include in situ (i.e., in place) water treatment. Each alternative would contain the waste under a vegetated soil cover to limit radiation levels and radon at the surface and to reduce the generation of ARD. Table 10-1 provides an overview of these and other elements of the six alternatives that include waste containment.

Under all alternatives, there would be a period of recovery until cleanup levels are achieved for sediments, surface water, and groundwater. For this reason, interim institutional controls are included for all alternatives until the cleanup levels for surface water, sediment, and groundwater are achieved. The area and duration of these controls is uncertain but would likely vary among the alternatives due to differences in containment effectiveness. In addition, for all alternatives permanent institutional controls on land use would be required in the waste containment areas. The area needed for waste containment differs among the alternatives.

For Alternatives 1 and 2b, it is not anticipated that the cleanup levels for water and groundwater would be achieved sitewide within the foreseeable future. For the other alternatives, it is estimated that a recovery period of one to several decades would be required to achieve cleanup levels for these media. The recovery periods for Alternatives 5a and 5c are expected to be somewhat shorter than for Alternatives 3c, 3d, 4d, and 4e.

Water treatment and sludge generation rates vary among the alternatives, as does the amount of earthmoving and the volumes of cover material needed. Cover material volume varies because of the different surface areas to be covered, but will also depend on the source and nature of material available. The table shows present worth costs estimated based on the assumption of off-site disposal of the WTP sludge and conservative volumes and haul distance for the cover material.

Present worth costs were estimated in the FS for two cost analysis scenarios: a 30-year period of analysis with a discount rate of 7 percent and a 140-year period of analysis with a discount rate of 3.1 percent. Consistent with the NCP, CERCLA guidance (1988) recommends that costs be included in the FS based on a standard 7 percent discount rate and 30-year period for national consistency. More recent CERCLA guidance (2000) recommends that cost estimates be provided that take into account the remedial period of performance and notes that a different discount rate may be appropriate, for example where cost estimates which have large future year expenditures. The 3.1 percent discount rate is well supported by federal documentation (January 2005 update of the Office of Management and Budget *Circular A-94*), while the 140-year period of analysis better accounts for the long-term O&M needed at the Site under all alternatives. Total and O&M costs estimated using the two scenarios are provided following the narrative descriptions for each alternative.

A number of elements are common to most or all of the alternatives, as described below:

- ***Common Elements – Cover Systems***

Under Alternatives 3, 4, and 5, containment of the mine waste beneath an engineered cover is a major element. The cover would be designed to perform many functions, including:

- Eliminating the direct exposure pathway for humans and ecological receptors to COCs.
- Reducing radon flux and external radiation exposures to acceptable levels.
- Reducing percolation of surface water and diffusion of oxygen through potentially reactive waste materials (i.e., mine wastes that may leach contaminants).
- Supporting vegetation and limiting uptake of COCs through plant roots.

Alternatives 3 and 4 assume a simple soil cover would be used. The cover would be thickest over areas of ore and proto-ore because these materials release more radiation and radon and tend to leach more contaminants. Areas of about 240 acres and 260 acres would be covered under the variants of Alternatives 3 and 4, respectively.

Alternative 5c assumes a synthetic liner would be included under the soil cover. The liner would be relatively impermeable to movement of radon, radiation, and water. Areas of about 97 acres and 80 acres would be covered under Alternatives 5a and 5c, respectively.

As noted above, variations in the waste containment area “footprint” affect the volume of material needed for the cover. In addition, the cover thickness necessary to achieve radon cleanup levels varies depending on the borrow material characteristics, such as loam, clay, or sand content. Details of the cover design and sources of cover construction materials would be further evaluated during remedial design.

- ***Common Elements – Water Treatment and Sludge Disposal***

Each of the alternatives (except the No Action Alternative) includes treatment of contaminated site water. Treatment would be conducted ex situ in a water treatment plant (WTP) using the existing chemical precipitation process. Alternatives 3d and 4d would treat water in situ, with further treatment in the WTP as needed. Water treatment using a chemical precipitation process is currently conducted at the Site by Dawn, and the WTP effluent must meet discharge limits set forth in an existing NPDES permit.

As part of a Superfund remedial action, the WTP effluent will be subject to ARARs if discharged on site. If discharged off-site, discharge limits will be established in a new NPDES permit separate from the Superfund process. Some modifications to the existing treatment process may be needed to meet the ARARs or updated permit limits.

The existing plant is over 20 years old and is constructed on top of mine waste. Alternatives that include moving the waste require a replacement treatment plant earlier than other alternatives. Periodic replacement of the WTP is assumed every 30 years under all alternatives.

The chemical precipitation process produces a sludge that contains the treatment chemicals, contaminants, and other metals and metalloids. Because the sludge contains certain radionuclides and heavy metals, it must be disposed of in a facility that is designed to limit human exposure and migration of contaminants in surface water and groundwater to acceptable levels. Currently, the sludge is disposed of at the Dawn Mill in Ford, Washington, just outside of the Spokane Indian Reservation. The mill is undergoing closure, and an alternative disposal location will be needed. Depending on the scheduling of the closure activities, the new location will probably be needed between 2008 and 2010.

In the RI/FS, EPA evaluated the potential for changes to the treatment process that would achieve the Spokane Tribe's water quality standard for sulfate of 250 mg/L. Removal of sulfate to low levels is technically challenging and would increase sludge production rates and off-site disposal costs significantly. For this reason, the FS included the option of relocating the discharge point to a location where mixing would achieve the standard at the edge of a mixing zone and would be inaccessible to humans and ruminants, receptors for which sulfate exposure at this level is of potential concern.

In addition, the RI/FS assessed ways to alter the characteristics of the sludge to reduce disposal costs. Ion exchange resins were previously tested by Bureau of Mines and can be used to remove uranium from the water before other contaminants are precipitated to form sludge. This would reduce radiation levels in the sludge by over 95 percent and change the waste from low-level radioactive waste to "special waste" that can be safely disposed of at a lower cost.

The estimated costs presented in this section are based on the assumption that the sludge would be disposed of at the U.S. Ecology low-level radioactive waste disposal facility in Richland, Washington, after closure of the mill. The sludge would be further processed on Site to remove excess water prior to transport to the facility.

- ***Common Elements – Gravel Haul Roads and Sediments***

Each of the variants of Alternatives 3, 4, and 5 include response actions to address potential exposures to surface gravel and soil on and adjacent to the haul roads. Response actions for the gravel haul roads include access controls, containment, and excavation. In addition, the variants of Alternatives 3, 4, and 5 address sediments in the mine drainages and Blue Creek. Response actions for sediments include in-place stabilization and excavation of contaminated sediments. Sediment response actions would be implemented after containment of the mine waste was completed to reduce the potential for recontamination.

9.1 ALTERNATIVE 1 – NO ACTION

Description: Alternative 1 includes no actions to protect human health and the environment. Collection and treatment of contaminated water would be discontinued. No actions would result in no remedial costs.

9.2 ALTERNATIVE 2B – INSTITUTIONAL CONTROLS AND CONTINUED EX SITU WATER TREATMENT

Description: Alternative 2b represents current conditions, with the addition of institutional and access controls to limit exposure of humans to contamination. Current conditions include collection of contaminated seeps and seasonal treatment of the collected water in the water treatment plant. Costs include periodic replacement of the plant and the addition of a filter press to allow disposal of sludge at a commercial low-level radioactive waste facility. No waste containment actions, such as re-grading and covering, would be taken to reduce the potential for direct exposure to the mine waste or contact between the mine waste and water. Access to the Mined Area would be limited by a fence. Use of surface water and groundwater for drinking water or sweat lodges would be limited through use restrictions, such as prohibitions on groundwater well installation. The area of surface water use restrictions would include all of Blue Creek below its confluence with the Eastern Drainage.

The estimated cost of Alternative 2b (in millions of dollars) is summarized below:

	<u>Present Worth</u> <u>140 years/3.1 percent</u>	<u>Present Worth</u> <u>30 years/7 percent</u>
Capital	\$ 2.4	\$ 2.4
O&M	<u>\$116.0</u>	<u>\$42.0</u>
Total Costs:	\$118.4	\$44.4

Because Alternative 2b includes no measures to reduce the production of contaminated water, the estimated long-term costs for treating water and disposing of the treatment sludge are the majority of the total cost.

9.3 ALTERNATIVES 3C AND 3D – ABOVE-GRADE CONSOLIDATION AND CONTAINMENT OF MINE WASTE

Alternative 3c – Above Grade Consolidation and Containment of Mine Waste and Ex Situ Water Treatment and

Alternative 3d – Above Grade Consolidation and Containment of Mine Waste and In Situ Water Treatment

Description: Alternative 3 variants include above-grade containment of mining waste materials, except for waste in the Backfilled Pit Area. The stockpiled ore and proto-ore would be consolidated above grade near the center of the Mined Area. Waste rock areas would be regraded to improve drainage and reduce surface slopes, as necessary. The containment system includes a

“thick” cover over areas containing ore and proto-ore and a “thin” cover over other areas containing waste rock. To protect the containment systems constructed under Alternative 3 and reduce human health risks, institutional controls would prohibit residential and commercial/industrial uses in containment areas, and physical barriers would be used to discourage vehicle traffic in these areas. The size of the restricted use area would be 310 acres.

The open pits would remain open, and fences would be installed to prevent access by humans and large animals. Under Alternative 3c, Pit 3 would continue to be used for storing contaminated seepage and groundwater prior to treatment. The water would be treated ex situ in the water treatment plant, which would be upgraded to meet new discharge requirements. Under Alternative 3d, contaminated seepage would be treated in situ using permeable reactive barriers (PRBs) in downgradient areas of the Site. Water in the open pits would also be treated in situ using a combination of organic and inorganic amendments. Further studies would be needed to determine the exact nature and effectiveness of the in situ treatment systems.

Under Alternative 3c, poor-quality groundwater in the Backfilled Pit Area would be collected for treatment using wells constructed in the waste backfill. Under Alternative 3d, that groundwater would be treated using PRBs near the southern boundary of the Mined Area. Both alternatives address contaminated groundwater that bypasses the current seep collection system at depth. Under Alternative 3c, this groundwater is collected and treated in the water treatment plant. Under Alternative 3d, it is treated in situ using PRBs.

Surface water and groundwater use restrictions would be needed initially, as described under Alternative 2b. However, use restrictions may no longer be needed in areas outside of the Mined Area after a recovery period of one to several decades. Use restrictions in the waste containment areas would be needed for the foreseeable future.

The estimated costs (in millions of dollars) for Alternative 3c and Alternative 3d are shown below:

	<u>Alternative 3c</u>		<u>Alternative 3d</u>	
	<u>Present Worth</u> <u>140 years/3.1%</u>	<u>Present Worth</u> <u>30 years/7%</u>	<u>Present Worth</u> <u>140 years/3.1%</u>	<u>Present Worth</u> <u>30 years/7%</u>
Capital	\$ 71	\$ 71	\$103	\$103
O&M	<u>\$ 81</u>	<u>\$ 30</u>	<u>\$115</u>	<u>\$ 36</u>
Total Costs:	\$152	\$101	\$218	\$139

The estimated cost of Alternative 3d is high largely because of the large volume of high-cost reactive materials needed to construct and replace the PRBs.

9.4 ALTERNATIVES 4D AND 4E – CONSOLIDATION OF MINE WASTE IN OPEN PITS

Alternative 4d – Amendment and Consolidation of Mine Waste in Open Pits (Partial Backfill) and In situ Water Treatment and

Alternative 4e – Consolidation of Mine Waste in Unlined Open Pits (Partial Backfill) with Pit Drains and Ex Situ Water Treatment

Description: Both Alternatives 4d and 4e include placement of the ore stockpiles into Pit 3 and part of the waste rock from the Hillside Dump into Pit 4. This partial backfill would eliminate the pathway for exposure of humans and ecological receptors to contaminated surface water in the pits. Other waste rock areas would be re-graded and covered like Alternatives 3c and 3d. Institutional and access controls would be used in the Mined Area, like Alternatives 3c and 3d. The containment area requiring permanent use restrictions would be 310 acres.

Mine waste in the pits would be below the existing water table elevation. To address the potential for accumulation of poor-quality water in Pits 3 and 4, Alternatives 4d and 4e include different measures. Alternative 4d would allow the pit backfill to be saturated but would include in situ treatment of water in the backfilled pits using organic and inorganic amendments. The amendments would be used by microorganisms which would convert the heavy metals and radionuclides into insoluble forms. If this approach is successful, contaminated seepage could also be pumped and treated in the pits. Alternative 4e does not allow the pit backfill to become saturated. This alternative would include a passive drainage system, which would divert any water that enters the pit into a collection sump at the low point of the pit. That water would drain out of the pit through an inclined borehole in the bedrock. Where the borehole daylights south of the Mined Area, the water would be collected for treatment.

To address poor-quality groundwater from the backfilled pits, seeps, and groundwater would be collected for treatment near the southern boundary of the Mined Area. Both Alternatives 4d and 4e include collection and treatment of contaminated groundwater that flows below and past the current seep collection system.

Surface water and groundwater use restrictions would be needed initially; however, use restrictions may no longer be needed in areas outside of the Mined Area after a recovery period of one to several decades. Use restrictions would be needed within the Mined Area for the foreseeable future.

The estimated costs (in millions of dollars) of Alternatives 4d and 4e are summarized below:

	<u>Alternative 4d</u>		<u>Alternative 4e</u>	
	<u>Present Worth</u> <u>140 years/3.1%</u>	<u>Present Worth</u> <u>30 years/7%</u>	<u>Present Worth</u> <u>140 years/3.1%</u>	<u>Present Worth</u> <u>30 years/7%</u>
Capital	\$114	\$114	\$ 86	\$ 86
O&M	\$ <u>63</u>	\$ <u>22</u>	\$ <u>81</u>	\$ <u>30</u>
Total Costs:	\$177	\$136	\$167	\$116

Similar to Alternative 3d, treatability studies would be needed to better evaluate the effectiveness and cost of the in situ water treatment included under Alternative 4d.

9.5 ALTERNATIVES 5A AND 5C – CONSOLIDATION OF MINE WASTE IN OPEN PITS AND EX SITU WATER TREATMENT

Alternative 5a – Consolidation of Mine Waste in Open Pits (Complete Backfill) with Pit Drains, and Ex Situ Water Treatment and

Alternative 5c – Excavation of Backfilled Pits, Consolidation of Mine Waste in Open Pits (Complete Backfill) with Pit Drains, and Ex Situ Water Treatment

Description: Alternative 5c was initially proposed by the Spokane Tribe. Alternative 5a and Alternative 5c include containment of all the mine waste in mine pits. Under both alternatives, Pits 3 and 4 would be backfilled to or above pre-mining surface elevations. However, the alternatives include different measures to address waste in the existing Backfilled Pit Area. Under Alternative 5a, all mine waste except that already contained in the existing backfilled pits would be excavated and placed in Pits 3 and 4. Under Alternative 5c, all mine waste including that contained in the existing backfilled pits would be excavated and placed in Pits 3 and 4.

Both alternatives include a vegetated soil cover over the backfilled pits to minimize infiltration and ARD generation. Both would include a sump and drainage layer in Pits 3 and 4, so that water entering the pits would flow to the drainage layer and sump below the waste rock. Under Alternative 5a, water entering the pits would flow by gravity from the pit sump through inclined borings for collection at the surface (i.e., passive drains). Under Alternative 5c, the water would be actively pumped from the pit sumps using wells. In both cases, water from Pits 3 and 4, would be treated in the WTP.

Under Alternative 5c, waste rock in the existing Backfilled Pit Area would be excavated and consolidated in the open pits. A channel would be excavated so that surface water and groundwater entering the excavated Backfilled Pit Area would flow to a collection point for treatment. Under Alternative 5a, a passive drain would channel water entering the Backfilled Pit Area to a collection point. In both cases, water from the Backfilled Pit Area would be treated in the WTP. Under Alternative 5c this water was assumed to include a larger component of precipitation, leading to higher volumes of less contaminated water.

Alternative 5c includes the use of synthetic liners above the waste as an element of the Pit 3 and Pit 4 covers. Synthetic liners would also be used at the base of the waste backfill to keep the waste separate from the drainage layer.

Under both alternatives, areas of the watershed currently buried under mine waste would be restored to approximately pre-mining topography, except in areas excavated during mining. Alternatives 5a and 5c would not include collection of surface water that did not contact waste.

Institutional and access controls would be required in the waste containment areas, as under the other alternatives; however, the size of the restricted use area would be reduced to 97 acres and 80 acres under Alternative 5a and Alternative 5c, respectively.

Surface water and groundwater and use restrictions would be needed initially; however, use restrictions may no longer be needed in areas outside of the waste containment areas after a recovery period of one to several decades. Use restrictions within the waste containment areas would be needed for the foreseeable future.

The estimated costs (in millions of dollars) of Alternatives 5a and 5c are summarized below:

	<u>Alternative 5a</u>		<u>Alternative 5c</u>	
	Present Worth <u>140 years/3.1%</u>	Present Worth <u>30 years/7%</u>	Present Worth <u>140 years/3.1%</u>	Present Worth <u>30 years/7%</u>
Capital	\$118	\$118	\$125	\$125
O&M	<u>\$ 41</u>	<u>\$ 15</u>	<u>\$ 29</u>	<u>\$ 11</u>
Total Costs:	\$159	\$133	\$154	\$136

SECTION 10 – SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA uses nine criteria to evaluate the remedial alternatives. Two of the evaluation criteria (Protection of Human Health and the Environment and Compliance with ARARs) are called “threshold criteria.” Alternatives that do not meet the threshold criteria are not evaluated using the remaining seven criteria. Alternatives that meet the threshold requirements are further evaluated using the five “balancing criteria” (Long-Term Effectiveness and Permanence; Short-Term Effectiveness; Implementability; Reduction of Toxicity, Mobility or Volume through Treatment; and Cost).

The remaining two criteria (Tribal Acceptance and Community Acceptance) are “modifying criteria” which take into account comments received on the Proposed Plan. This section refers to alternatives by number (e.g., Alternatives 2, 3, 4, and 5). Variations of an alternative (e.g., Alternative 3c and 3d) are specified only if the variations differ in terms of the criterion being discussed.

Some of the information developed to support the comparative evaluation of the alternatives in the FS is summarized on Table 10-1 and referenced in the following sections. More detailed information is available in the FS and Administrative Record.

10.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion evaluates whether an alternative achieves and maintains protection of human health and the environment.

Alternative 1 (No Action) is not protective of human health and the environment. All of the other alternatives would protect human health. Alternative 2 would not be protective of the environment.

The alternatives rely to different degrees on access restrictions and institutional controls to ensure human health protection. Alternative 2 relies on institutional controls and access restrictions (such as a fence) to prevent direct exposure to contaminants in the waste rock, as well as radiation, radon, and contaminated water and foods in the Mined Area. These controls and restrictions would be required indefinitely for the whole Mined Area. Access restrictions such as Mined Area fencing would reduce risks for larger animals but would not reduce exposure to waste and contaminated pit water for smaller animals and birds.

Alternative 2 also would not reduce ARD formation or prevent loading of contaminants to groundwater and surface water. Like the other alternatives, Alternative 2 relies on institutional controls to limit human exposures in the Mining Affected Area, including Blue Creek. However, the institutional controls would be needed for the indefinite future and would not protect ecological receptors.

Table 10-1. Summary Information for Remedial Alternatives

	Alternative 2b	Alternative 3c	Alternative 3d	Alternative 4d	Alternative 4e	Alternative 5a FS ^b	Alternative 5a (preferred) ^c	Alternative 5c
Total Cost (millions) ^a	\$118	\$152	\$218	\$177	\$167	\$159	\$152	\$154
Capital Cost (millions)	\$2.4	\$71	\$103	\$114	\$86	\$118	\$123	\$125
Present Worth O&M Cost (millions):	\$116	\$81	\$115	\$63	\$81	\$41	\$29	\$29
Areas of Restricted Access (in acres)	350	260	260	280	280	97	97	80
Sludge to be Disposed of (in cubic feet per year)	12,000	5,800	1,300	2,900	5,800	2,000	1,000	1,000
Water Needing Treatment (in millions of gallons per year)	80	38	16	Up to 37	38	13	6.5	10
Cover Construction Materials Needed (in cubic yards)	None	1–2 million	1–2 million	1–2 million	1–2 million	600 thousand	600 thousand	400 thousand
Earthmoving On-Site (in cubic yards)	None	~5,000,000	~5,000,000	~5,000,000	~5,000,000	~17,000,000	~17,000,000	~19,000,000
Time to Construct (in years)	None	2–3	2–3	4–5	4–5	6–8	6–8	7–9
^a Present worth estimate, based on 3.1% discount rate, 140-year period. ^b Alternative 5a from Feasibility Study. ^c Preferred Alternative as presented in the Proposed Plan, EPA, September 2005.								

Alternatives 3, 4, and 5 all include waste containment and capture of ARD water for treatment. For these alternatives, the containment provides comparable protection for human health and the environment related to soil ingestion, plants in the Mined Area, and radiation and radon levels at the surface. Alternative 3 would rely on institutional controls and access restrictions to limit human and large animal exposures to water in the pits. This pathway would be eliminated under Alternatives 4 and 5, which involve partially or completely backfilling the pits.

Different waste containment “footprints” for Alternatives 3, 4, and 5 result in different land areas requiring access restrictions (a boulder barrier to prevent vehicle access) and permanent institutional controls to protect the containment remedy. Smaller areas are easier to maintain and to monitor the effectiveness of access restrictions and institutional controls. Alternative 5, with the smallest footprint, has the smallest area requiring access restrictions and permanent institutional controls. Alternatives 3 and 4 require access restrictions and institutional controls for a larger area.

Containment also reduces ARD formation. The degree of ARD reduction differs among alternatives. Alternatives 3 and 4, with larger “footprints” than Alternative 5, are likely to produce ARD in higher volumes and capture ARD less effectively. The more effectively ARD water is captured, the sooner groundwater and surface water can begin to recover. Thus, institutional controls on groundwater and surface water use outside the containment area may be needed for a shorter time under Alternative 5 than Alternatives 3 and 4, and protection of ecological receptors will take place sooner.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA and 40 CFR 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate requirements (ARARs) unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site” address problems or situations sufficiently similar to those encountered at the CERCLA site, and that the use of these standards is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be applicable or relevant and appropriate.

CERCLA Section 126 directs EPA to afford Indian tribes substantially the same treatment as states for certain specified subsections of CERCLA Sections 103, 104, and 105. EPA believes, as a matter of policy, that it is similarly appropriate to treat Indian tribes as states for the purpose of identifying ARARs under Section 121(d)(2) of CERCLA (55 Federal Register 8741, March 8, 1990).

All of the containment alternatives (Alternatives 3, 4, and 5) would meet the NESHAPS radon flux standard for air, UMTRCA standards for radium activity concentrations, and UMTRCA numerical standards for groundwater protection (which is background, where background is greater than the listed standard).

To comply with the Tribal standards for protection of human health for surface water, groundwater, sediment, and surface materials, the concentrations of most COCs need to be reduced to approximately background, or the pathway needs to be eliminated. All of the alternatives other than No Action and Alternative 2 would meet these standards, although the time to achieve the standards may vary. Groundwater within the waste management areas (for containment alternatives 3, 4, and 5) would not be required to meet standards (55 Federal Register 8712, 8753, March 8, 1990). For surface water and groundwater downgradient of the waste management areas, a period of recovery would be needed until compliance with standards is achieved. As noted above, the period of recovery, while not quantitatively predicted, is expected to be shorter for Alternative 5 than Alternatives 4 and 3.

With minor operational modifications, discharge from the current water treatment plant would meet the national recommended water quality criteria and Spokane Tribe Water Quality Standard (WQS) for COCs, adjusted to reflect background levels (see Table 8-1). Water treatment plant discharge would not comply with certain substantive requirements of the Spokane Tribe WQS; however, unless discharged to a larger receiving water than is available on-site and until a mixing zone provision is added to the Spokane Tribe WQS.

10.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion evaluates the ability of an alternative to maintain protection of human health and the environment over time. This criterion is of primary importance among the five balancing criteria.

The following factors were considered in the evaluation of long-term effectiveness:

- Magnitude of the residual risks remaining at the completion of remedial activities.
- Adequacy and long-term reliability of management and technical and institutional controls for providing continued protection from the residual risks.

The primary tradeoffs with respect to the long-term effectiveness and permanence criterion are related to the extent to which the alternatives rely on institutional controls to reduce risk and protect the integrity of waste containment and the ability to effectively enforce these controls, the level of long-term water treatment O&M that would be necessary, and the long-term effectiveness of in situ treatment methods included under Alternatives 3d and 4d.

Alternatives 5a and 5c are ranked highest for long-term effectiveness and permanence. These alternatives rely on institutional controls to achieve protection of human health and protection of the integrity of cover systems for a smaller area (see Table 10-1). The surface water and sediment exposure pathways in the open pits would be eliminated. The areal extent and duration of surface water and groundwater use restrictions needed under these alternatives are less than under other alternatives. Risks from exposure to surface materials, external radiation, radon, surface water, and groundwater would be as low, or lower, than under any other alternative.

Alternatives 5a and 5c are expected to achieve the greatest level of hydraulic containment of mine waste and, as a result, the greatest protection of groundwater and surface water quality with the least long-term O&M. However, if the pit drainage system maintenance is unsuccessful, groundwater could accumulate in the pits and cause poor water quality. In this case, increased O&M efforts would be necessary.

Alternatives 3c and 4e are ranked next highest for long-term effectiveness and permanence. These alternatives rely more on institutional controls than Alternative 5, as the containment area is over twice as large. The areal extent and duration of water and groundwater use restrictions under these alternatives are somewhat greater than under Alternative 5. Under Alternative 4e, the surface water and sediment exposure pathways in the open pits would be eliminated. Under Alternative 3c, a fence would be used to prevent exposure, which would be less permanent.

Under Alternatives 3 and 4, long-term O&M needed to treat water and dispose of sludge is expected to be more than under Alternatives 5a and 5c. The covers used under Alternatives 3c and 4e would not be expected to achieve the same level of isolation as Alternative 5. Long-term maintenance of the pit drainage system under Alternative 4e, if unsuccessful, could result in poor quality groundwater in the pits. In this case, increased O&M efforts would be necessary.

Alternatives 3d and 4d are ranked next highest for long-term effectiveness and permanence. The long-term reliability of in situ water treatment is less certain than the ex situ treatment systems of Alternatives 3c and 4e. The performance and maintenance requirements of the in situ treatment actions would need to be evaluated using treatability studies. While in situ treatment could reduce the O&M associated with sludge disposal, it would require intensive monitoring and periodic replacement or reapplication of reactive media for PRBs, amendments for pit lakes, and nutrients for pit backfill. Alternative 4d would be subject to the potential for poor quality groundwater in the pits if in situ treatment proves ineffective.

Alternative 2b relies more on institutional controls to achieve protection of human health than other alternatives, including access restrictions (fence) for the entire Mined Area. The fence would be a less reliable control for reducing human risk, and would not significantly reduce risks for ecological receptors. Risks from surface water and groundwater, while significantly reduced compared to No Action, would be higher than under other alternatives, and use restrictions would need to be enforced for the foreseeable future.

10.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

CERCLA states a preference for selecting remedial actions that principally employ treatment technologies to permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances at the Site. There is also a preference for treatment of “principal threats” at a Site through destruction of toxic COCs, reduction of the total mass of toxic COCs, irreversible reduction in constituent mobility, or reduction of total volume of media containing COCs. Section 11 discusses principal threats at the Site.

In determining an appropriate range of alternatives for sites with high volume/low risk waste, EPA has stated its position in the regulations, as well as guidance documents. Specifically, EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable (40 CFR 300.430[a][iii][B]). In addition, EPA Guidance for Conducting RI/FS under CERCLA, Interim Final (EPA 1988) states “Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low-concentrated wastes, such as some municipal landfills and mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved.”

Treatment is not practical given the large volume of overburden material present at Midnite Mine, limitations of treatment technologies potentially implementable for the material, and extreme costs. However, because CERCLA sets forth a statutory preference for remedial actions in which treatment permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, the FS considered treatment of solids as well as groundwater in the screening of alternatives and retained for detailed evaluation only alternatives that included groundwater treatment.

Each of the retained alternatives includes treatment to reduce the toxicity of contaminated water. The primary tradeoffs involve the types and volumes of residuals produced by water treatment and the potential for remobilization of contaminants treated in situ. Because in situ treatment would reduce contaminants but would be unlikely to achieve cleanup standards, continued operation of a water treatment plant is included in all alternatives.

Alternatives 2b, 3c, 4e, 5a, and 5c would use the same ex situ water treatment process, achieve the same reduction in the toxicity of contaminated water, and produce residuals with similar characteristics. Table 10-1 shows the estimated average annual sludge production rates.

In situ treatment methods evaluated include the permeable reactive barriers in Alternative 3d, nutrient amendments to create a reducing environment in Alternative 4d, and lime application to open pit water in Alternative 3d. These treatment technologies address ARD. There is no treatment technology known to reduce or prevent radioactive decay.

10.5 SHORT-TERM EFFECTIVENESS

The short-term impacts of alternatives were assessed by considering the following: 1) Short-term risks that might be posed to the community during implementation of an alternative; 2) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; 3) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and 4) time until protection is achieved.

Alternatives that require less earthwork are ranked more favorably in terms of short-term effectiveness than those involving more extensive earthwork. Less earthwork means less worker risk, less potential for environmental releases during construction, and a shorter time to achieve RAOs related to surface exposure. For example, Alternative 2b would achieve RAOs for human health once the Mined Area was fenced and institutional controls were implemented in the Mined Area and affected areas. The waste containment alternatives (Alternatives 3, 4, and 5) would take 2 to 8 years to achieve RAOs. The waste containment alternatives would need imported construction materials, which could affect the community. Community impacts from the transport of water treatment sludge through the community over the long-term are greater for alternatives which generate higher sludge volumes. Information about the volume of earthwork, sludge disposal volumes, imported construction materials, and time to achieve RAOs is provided in Table 10-1. In terms of this criterion, the alternatives are ranked as follows: Alternative 2b is ranked highest, followed by Alternatives 3c and 3d, then Alternative 4d, then Alternative 4e, with Alternatives 5a and 5c ranked lowest.

10.6 IMPLEMENTABILITY

The implementability of the alternatives was assessed by considering the following factors:

1) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy; 2) Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions); 3) Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and the availability of prospective technologies. While all of the alternatives are implementable, the primary tradeoffs among the Midnite Mine alternatives in terms of implementability are related to five considerations.

The first primary tradeoff is related to the availability of materials, including cover materials, drainage blanket materials, reactive media, and organic amendments. This consideration is greatest for Alternatives 3d and 4d, which require reactive media or amendments for in situ treatment, as well as relatively large cover material volumes. This consideration would also be significant for Alternatives 3c and 4e, which also require relatively large cover material volumes. Alternatives 5a and 5c require the least cover material because these alternatives have the smallest waste footprints; however, both require large volumes of rock for construction of the drainage layer. Materials availability is not a significant consideration under Alternative 2b, which does not require cover material. An administrative implementability consideration related to cover materials is the ability to obtain the approvals needed to develop a source of material.

The second primary tradeoff is the technical feasibility of in situ water treatment included under Alternatives 3d and 4d. Treatability studies would be needed to demonstrate the effectiveness of and design in situ treatment systems.

The third primary tradeoff is related to construction staging to allow the containment and treatment of contaminated water. This consideration is most significant under Alternatives 5a and 5c, which utilize Pit 3 and Pit 4 for waste storage and which have the longest construction times. It is also a consideration under Alternative 4e.

The fourth primary tradeoff relates to the long-term availability of disposal sites for water treatment sludge and spent reactive media. The Richland facility may become unavailable for off-site disposal in the future and alternative disposal options may be more costly. Alternative 2b generates the largest volumes of sludge and would be most affected by disposal limitations. Alternatives 4d, 5a, and 5c generate the smallest volumes of water treatment sludge and would be least affected.

The fifth primary tradeoff relates to the capacity of the open pits to contain mine waste under Alternatives 5a and 5c. Under Alternative 5a, excess material could be placed over the Backfilled Pit Area. Alternative 5c would not have this option and would require more capacity for the waste removed from the Backfilled Pit Area.

Based on these factors, Alternative 2b is ranked highest for implementability, followed by Alternatives 3c, 4e, 5a, 5c, and 3d.

10.7 COST

This criterion includes estimated capital and operation and maintenance costs, as well as estimated present worth costs. Drivers of capital costs vary among the alternatives but include borrow material for covers and drainage layers, earthwork costs, and materials (amendments or reactive materials) for in situ treatment included in some alternatives. Drivers of O&M costs include WTP sludge disposal and replacement materials for in situ treatment. In general, alternatives with higher capital costs for construction of waste containment systems and/or treatment elements lead to reduced sludge generation and associated long costs.

The estimated costs are based on the best available information regarding the anticipated scope of the remedial alternatives. Present worth cost estimates are expected to be accurate with a range of +50 and -30 percent.

Table 10-2 presents a summary of the capital costs, annual O&M costs, and total present worth costs for each of the alternatives developed for detailed evaluation in the FS, assuming off-site sludge disposal, higher borrow material volumes and an off-reservation borrow source.

Table 10-2 shows the effect of two different costing scenarios, assuming 1) a discount rate of 7 percent and a 30-year period of performance, and 2) a discount rate of 3.1 percent and a 140-year period of performance. The latter scenario better addresses long-term O&M needs at the Site and current CERCLA guidance and OMB recommendations. The relative costs of the alternatives differ depending on period of performance and discount rate assumptions used.

Table 10-2. Summary of Capital, Present Worth (PW), O&M, and Total Costs

Alternative	Capital Cost (\$)	Annual O&M Cost (\$)	PW (30 year, 7%) (\$)	PW (140 year, 3.1%) (\$)
2b	2,400,000	3,800,000	44,000,000	118,000,000
3c	71,000,000	2,600,000	101,000,000	152,000,000
3d	103,000,000	1,300,000	139,000,000	218,000,000
4d	114,000,000	1,900,000	136,000,000	177,000,000
4e	86,000,000	2,600,000	116,000,000	167,000,000
5a	118,000,000	1,300,000	133,000,000	159,000,000
5c	125,000,000	900,000	136,000,000	154,000,000
Preferred Alternative ⁵	123,000,000	870,000	133,000,000	152,000,000
<p>Notes:</p> <ol style="list-style-type: none"> 1 Alternatives 2b, 3c, 3d, and 4e include a periodic cost of \$1,600,000 (including contingency) for replacement of the WTP in year 10 and every 30 years thereafter. 2. Alternative 3d includes periodic costs of \$26,000,000 to \$42,000,000 (including contingency) for replacement of the spent reactive media in year 15 and every 15 years thereafter and \$130,000 (including contingency) for reapplication of pit lake amendments in year 5 and every 5 years thereafter. 3. Alternative 4d includes a periodic cost of \$1,500,000 (including contingency) for reapplication of bioreactor amendments in year 30 and every 30 years thereafter . 4. Alternatives 5a and 5c include a periodic cost of \$1,200,000 for replacement of the WTP in year 30 and every 30 years thereafter. 5. Preferred Alternative as presented in the Proposed Plan, EPA, September 2005. 				

10.8 TRIBAL ACCEPTANCE

The Spokane Tribe has reviewed the RI/FS, Proposed Plan, and ROD. In comments on the Proposed Plan, the Spokane Tribe stated its view that, apart from Alternatives 5a and 5c, the FS alternatives are not protective of human health and the environment. For the Spokane Tribe, long-term effectiveness and permanence is of particular importance, since the Spokane Reservation is the permanent homeland of the Spokane Tribe and is comprised of finite resources on which present and future generations of the Spokane Tribe depend to sustain themselves, their resources, and their lifeways in perpetuity.

EPA has taken into consideration the concerns of the Spokane Tribe relating to impacts of the site and alternative response actions on Tribal human health, natural resources, and the environment in evaluating and selecting this remedy. This includes consideration of the fact that the Spokane reservation is the permanent homeland of the Spokane Tribe. The Tribe concurs with the Selected Remedy in this ROD.

10.9 COMMUNITY ACCEPTANCE

This criterion evaluates whether the local community and general public agree with EPA's analyses and preferred alternative.

While the community comments did not generally identify a preference among the alternatives, many indicated that the Tribe's preference should be supported. Long-term funding and commitment to effective containment of the waste and management of the water in perpetuity were key concerns. Community comments were supportive of the need for cleanup and emphasized the importance of addressing Blue Creek human health and ecological issues. Several commenters noted that the uranium at the Site may be a valuable resource in the future and recommended against alternatives that would limit access to the resource.

Environmental groups commented favorably on EPA's preferred alternative, but they echoed the community support for EPA consideration of the Tribe's preferences in remedy selection and concerns regarding long-term funding needs and Blue Creek.

Federal agencies (BIA, FWS) and the Colville Tribe supported both Alternatives 5a and 5c and indicated a preference for off-site disposal of WTP sludge. The State Department of Health raised concerns about the risk assessment but did not comment on a specific alternative.

Comments submitted by the mining companies challenged a number of EPA technical assumptions, approaches to cost estimating, and regulatory interpretations. The mining companies stated that reports prepared by their consultants supported only a remedy along the lines of Alternative 3.

EPA has carefully considered all comments submitted during the public comment period and taken them into account during the selection of the remedy for the Midnite Mine Site. EPA responses to comments received during the public comment period are provided in the Responsiveness Summary (in Appendix B).

SECTION 11 – PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

EPA has stated its position in the regulations as well as guidance documents. Specifically, EPA “expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable” (40 CFR 300.430[a][iii][B]). In addition, EPA Guidance for Conducting RI/FS under CERCLA, Interim Final (EPA 1988) states, “Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low concentrated wastes such as some municipal landfills and mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved.”

Exposed ore, proto-ore and, to a lesser degree, waste rock at the Site pose a significant risk to humans through direct radiation exposure, radon gas inhalation, and soil ingestion. Containment of such materials effectively reduces these risks. As there is no known method to reduce or prevent radioactive decay, treatment of the material to reduce the risk posed by the uranium in these materials is not practicable.

ARD, which mobilizes metals and radionuclides from the waste rock, ore, and proto-ore in surface water and groundwater, is the cumulative effect of bio-geochemical reactions on rock surfaces exposed by mining. The remedial alternatives will reduce the generation of ARD by limiting contact between the rocks and water and treating ARD water that forms.

Treatment of these large volumes of rock to eliminate ARD is not practicable.

This Site is not identified as having principal threat wastes, as defined by EPA, because the waste rock, ore, and proto-ore is not highly concentrated and the toxicity and mobility of contaminants associated with this material is largely a function of the amount of material exposed. The mass and volume of the waste materials and the fact that it cannot be treated to prevent radioactive decay makes treatment impracticable.

SECTION 12 – THE SELECTED REMEDY

The Selected Remedy is Alternative 5a of the Feasibility Study, modified as described below. The Selected Remedy meets the requirement of protection of human health and the environment, while providing the best balance of benefits and tradeoffs among the five balancing criteria—long-term effectiveness and permanence; short-term effectiveness; implementability; reduction in toxicity, mobility, and volume through treatment; and cost. The Selected Remedy will meet the remedial action objectives and cleanup levels presented in Section 8 and the ARARs identified in Section 13, except for ARARs waived as part of an interim action as described below.

12.1 RATIONALE FOR EPA SELECTION

The Selected Remedy is preferred for the following key reasons:

1. The soil cover over the mine waste (which includes waste rock, proto-ore, ore, road gravel and other waste materials) reduces risks from direct soil contact, radiation exposure, and radon. As a result, people and animals using the site and plants at the site will have reduced risk, and people who eat the plants and animals will have reduced risk from dietary pathways.
2. Use of the open and backfilled mine pits for waste containment eliminates the exposure pathway for pit water, pit sediments, and exposed pit walls.
3. Grading and covering the waste in the pits prevents water from precipitation (e.g., rain, snow) from accumulating in the pits and becoming contaminated.
4. Isolating the waste from contact with water through the use of covers, liners, and drainage layers; and removal of water that enters the pit reduces the generation of ARD more than most alternatives.
5. Reduced ARD generation leads to reduced water treatment and residuals management needs and costs.
6. Effective isolation of waste from contact with water allows impacted groundwater and surface water to recover sooner than most other alternatives, leading to reduced human and ecological risks related to exposure to contaminated water.
7. Consolidation of waste within the pits creates a smaller waste footprint than most other alternatives. This in turn reduces the amount of cover construction material needed and reduces the areas where cover maintenance, permanent institutional controls, and access restrictions are needed.
8. Excavation and containment of mine drainage sediments and cleanup of road gravel and affected soils eliminates exposure to these materials.

The FS alternatives (other than No Action and Alternative 2a) all include mechanisms to reduce human health and ecological risks through combinations of waste containment, water treatment, institutional controls, and access restrictions. The alternatives differ mostly in terms of how effectively they reduce the generation of ARD. Alternatives that provide greater reductions in ARD generally have higher capital costs but lower costs for long-term water treatment and residuals (sludge) management. ARD reduction is essential to surface water and groundwater quality improvement.

Alternatives 3 (c and d) and 4 (d and e) would consolidate and cover waste rock above grade or in partially-filled pits. Consolidating, grading, and covering the waste would direct the majority of clean surface water away and reduce infiltration through the waste and loading from the waste to water. The Selected Remedy would consolidate and cover all above-grade waste rock in the open pits, resulting in a smaller waste containment surface area than the above-grade options and providing the maximum reduction in surface water infiltration.

Containment of the waste rock in the pits reduces the area of soil cover through which water may infiltrate and become contaminated. Groundwater entering the pits will be diverted through a nonreactive drainage layer to a sump and removed, minimizing contact between groundwater and reactive waste, which in turn is expected to reduce contaminant concentrations in the groundwater. From a long-term water management perspective, the reduction in the volume of water to be treated and reduction in contaminant concentrations in that water, will lead to water treatment that requires less chemical reagent and produces less sludge. This is particularly important in light of the disposal requirements for uranium-bearing sludge, classed as low-level radioactive waste. Filling the pits also prevents accumulation of surface water in the open pits and eliminates the pathway for humans and animals to contact contaminated pit water and exposed pit walls.

Engineered containment of the waste in the pits results in a smaller area requiring access restrictions and cover maintenance, and the amount of cover material is also smaller. Engineered containment with collection and treatment of contaminated water is expected to reduce or eliminate the loading of contaminants into groundwater and surface water, allowing existing groundwater and surface water contamination to diminish through natural attenuation processes.

Under Alternative 5c, waste in the Backfilled Pit Area would be moved to Pits 3 and 4, leaving the walls of the excavated pit area exposed. Alternative 5c also included removal of water from Pits 3 and 4 using wells, rather than passive drains, and included synthetic liners both under the soil cover and between the waste rock and the underlying drainage layer.

While the Selected Remedy does not include the excavation of the Backfilled Pit Area, it includes modifications to Alternative 5a to ensure the effectiveness of waste containment in this area. Specifically, the Selected Remedy includes the following:

- Use of a liner as part of the waste cover over the Backfilled Pit Area, to reduce infiltration.
- Use of wells to extract groundwater from the Backfilled Pit Area, rather than passive drains, to allow effective water removal from several pit low spots.
- Construction of diversion drains for shallow groundwater up-gradient of the area, to reduce groundwater flow into the pits.

These modifications further reduce ARD formation, avoid the cost of additional waste excavation, and allow the use of the Backfilled Pit Area footprint for disposal of other waste rock, should the capacity of the open pits be exceeded by waste volumes.

The long-term effectiveness of the Selected Remedy and the importance of assuring funding for O&M in perpetuity were concerns raised during the public comment period. The concerns apply to all of the remedial alternatives, as the alternatives all require perpetual water management to be effective. Over the long term, the Selected Remedy is anticipated to provide the greatest reduction in ARD needing treatment, the least sludge needing disposal, and (except for Alternative 5c) the smallest containment footprint needing cover maintenance and permanent institutional controls.

Because of the volume of waste excavation and earthwork, capital costs for the Selected Remedy are higher than for the other alternatives evaluated, with the exception of Alternative 5c. After construction, however, annualized costs are lower than for the other alternatives. Using standard present worth assumptions (30-year evaluation period and 7 percent discount rate), the Selected Remedy total cost is up to \$32 million more than Alternative 3c, the least costly among the other protective remedies. However, using present worth assumptions that better reflect the need for perpetual O&M and more current economic expectations (140-year evaluation period and 3.1 percent discount rate), the total present worth cost of the Selected Remedy is comparable to Alternative 3c (see Table 10-2). The cost for the Selected Remedy is shown in Table 12-1.

Table 12-1. Detailed Cost Estimate for Selected Remedy

ESTIMATED DIRECT CAPITAL COSTS							
Cost Item	Units	No.	Unit Cost	Estimated Cost			
Regrading	CY	420,000	\$1.64	\$700,000			
Boulder barriers	LF	10,000	\$2.47	\$20,000			
Consolidation, Pit 3&4, and Aboveground ore/protore	CY	16,700,000	\$1.98	\$33,000,000			
Cap for Pit 3 and Pit 4 (FML + 2.7' soil cover)	AC	97	\$134,000.00	\$13,000,000			
Soil cover	AC	120	\$28,000.00	\$3,400,000			
Drainage blanket, Pit 3	SF	3,700,000	\$1.62	\$6,000,000			
Drainage blanket, Pit 4	SF	2,700,000	\$1.62	\$4,400,000			
Basal FML liner, Pit 3	SF	260,000	\$1.16	\$300,000			
Basal FML liner, Pit 4	SF	70,000	\$1.16	\$100,000			
Drainage wells, Pit 3 (4 @ 500 ft)	LF	2,000	\$450.00	\$900,000			
Drainage wells, Pit 4 (4 @ 250 ft)	LF	1,000	\$450.00	\$500,000			
Drainage wells, backfilled pits (8 @ 150 ft)	LF	1,200	\$450.00	\$500,000			
Pipelines from wells to WTP	LF	6,000	\$13.00	\$80,000			
New water treatment plant	LS	1	\$1,200,000.00	\$1,200,000			
Untreated water storage pond	AC	5	\$140,000.00	\$700,000			
Filter press	LS	1	\$350,000.00	\$350,000			
Pipeline, WTP to Spokane Arm	LF	36,000	\$13.00	\$470,000			
Stormwater system	LF	6,000	\$19.00	\$110,000			
Excavation, pit sediments	CY	6,400	\$25.00	\$160,000			
Excavation, MAA sediments	CY	20,700	\$20.00	\$410,000			
Excavation, haul roads	CY	56,000	\$10.20	\$600,000			
Temporary water control measures	LS		\$0.10	\$6,690,000			
Unlisted items			\$0.05	\$3,310,000			
Total Estimated Direct Capital Cost				\$77,000,000			
ESTIMATED INDIRECT CAPITAL COSTS							
Contingency (30% of direct capital cost)				\$23,100,000			
Non-construction Costs (Engineering, etc.) (30% of direct capital cost)				\$23,100,000			
Total Estimated Indirect Capital Cost				\$46,200,000			
Total Estimated Capital Cost				\$123,000,000			
ESTIMATED OPERATIONS AND MAINTENANCE (O&M) COSTS							
Cost Item	Units	No.	Unit Cost	Years	Annual Cost	PW (30,7%)	PW (140,3.1%)
Cover maintenance		1% of direct capital cost		1-140	\$164,000	\$2,342,677	\$5,216,656
Treatment system O&M	Mgal/yr	6.5	\$8,400.00	1-140	\$54,600	\$677,534	\$1,736,765
Sludge disposal 2006-2008	tons/yr	110	\$30.00	1-3	\$3,300	\$8,660	\$9,316
Sludge disposal, Richland (beginning 2009)	tons/yr	40	\$4,600.00	4-140	\$184,000	\$1,800,000	\$5,300,000
Treatment system replacement (periodic cost)	LS	1	\$1,200,000.00	30,60,90,120	\$1,200,000	\$160,000	\$800,000
Drain well (O&M)		1% of direct capital cost		1-140	\$19,000	\$235,772	\$604,369
Pipeline maintenance		2% of direct capital cost		1-140	\$11,000	\$136,499	\$349,898
Monitoring	LS	1	\$245,000.00	1-140	\$245,000	\$3,040,215	\$7,793,176
Subtotal, O&M Costs							\$8,000,000
Contingency (30%)							\$2,400,000
Total Estimated O&M Cost							\$10,000,000
TOTAL ESTIMATED NET PRESENT WORTH COST							\$133,000,000
							\$152,000,000

12.2 DESCRIPTION OF THE SELECTED REMEDY

The cleanup levels for the Selected Remedy described below are provided in Section 8. Key elements of the Selected Remedy for the Midnite Mine Superfund Site address the Mined Area and Mining Affected Area as listed below. Figure 12-1 shows a plan view of the Selected Remedy. Figure 12-2 and Figure 12-3 show a conceptual cross-section of the waste containment areas in the open pits, while Figure 12-4 shows a conceptual cross-section for the Backfilled Pit Area.

1. Containment of Mine Waste in Pits:

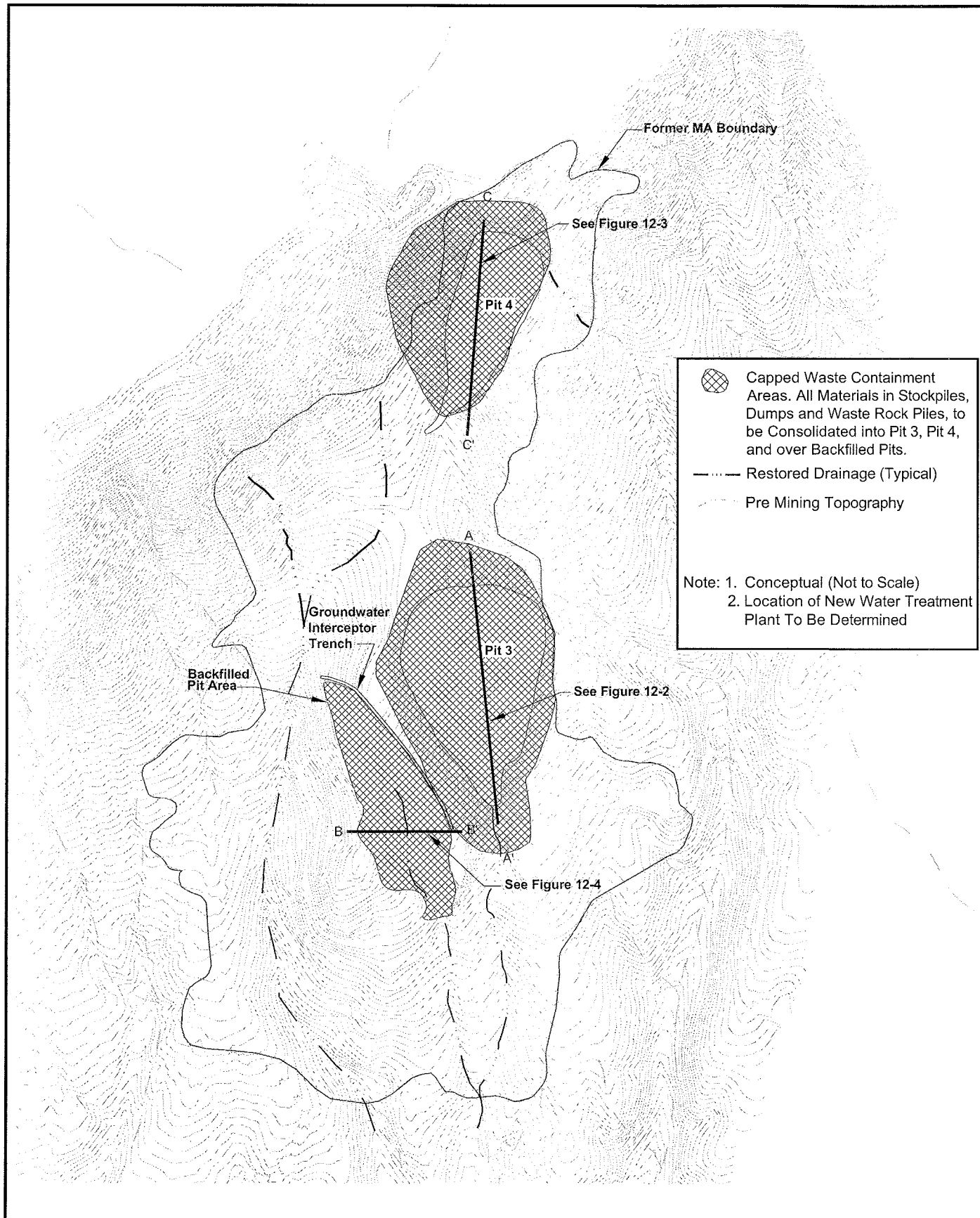
- Excavation of above-grade mine waste. Waste to be excavated includes waste rock, ore and proto-ore, stored mine cores, road gravel, contaminated soil, and pit and drainage sediments. It does not include waste rock in the Backfilled Pit Area.
- Consolidation of the excavated mine waste in Pit 3 and 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 Backfilled Pit Area 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, continued collection and ex situ treatment of contaminated seeps and pit water, with on-site discharge of treated water in compliance with interim discharge limits.
- Following containment, removal of water that enters Pit 3, Pit 4, and the Backfilled Pit Area using pumping wells; 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 Arm under an NPDES permit.

3. Residuals Management:

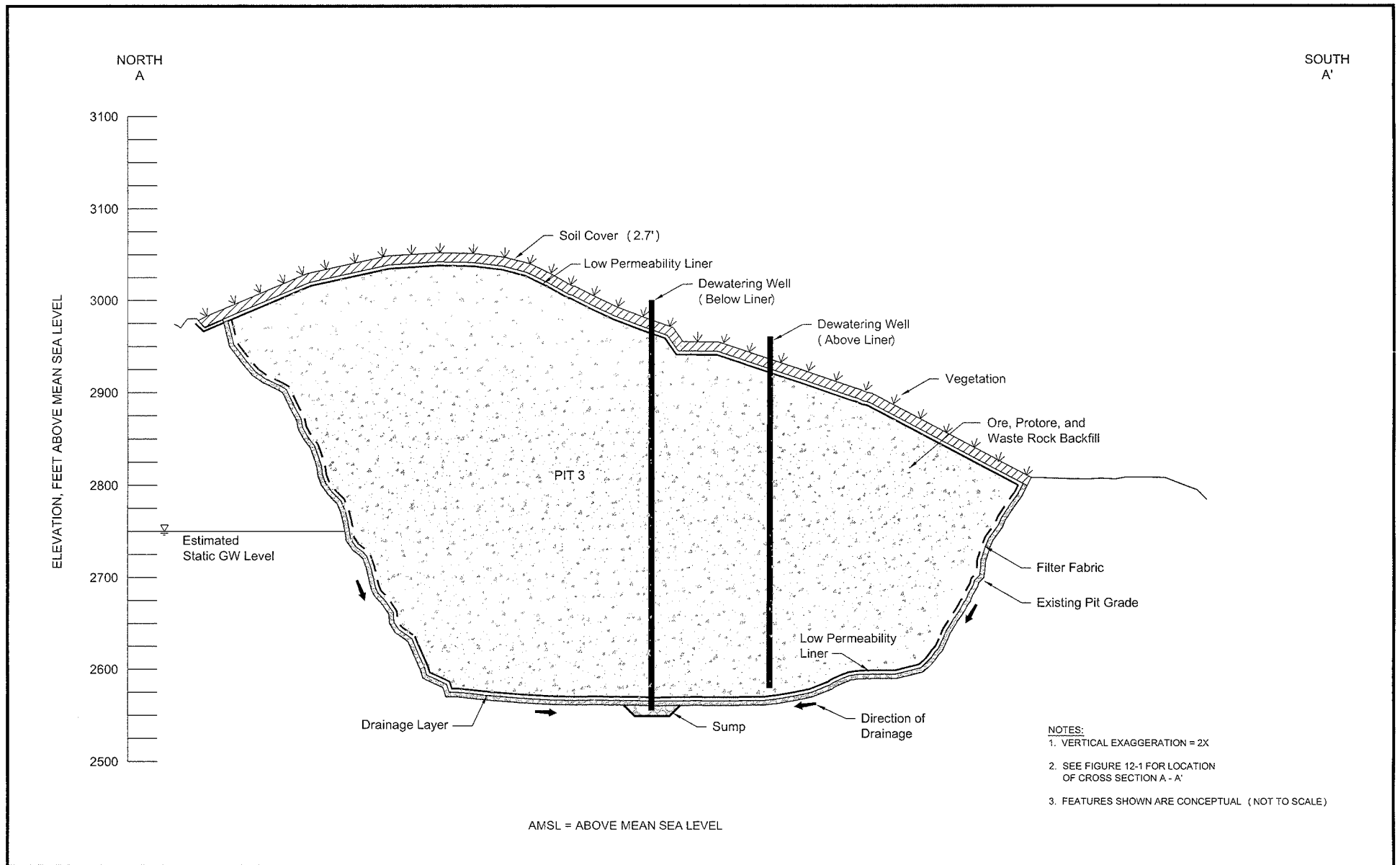
- Disposal of water treatment sludge at the Dawn mill until alternate disposal is required by mill closure.
- Following mill closure, disposal of sludge at a licensed off-site facility, unless the sludge characteristics are modified to allow alternative disposal.



DATE: Sep 25, 2006 FILE: PMXSelected Remedy

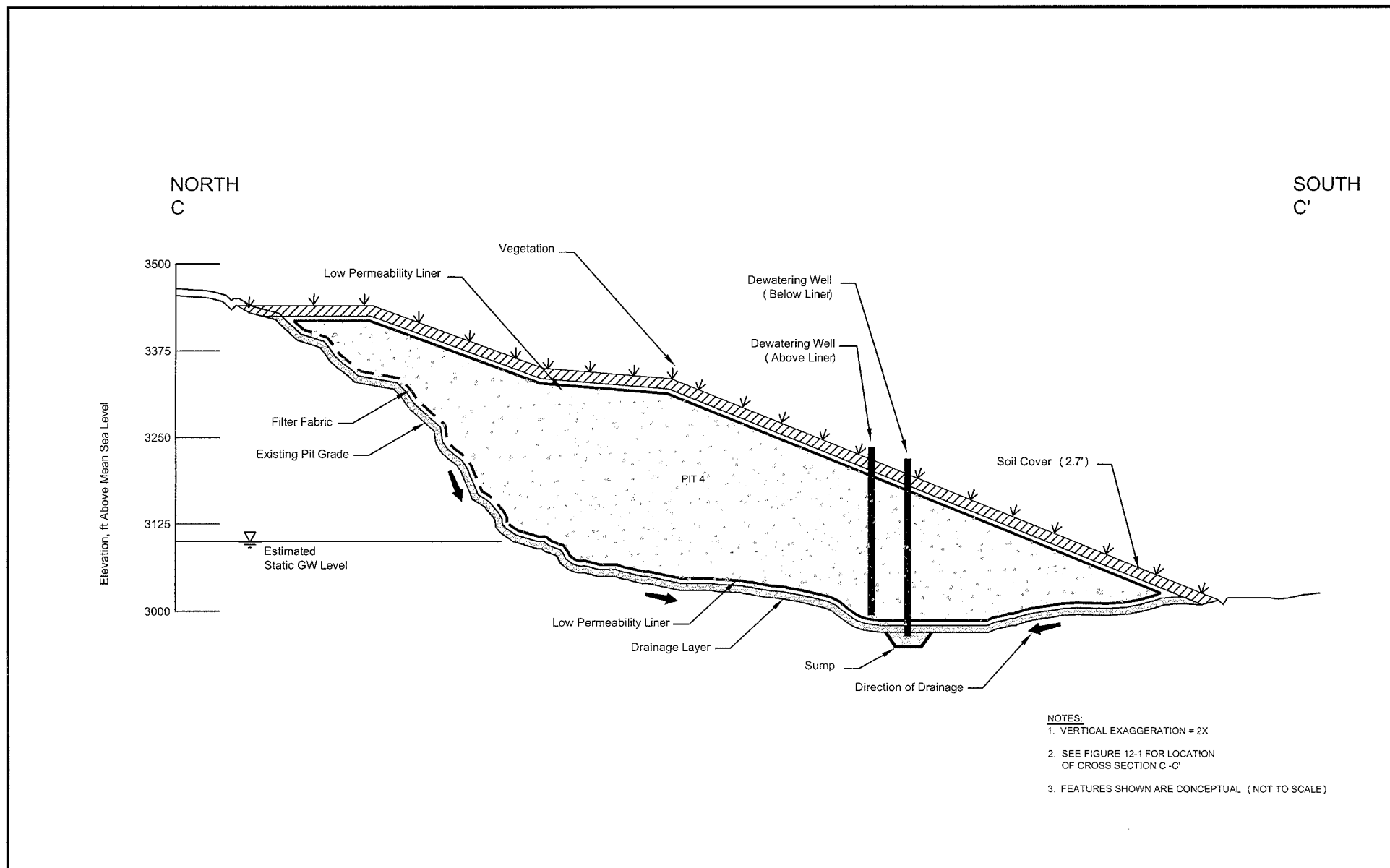
Figure 12-1
Selected Remedy
Plan View

Midnite Mine Record of Decision



DATE: Sep 25, 2006 FILE: PMXCONCEPTUAL_BACKFILL_PLAN_ALT5c

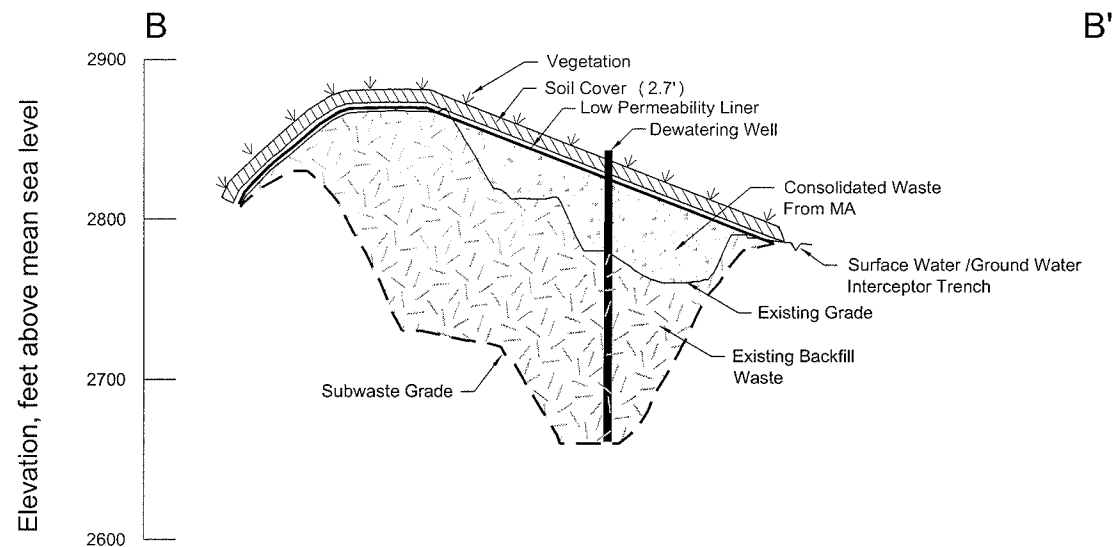
Figure 12-2
Conceptual Backfill
Cross Section for Pit 3
Midnite Mine Record of Decision



DATE: Sep 25, 2006 FILE: PMXPit 4-C-C'



Figure 12-3
Conceptual Backfill
Cross Section for Pit 4
 Midnite Mine Record of Decision



Notes:

1. Vertical Exageration = 2.5:1
2. See Figure 12-1 For Location of Cross Section B-B'
3. Features Shown are Conceptual (Not to Scale)

DATE: Sep 25, 2006 FILE: PMXConceptual_Grading_3cd



Figure 12-4
Conceptual Cross Section
of Remediated Backfilled Pits
 Midnite Mine Record of Decision

4. Surface Water and Sediment Management:

- Contouring, revegetation, 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.

7. Long-Term Site Management:

- Long-term monitoring to assess the effectiveness of the remedy, including physical inspections, revegetation 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.
- Implementation of other enhancements to reduce ARD.
- These key components are described in greater detail below.

12.2.1 Mine Waste Containment in Pits

The Selected Remedy requires the excavation of all above-grade mine waste and containment of the waste in the existing open pits, Pits 3 and 4. Mine waste in the Backfilled Pit Area will be contained in place. The objective of the containment is to isolate the mine waste from water in order to minimize the formation of ARD. All waste-filled pits will have a soil cover designed to minimize infiltration and to meet soil, radiation, and radon cleanup levels. Additional objectives include minimizing erosion, supporting suitable vegetation, and minimizing biointrusion.

A cover thickness of at least 2.7 feet is likely and may be greater depending on the source of cover material. Sources of soil cover construction materials will be refined during design and may include on-site materials, if suitable on-site materials are available. The containment areas will be graded to encourage runoff and revegetation.

Pits 3 and 4 will include an engineered system with liners to isolate the waste and drainage layers and wells to collect and remove water entering the pits. The Backfilled Pit Area will not have an underlying liner or drainage layer, as the waste is already in the pits. Wells will be installed in the waste to pump water out of the Backfilled Pit Area as it enters. As necessary, shallow groundwater from upgradient areas will be diverted away from the Backfilled Pit Area through the use of diversion drains.

Water pumped from all of the pits will be piped to the water treatment plant. About 6.5 million gallons per year are expected to require treatment after the pits are filled and covered.

As needed, a layer of suitable soil or soil amendments will be placed over areas cleared of mine waste. Such areas will be graded and revegetated to minimize erosion and ARD formation and to channel water from waste containment areas.

Because all waste will be contained and groundwater removed as it enters the waste containment area, mine-related sources of groundwater contamination will be controlled. Groundwater impacts may occur in the oxidized zone beyond the pit wall, however. For purposes of compliance with cleanup objectives, groundwater in the pit, within the oxidized zone outside the pit wall, and below soil covers used to contain waste in the mine pits is considered to be within a waste management area and is not required to attain groundwater cleanup standards (see Section 10, Summary of Comparative Analysis of Alternatives, Compliance with ARARs).

12.2.1.1 Pit 3 and Pit 4 Waste Containment

The objective of waste containment in the open pits is to isolate the acid-generating waste materials from water, minimize infiltration of water from the surface, and to remove water entering the pits to ensure that the maximum water elevation is below the waste. The containment area must meet soil and radon cleanup levels at the surface.

For each open pit, the pit floor will be graded to drain to a sump, and a drainage layer of nonreactive (not acid-generating) rock, approximately five feet in thickness, will be constructed on the pit bottom for water to drain through. A liner will be placed above the drainage layer to isolate the waste and keep contaminated water and particles out of the drainage layer, particularly prior to completion of the waste containment. Waste material will be added above the liner, and with successive lifts, liner material and drainage material will be placed between the waste and the pit walls as necessary to isolate the waste and drain groundwater entering from the pit walls to the sump at the bottom. The waste materials may be mounded above the pit lip to the edge of the pit catchment area and graded to maximize runoff and minimize infiltration while preserving slope stability. During construction, temporary covers and water capture and removal systems will be needed. The final cover will be constructed over the waste and will be as thick as necessary to permanently meet radiation and radon flux standards at the surface (assuming that a synthetic layer will degrade over time). To achieve the radon standards, a cover thickness of 2.7 feet is anticipated.

The cover system will include a synthetic liner designed to minimize infiltration, particularly during the initial years when vegetation is not well established. The cover will be constructed to maximize runoff and minimize infiltration while preserving slope stability, minimizing erosion and biointrusion, and supporting vegetation. Water that collects in the drainage layer and in waste rock above the sub-waste liners in Pits 3 and 4 will be pumped out using wells in the drainage layer and in the waste rock. Water removed from the pits will be treated in the water treatment plant (see Section 12.2.2 below). Water levels in the Pit 3 and Pit 4 sumps and drainage layers will be maintained as low as possible to prevent the interaction of groundwater with reactive materials.

Waste materials and cover material will be compacted to design specifications during backfilling. As much as possible, less reactive materials will be placed in portions of the pit below the surrounding groundwater level to minimize ARD should pit water levels rise unavoidably. High activity concentration materials such as ore and proto-ore will be placed in the pits beneath tens of feet of waste rock to minimize radon flux and meet the radon cleanup standard at the surface without additional cover thickness. During construction, temporary water storage facilities may be needed and the pits, the pollution control pond, or a new impoundment will be included if necessary.

Additional investigation of pit wall characteristics during remedial design may indicate that grouting of bedrock fractures, diversion drains, or other flow barriers would be effective at further reducing groundwater flow into the pit. If such measures are demonstrated to be effective and do not significantly increase overall costs, the measures may be incorporated into the containment system design.

12.2.1.2 Backfilled Pit Area Waste Containment

Waste in the Backfilled Pit Area will not be excavated, so containment in this area will not include construction of a drainage system below the waste. Waste rock may be mounded on top of the Backfilled Pit Area if the open pits do not provide sufficient capacity or if necessary to enhance surface water runoff. To minimize ARD generation, a lined soil cover will be constructed over the consolidated waste, a diversion trench will be constructed upgradient of the Backfilled Pit Area to minimize shallow groundwater entering the waste, and wells will be installed to effectively remove water that enters the Backfilled Pit Area.

The cover will consist of a liner and approximately three feet of soil. The liner will be of thick plastic flexible membrane liner (FML) or a suitable alternative liner material designed to prevent infiltration. The cover will be graded and revegetated to minimize erosion.

12.2.1.3 Mine Wastes to be Contained

Waste materials to be contained include waste rock, stockpiled ore and proto-ore, mine haul road material and affected soil, ore debris from the haul road removal action, stored cores, and contaminated sediments. During remedial design, volumes of waste to be excavated will be refined. Waste will be compacted in lifts to minimize settling, and will be graded to encourage runoff, support vegetation, ensure slope stability, and limit erosion.

Haul roads will be bladed or excavated to remove radioactive gravel. Soils adjacent to the roads, which may have been affected by particulate transport, will be further characterized. Affected surface soils will be removed to meet the soil cleanup levels. Excavated soil and gravel will be replaced with suitable clean material to pre-excavation elevations.

Mine waste piles may have been placed in areas cleared of topsoil or may have caused the contamination of topsoil, which would require soil removal. Areas cleared of mine waste will be graded and re-vegetated as necessary to minimize ARD formation and erosion, achieve background levels of radiation at the ground surface, and avoid impacts to the integrity and effectiveness of the waste containment.

12.2.2 Water Collection, Treatment, and Discharge

It is anticipated that treatment of contaminated water will be necessary in perpetuity. Existing, interim, and replacement facilities necessary to collect, store, treat, and discharge the water are part of the Selected Remedy. Water to be collected and treated includes water that enters the waste containment areas and seeps that do not meet cleanup levels.

Groundwater entering the pits may exceed cleanup levels indefinitely due to oxidation in bedrock fractures near the pits and along the pit walls. Groundwater and other water entering the Backfilled Pit Area will contact reactive waste rock before being removed. However, water volumes and the duration of waste contact will decrease significantly when the containment areas are constructed, and groundwater quality is expected to improve. Treatment plant operations will be adjusted as appropriate to reflect these changes.

A replacement water treatment system is required as part of the final remedial action. Discharge of treated water from the final treatment system must meet the surface water cleanup levels in Table 8-1 and is also subject to substantive requirements of the Clean Water Act NPDES program, specifically limits that address pollutants or contaminants likely to lead to an exceedance of applicable water quality standards in the receiving water. The Spokane Tribe Surface Water Quality Standards are applicable and include standards additional to the cleanup levels listed in Table 8-1 and the limits in the existing NPDES permit.

Prior to completion of the waste containment area, water that contacts reactive materials in the pits, waste piles, and exposed surface areas will be collected, stored, and treated. During the construction phase, an increase in contaminant loading to surface water is likely, and controls to minimize and manage surface water run-on and to prevent contaminated run-off will be implemented. Additional water storage impoundments and facilities for treatment of water will be developed as necessary for this purpose. This ongoing collection and water treatment is an interim action pending waste containment and a replacement treatment system.

Discharge from the existing water treatment plant is not expected to comply with permit limits based on the Tribe's current Surface Water Quality Standards (WQS). This ROD therefore establishes interim limits for water treatment plant discharge on-site. The interim limits, set forth in Table 12-2, include Midnite Mine COCs and parameters included in the existing permit. Modifications or adjustments to the current treatment process will be implemented as necessary to achieve the interim limits set forth in this section. The interim action is temporary and will not exacerbate site problems or interfere with the final remedy (55 Federal Register 8747, March 8, 1990). The interim action will become part of a final remedial action that will attain applicable or relevant and appropriate federal or tribal requirements (CERCLA Section 121[d][4][A], 40 CFR 300.430[ii][C)(1)).

Table 12-2. Interim Limits for Discharge to Surface Water		
Pollutant or Contaminant	Interim Discharge Limit ^{a, b}	
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.

(Table Continues)

Table 12-2. Interim Limits for Discharge to Surface Water (Continued)

Pollutant or Contaminant	Interim Discharge Limit^{a, b}	
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	
^a Discharge limits are consistent with NPDES Permit WA-002572-1 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 in Table 12-1 shall continue per NPDES Permit WA-002572-1 until alternative monitoring plan is approved by EPA. Alternative 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 permit was issued.		

Because the current WTP is built on top of mine waste, the replacement water treatment plant will need to be operational before the waste containment area construction is complete. The current treatment technology, consisting of barium-chloride addition, lime precipitation, and clarification will continue to be the central mechanism for contaminant removal from the influent water. The replacement water treatment plant will be designed for flow and water quality conditions anticipated following containment. Treated water will be conveyed through a pipe along Blue Creek to an appropriate discharge location in the Spokane River Arm of Lake Roosevelt.

12.2.3 Residuals Management

The water treatment plant produces residuals containing licensable quantities of uranium (greater than 0.05 percent by weight), and hence is subject to the substantive requirements of NRC regulations (10 CFR 40.13).

Residuals generated as a result of water treatment will be disposed of in accordance with the license at the Dawn Mining Company Mill in Ford, Washington, until such disposal must be discontinued to allow for closure of the mill. Alternative disposal facilities will be identified in advance for disposal at a commercial low-level radioactive waste facility following mill closure.

Because disposal of the sludge at a low-level radioactive waste disposal facility is costly and the availability of such facilities may change over time, treatability testing may be performed to assess the addition of an ion exchange or other uranium removal step to the water treatment process. If the addition of ion exchange or alternative step would change the waste designation of sludge to allow less costly disposal without significantly increasing overall costs, the water treatment process may be altered to incorporate such technology.

Short-term, on-site storage of treatment residuals may be necessary if year-round operation of the WTP is needed to support the timely construction of the waste containment areas. In this case, the substantive requirements of waste storage and disposal ARARs will be met. Residuals transported to an off-site location will be subject to applicable regulations.

Residuals will be subject to shipping and landfill acceptability requirements. This may require the addition of a filter press stage to the water treatment plant to reduce the water content of the sludge waste stream.

12.2.4 Surface Water and Sediment Management

To minimize the formation of ARD due to contact between clean water and reactive waste, clean surface water (rain, snowmelt) and shallow groundwater (in near-surface weathered, or “foliated,” bedrock) will be channeled away from pits containing waste. Surface water management structures will be designed for this purpose and will address the potential for erosion. Groundwater seeps that exceed the cleanup levels for surface water will be collected and treated.

12.2.4.1 Control and Removal of Mine Drainage Sediments

To allow Blue Creek sediments to recover naturally and to prevent impacts from additional sediment migration during construction in the Mined Area, sources of contaminated sediment to Blue Creek will be controlled. During remedial design, mechanisms to prevent sediment migration from the mine drainages into Blue Creek will be evaluated and implemented. For example, a sediment barrier may be needed below the convergence of the three main drainages and above the point where the drainage flows into Blue Creek to minimize the movement of mine drainage sediments into Blue Creek.

Prior to the completion of final waste containment, mine drainage sediments which exceed cleanup levels will be excavated and contained with other waste materials in the waste containment area. Because the drainages have a steep gradient, it is likely that the majority of sediment requiring excavation will be in localized depositional zones and behind the sediment barrier.

Contaminated sediment deposits in riparian areas will be excavated to a stable slope, to natural ground surface or to the water table, as appropriate for the individual deposits. Excavated areas will be backfilled, graded, and/or revegetated as necessary for stability and proper drainage.

12.2.4.2 Natural Recovery of Blue Creek Sediments

In-stream sediments in Blue Creek exceed background for a limited number of COCs and by a factor of less than 10. These sediments will be addressed through natural recovery following source control at the Mined Area. Containment of mine waste will result in reduced loading of contaminants in water, and sediment cleanup and controls will reduce sediment transport from the mine drainages. Blue Creek is generally erosive or down-cutting, with dynamic seasonal flows. Sediments in the creek are expected to move downstream or be covered by upstream sediments within a reasonable timeframe of approximately 10 years following mine waste containment.

Riparian sediments (sediments deposited on the stream bank at high water) along Blue Creek have similarly moderate levels of contamination. As with in-stream sediments, riparian sediments will be allowed to recover naturally.

12.2.4.3 Natural Attenuation of Groundwater and Surface Water

The Selected Remedy calls for source controls and monitored natural attenuation of groundwater and surface water. Once ARD sources are isolated from water through containment in the pits, groundwater already affected by ARD will gradually be flushed out of the groundwater system outside the containment area, leading to further improvements in surface water quality.

Surface water in the pits, seeps, and mine drainages exceed background by orders of magnitude for some contaminants. Similarly groundwater contamination is greatest in the shallow, alluvial materials in and downgradient of the Mined Area. This groundwater interacts with surface water in the mine drainages. As shallow groundwater leaves the system to flow into downgradient surface water and as clean recharge enters the system, the area of impacted groundwater is expected to decrease. COCs previously deposited in alluvial materials along the drainages may serve as reservoirs of residual COCs to surface and groundwater for some time.

While variable, surface water concentrations in Blue Creek are generally lower and exceed background levels by a factor of less than 5. Improvements in surface water quality in the mine drainages is expected to lead to improvements in Blue Creek surface water.

Sampling will be performed to monitor the effectiveness of source control and the progress of groundwater and surface water recovery. The timeframe for groundwater recovery is uncertain, given the complexity of fracture flow. Until groundwater recovers, it is likely to affect surface water quality to some degree. The Selected Remedy calls for restrictions on the use of groundwater, as described below.

12.2.5 Institutional Controls and Access Restrictions

Institutional controls and access restrictions are required to protect the integrity of the Selected Remedy and to preclude uses that would result in unacceptable risks from exposure to contaminants.

Exceptions to both temporary and permanent institutional controls described below require EPA approval. Specific exceptions (such as for necessary monitoring, maintenance, and repair purposes) or procedures for EPA approval of exceptions will be identified and documented as part of the implementation of the controls.

Permanent Institutional Controls

The following areas will need permanent institutional controls and access restrictions to protect the integrity of the remedy and to preclude uses of the Site that would result in unacceptable risks from exposure to contaminants:

- **Waste Containment Area:**
 - **Geographic Location:** Where waste is contained on-site as part of the Selected Remedy (including the Pit 3, Pit 4, and Backfilled Pit Area soil cover area and areas between pits).
 - **Objectives of Permanent ICs:** Throughout the Waste Containment Area, the following objectives must be met:
 - No construction of any structure (e.g., roads, utility corridors, buildings) that may adversely impact the effectiveness of the remedy.
 - No disturbance of the waste containment area or other actions that may adversely impact the effectiveness of the remedy.
 - No wells, borings, or excavations that may adversely impact the effectiveness of the remedy.
 - No vehicle access or other forms of transportation.
 - **Mechanisms:** The mechanisms for these controls are expected to be ordinances passed by the Spokane tribal government. Land use planning documents, such as the Spokane Tribe's Integrated Resource Management Plan (IRMP) will need to reflect these restrictions. Where possible, proprietary use restrictions, such as easements, rights-of-way, or covenants, will be obtained. Institutional controls may also be accomplished using enforcement tools, such as an enforceable agreement or a Consent Decree. Since the waste containment area is partially on allotted land, some easements, rights-of-way, or covenants will need to be obtained from the allotment holder. Vehicular access will be restricted by a boulder barrier around the waste containment area.
 - **Comment:** Permissible land uses in the waste containment area may include wildlife foraging or stock animal grazing or pasture, provided these practices do not adversely affect the vegetation and cover effectiveness or increase maintenance costs. Human passage on foot is also acceptable.

- ***Areas Supporting Water Treatment:***

- **Geographic Location:** Throughout areas necessary to support water management and water treatment, permanent institutional controls are needed.
- **Objectives of Permanent ICs:** Throughout these areas, the following objectives must be met:
 - No access to the fenced WTP area except for the purposes set forth in the EPA-approved O&M plans or as otherwise approved by EPA.
 - No activities outside the WTP area that may adversely affect wells, pipes, or other elements of the water management system.
- **Mechanisms:** O&M plans will be the mechanism for implementing these restrictions. Where possible, proprietary use restrictions, such as easements, rights-of-way, or covenants will be obtained. Institutional controls may also be accomplished using enforcement tools, such as an enforceable agreement or a Consent Decree. Land use planning documents, such as the IRMP, need to reflect these restrictions.

- ***Other Remediated Areas of the Site:***

- **Geographic Location:** Areas of the Mined Area cleared of mine waste, buildings, or other structures.
- **Objectives of Permanent ICs:** Throughout these areas the following objectives must be met:
 - No mining, water extraction, or other development that is inconsistent with the Selected Remedy and that would compromise the cleanup levels established in this ROD.
- **Mechanisms:** Tribal ordinance will be the mechanism for these restrictions. Land use planning documents, such as the IRMP, need to reflect these restrictions.
- **Comment:** Any development in these areas should consider the availability of a water supply that is safe for consumptive uses.

- ***Groundwater:***

- **Geographic Area:** Areas of the Mining Affected Area where groundwater cleanup levels established in this ROD are not met:
- **Objectives:** Throughout these areas, the following objectives must be met.
 - No installation of wells for purposes other than monitoring or O&M, except as approved by EPA.
 - No extraction of groundwater for drinking, irrigation, or other consumptive purposes except as approved by EPA.

- **Mechanism:** These restrictions will be imposed by tribal ordinance. Land use planning documents, such as the IRMP need to reflect these restrictions.
- **Comment:** As the area requiring these restrictions changes due to groundwater recovery, the ordinance may be updated.
- ***Surface Water:***
 - **Geographic Area:** Areas of the Mining Affected Area where surface water cleanup levels established in this ROD are not met.
 - **Objectives:** Throughout these areas, the following objectives must be met:
 - No use of surface water for drinking, irrigation, or other consumptive purposes except as approved by EPA.
 - Visibly posted notices that discourage subsistence plant, fish, and wildlife harvesting.
 - **Mechanism:** These restrictions will be imposed by tribal ordinance or through a health advisory. Land use planning documents, such as the IRMP need to reflect these restrictions.
 - **Comment:** As the area requiring these restrictions changes due to surface water recovery, the ordinance may be updated.
- ***Operable Unit 2 – BIA Highway from Midnite Mine to Ford Mill:***
 - **Geographic Area:** Areas within the easements or rights-of-way developed for the segment of the McCoy Lake-Wellpinit and Ford-Wellpinit roads between the western haul road and the Dawn Mill access road, where subsurface ore debris may be located.
 - **Objectives:** Throughout these areas, the following objectives must be met:
 - Ensure public and worker safety during excavation activities along the road by following appropriate monitoring and safety procedures.
 - Appropriate management of ore debris identified during excavation.
 - **Mechanism:** Procedures will be developed by EPA in coordination with the Tribe and other entities as appropriate (e.g., land owners, utilities, county, BIA) for ground disturbing activities such as road and utilities work along the road.
- ***Short-Term Access Restrictions:***

To protect the public and workers pending remediation and during construction, the existing barbed wire fencing around the lease area and mine drainages will be replaced with a gated chain-link fence visibly posted with warning signs along the fence and at gates.

12.2.6 Long-Term Site Management

Long-term site management will be required for the waste containment, seep and groundwater collection, surface water management system, and water treatment plant operations.

12.2.6.1 Operation and Maintenance

Operation and maintenance (O&M) will be required in perpetuity. O&M plans will be prepared to assure that all elements of the Selected Remedy are properly operated, monitored, and maintained, and to track residuals management and costs. O&M plans will establish a schedule for inspections, maintenance, monitoring, and reviews of institutional controls and access restrictions to evaluate the effectiveness of the remedy and to support five-year reviews.

12.2.6.2 Monitoring and Inspections

A plan will be developed for monitoring prior to and during excavation and waste containment construction, to assure the effectiveness of surface water and sediment construction BMPs. Following the waste excavation but, if possible, before placement of a final cover over the waste containment area, synoptic sediment chemistry and biological data (including sediment toxicity tests and benthic community analyses) will be obtained in Blue Creek depositional areas, the Blue Creek delta, and an appropriate reference area. The data will be used to assess baseline conditions in Blue Creek and the potential need for active remediation (see Section 12.3).

A long-term monitoring plan will be developed and implemented to assure the long-term effectiveness of the Selected Remedy. Monitoring will assess the continued effectiveness of ARD source control and will address, at a minimum, radiation and radon reduction; revegetation; cover thickness; slope stability; and settlement, erosion, surface water management, water treatment process monitoring, access restrictions; and institutional controls. Monitoring will also assess groundwater, surface water, and sediment quality outside the containment area.

Following the recovery of water and sediment quality in Blue Creek, long-term monitoring will address sampling of selected areas along Blue Creek following significant runoff events to ensure that these areas do not exceed cleanup levels because of remobilization of upstream sediments.

The long-term monitoring plan will include a process for using monitoring results to determine the need for changes in monitoring and maintenance plans or to identify additional investigations or remedial actions needed.

12.2.6.3 Five-Year Reviews

Because hazardous substances will remain on site above levels that allow for unlimited use and unrestricted access, a review of the remedy is required every five years after the start of remediation. The Five-Year Reviews will address the effectiveness of the remedy, institutional controls. Data needed to support the Five-Year Reviews will be identified in plans for long-term monitoring.

12.3 CONTINGENT ACTIONS FOR SEDIMENTS IN BLUE CREEK AND DELTA

Natural recovery is preferred to active remediation in channel and riparian sediments along Blue Creek, because information to date indicates that ecological impacts in this area are relatively minor, while creek disturbance could damage Blue Creek habitat significantly. However, if additional ecological information indicates that COCs in Blue Creek sediments pose significant ecological risk or if monitoring indicates that the sediments are a source of contamination to downstream areas or are unlikely to achieve cleanup levels within a reasonable timeframe, active sediment remediation will be required.

Active sediment remediation may also be called for in the Blue Creek delta, where Blue Creek flows into the Spokane Arm of Lake Roosevelt. Limited characterization of sediments in this area indicated COC levels close to background; however, contaminated sediments transported downstream during active mining and before the implementation of seep capture systems and the South Spoils revegetation may have been deposited in areas where the sediments could be remobilized or exposed through seasonal flow and lake level changes.

The monitoring plan developed during remedial design will specify monitoring requirements and triggers for active sediment remediation. Synoptic data will be collected and evaluated to determine whether COC levels or ecological risks warrant sediment removal from riparian zones or depositional areas. If the data indicate achievement of the sediment cleanup levels set forth in the ROD or the absence of significant biological effects relative to reference areas, testing requirements will be reduced and will focus on verification of the continued effectiveness of contaminant source control. Where removal is not warranted by biological impacts or other triggers established in the plan, the data will serve as a baseline for subsequent monitoring to verify the recovery of sediment COC concentrations to cleanup levels set forth in this ROD. Where sediment removal is warranted, excavated sediments will be added to the waste containment areas.

Following the placement of the final waste containment area cover, sediment monitoring will be performed periodically. If the monitoring data do not indicate significant progress towards sediment recovery within 10 years following containment of the mine waste, active sediment remediation will again be considered based on sediment chemistry and, if determined to be necessary, will be completed prior to the following five-year review. Excavated sediments will be disposed of on site in a manner that does not interfere with the functioning of the remedy and is protective of human health and the environment.

12.4 SUMMARY OF ESTIMATED COSTS

The relative present worth costs of the alternatives are sensitive to the discount rate and evaluation period assumed. Although current CERCLA guidance recommends the inclusion of the costs estimated using a 7 percent discount rate, the 3.1 percent discount rate is well supported by federal documentation as a valid assumption. Similarly, although the 30-year performance period is included, the need for perpetual O&M at this Site for all alternatives supports the use of a longer period. The 140-year performance period is a reasonable assumption.

The total present worth cost of the Selected Remedy is \$133,000,000 based on a present worth discount rate of 7 percent and 30-year O&M. Of this, the capital cost is estimated to be \$123,000,000, with annualized O&M costs of \$870,000 estimated at \$10,000,000, based on the present worth assumptions above.

To reflect more likely conditions, including O&M costs beyond the first 30 years, total costs were estimated based on a 140-year period and 3.1 percent discount rate. Using these assumptions, the total cost is estimated at \$152,000,000, including the \$123,000,000 capital costs (same as above) and \$29,000,000 in present worth O&M costs.

A cost estimate for the Selected Remedy at the FS level of detail is shown in Table 12-1. The cost summary provided is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.5 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The remedial action is expected to reduce site-related risks by controlling sources, limiting exposure, and achieving cleanup levels for risk drivers in exposure media. For most of the risk drivers, cleanup levels are based on background levels.

Key outcomes include the following:

- Human health and ecological risks posed by COCs in surface materials will be reduced through the placement of a soil cover over the mine waste to prevent exposure to contaminated materials and to reduce surface radiation and radon levels at the surface.
- Human health and ecological risks posed by COCs in groundwater, surface water, and sediments will be reduced through the containment of ARD-generating materials in the mine pits and the treatment of ARD, as well as through institutional controls (effective for control of human exposures only), sediment excavation and source control, and natural recovery.

SECTION 13 – STATUTORY DETERMINATIONS

Under Section 121 of CERCLA and the NCP, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements, are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets the statutory requirements.

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy will protect human health and the environment as follows:

- Containment of mine waste under a soil cover will result in background levels of COCs in surface materials and will result in protective surface radon and radiation levels in the containment area.
- Control of sources of ARD and treatment of contaminated seeps and pit water will reduce contaminant loading to groundwater and surface water, allowing natural recovery to achieve background levels of COCs.
- Achievement of surface water, sediment, and soil cleanup levels will protect human and environmental receptors.
- Short-term and long-term institutional controls and access restrictions will limit human exposure to groundwater, surface water, sediments, and subsistence foods affected by these media pending achievement of cleanup levels.

13.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND OTHER POLICIES, GUIDANCE, AND DIRECTIVES

The Selected Remedy will comply with all chemical-specific, action-specific, and location-specific ARARs, with the exception of ARARs for water treatment discharge during interim action. ARARs and interim action waivers for certain ARARs are discussed below.

Clean Water Act Section 304 – Federal Ambient Water Quality (National Recommended Water Quality Criteria, November 2002, and 67 Federal Register 79091-79095, December 27, 2002).

Section 304(a)(1) of the Clean Water Act requires EPA to develop, publish, and revise criteria for water quality accurately reflecting the latest scientific knowledge. Section 121(d)(2)(B)(i) of CERCLA provides that, “In determining whether or not any water quality criteria under the Clean Water Act are relevant and appropriate under the circumstances of the release or threatened release, the President shall consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available.”

The water quality criteria have been determined to be relevant and appropriate for those contaminants in surface water where there are no other appropriate standards, such as the Tribal Water Quality (as discussed below) and where background criteria are not higher than the criteria (see Section 8, Remedial Action Objectives).

For certain metals, the water quality criterion is not a numerical standard but is a formula based on the hardness of the water. For comparison to such criteria, values should be corrected for hardness using site specific data.

National Pollutant Discharge Elimination System (NPDES) (40 CFR Part 122). The NPDES program requires that permits be obtained for point-source discharges of pollutants to surface water. Permit No. WA 002572-1 was issued by EPA in 1986 for the existing wastewater treatment plant operated by Dawn. An NPDES permit is not required for on-site response actions under CERCLA. However, substantive requirements which would be in an NPDES permit are applicable to on-site discharges from the water treatment plant. These substantive requirements would be developed to ensure that point source discharge to a surface water body would not cause an exceedance of applicable water quality standards in the receiving water body outside an approved mixing zone.

As described in Section 12, the Selected Remedy calls for continued water treatment and on-site discharge as an interim action. Interim limits for water treatment plant discharge are set forth in Section 12 and include limits no less stringent than the existing permit limits. This ROD authorizes an interim action waiver of discharge limits which may be additional to or more stringent than the interim limits in Table 12-2.

Following waste containment, water treatment in a replacement treatment plant is required as part of the final action, with discharge at an off-site location. Treatment plant discharge under the final action will comply with cleanup standards identified in Section 8.3.1 and with requirements to be identified in a new NPDES permit.

The substantive requirements of the general stormwater permit program for stormwater discharges associated with industrial and construction activities (40 CFR 122.26) are also applicable to remedial actions at Midnite Mine. “Industrial activities” include inactive mining facilities, hazardous waste treatment units, and Resource Conservation and Recovery Act (RCRA) Subtitle D landfills. “Construction activities” include land clearing, grading, and excavation. Substantive requirements state that best management practices (BMPs) must be used, and appropriate monitoring performed, to ensure that stormwater runoff does not cause an exceedance of water quality standards in a receiving surface water body.

Spokane Tribe of Indians Surface Water Quality Standards Resolution 2003-259, March 7, 2003.

This resolution establishes surface water quality standards for protection of human health and aquatic life for surface waters on tribal lands. These standards are applicable to surface water at the Site. EPA approved the Tribe’s standards on April 22, 2003, in accordance with the CWA Treatment As States procedures. In addition, EPA has stated in the preamble to the NPC (55 Federal Register 8741, March 8, 1990) that it is appropriate to treat Indian tribes as states for the purpose of identifying ARARs under Section 121(d)(2) of CERCLA. Further, EPA has determined that the Tribe’s water quality standards are appropriate standards to be considered in establishing cleanup levels.

Section 3(2) of the Tribe's water quality standards sets forth circumstances under which natural conditions rather than the numeric criteria assigned by the regulation might constitute water quality criteria. The section, which is applicable to the Site, states the following:

“Whenever the natural conditions of any specific surface waters of the Reservation are of a lower quality than the criteria assigned to waters typical of that class, the Department may determine that the natural conditions shall constitute the water quality criteria. ‘Natural conditions’ are defined in Section 2 of the standards to mean ‘surface water quality’ that was present before human-caused pollution. When assessing natural conditions in the headwaters of a disturbed watershed, it may be necessary to use an appropriate reference site.”

Since the natural condition of surface waters in the Mined Area and the Mining Affected Area are of a lower quality than the criteria for most COCs, natural conditions (background) will be the cleanup level for most COCs. Where this is not the case, cleanup levels will be the more stringent of numerical criteria in the ARAR or a risk-based level. Table 5-6 shows the comparison of background levels and water quality criteria for the surface water COCs.

For certain metals, the water quality criterion is not a numerical standard but is a formula based on the hardness of the water. For comparison to such criteria, values should be corrected for hardness using site specific data.

The Tribe's surface water quality standards are the applicable standards that would be considered in the issuance of an NPDES permit, as discussed above. For water treatment plant discharge as part of the final action, a new permit will be issued in consideration of these standards. For water treatment plant discharge as part of the interim action, this ROD authorizes an interim waiver of Tribal water quality standards that are additional to or more stringent than the interim limits set forth in Table 12-2.

National Primary Drinking Water Regulations (40 CFR Part 141) promulgated under the Safe Drinking Water Act (SDWA). These regulations protect the quality of public drinking water supplies through regulation of chemical parameters and constituent concentrations as maximum contaminant levels (MCLs). The MCLs are relevant and appropriate for human health COCs in groundwater outside waste management areas. For purposes of this ARAR, the waste management areas include Waste Containment Areas described in Section 12.2.1, areas between these areas, and the oxidized zones adjacent to the former pit wall. Groundwater within these areas is not required to meet these standards. The MCLs are also relevant and appropriate for human health COCs in surface water at the Site. For surface water and groundwater outside the waste management areas, an exception is made for COCs for which background is higher than the MCL. For such COCs, the MCL is relevant but not appropriate.

Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 40 CFR Part 192, Subpart A – Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites, Table 1: Maximum Concentrations of Constituents for Groundwater Protection. These standards were developed under the Uranium Mill Tailings Radiation Control Act (UMTRCA) and are relevant and appropriate to groundwater at the Site. UMTRCA allows the use of background levels where background levels exceed the listed standards, as is the case for U-234 and U-238.

Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 40 CFR Part 192, Subpart B – Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials. These standards were developed under the UMTRCA to govern the stabilization, disposal, and control of uranium and thorium mill tailings on land and buildings that are part of a uranium or thorium processing site. Portions of the regulations are relevant and appropriate to remedial actions at the Site.

The 40 CFR Part 192 Subpart B standards require that remedial actions at designated processing sites be conducted in such a manner as to provide assurance that residual radioactive materials are controlled as follows:

- Concentrations of radium-226 in land averaged over 100 square meters shall not exceed background by more than:
 - 5 pCi/g averaged over first 15 cm of soil below surface, and
 - 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below surface.

The UMTRCA soil standards above are relevant and appropriate to surface soils within and outside the waste containment area.

40 CFR Part 192 Subpart E states that the 5 pCi/g and 15 pCi/g standards are suitable for remediation of radium-228 at certain sites. When used in this way, the standards apply to the combined level of contamination of radium-226 and radium-228. The standards also apply to the combined level of contamination of thorium-230 and thorium-232, parent isotopes of radium-226 and radium-228.

Spokane Tribe of Indians Hazardous Substances Control Act (HSCA, Resolution 2004-085, December 22, 2003). The Tribe has established cleanup standards that are applicable to groundwater, surface water, and soil/sediment cleanups on the reservation. EPA has stated in the preamble to the NCP (55 Federal Register 8741, March 8, 1990) that it is appropriate to treat Indian tribes as states for the purpose of identifying ARARs under Section 121(d)(2) of CERCLA. The Tribe's implementation of these cleanup standards on its reservation is similar to a state's implementation of its state standards within such state. Since this cleanup is within the Spokane Reservation, HSCA, instead of state law, is applicable. Further, EPA has determined that HSCA is an appropriate regulatory requirement to be considered in establishing cleanup levels for this Site.

Section 34-1.11 of HSCA sets forth various ways to determine the appropriate cleanup standard for surface water, groundwater, soil, and sediment. This includes calculated cleanup standards using tables with standards for individual contaminants (HSCA 34-1.11{a}), a multi-contaminant/multi-pathway formula (HSCA 34-1.11{c}), as well as a recognition that cleanup standards under either of these methodologies do not require cleanup below background levels (HSCA 34-1.11{d}). Background levels are above HSCA standards for most COCs, and the cleanup standard in such cases is background. To the extent that the calculated cleanup standard is not below background for a COC, the calculated cleanup standard will be an applicable media cleanup standard.

HSCA also sets forth limitations on the siting of new permanent and temporary disposal facilities for hazardous substances. The Tribe's implementation of these siting standards on its reservation is similar to a state's implementation of its standards within such state. EPA has determined that HSCA is an appropriate regulatory requirement to be considered in establishing a disposal site for hazardous substances. Section 34-1.12 of HSCA prohibits the permanent disposal of hazardous substances in the follow locations:

- Within 1,000 feet of any wetland; or
- Within 1,000 feet of any intermittent stream, perennial stream, or other surface water that directly or indirectly flows to streams designated as Class A or Class AA in the Spokane Tribal Water Quality Standards; or
- Within 1,000 feet of any aquifer recharge zone.

The Tribe has documented that areas that would allow the siting of a disposal facility in compliance with the limitations above are present on the Spokane Reservation. However, no areas within or in close proximity to the Site have been identified that comply with these limitations. The sludge resulting from the current wastewater treatment process is a hazardous substance under HSCA. Thus, unless the characteristics change such that it is no longer a hazardous substance, the sludge must be disposed of off-site.

National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Uranium Mill Tailings Disposal Sites (40 CFR Part 61, Subpart T). These standards, also found at 40 CFR Part 192, Subpart A, limit radon-222 flux emissions to ambient air from inactive uranium mill tailings piles to 20 picoCuries per square meter per second. Under 40 CFR Part 192, Subpart A, the standard is an average applied over the entire surface of the disposal site and over at least a one-year period. It applies only to emissions from residual radioactive materials to the atmosphere (i.e., it is in addition to the radon flux that originates in the cover material). These standards are relevant and appropriate in waste containment areas under the Selected Remedy for the Site.

Resource Conservation and Recovery Act Subtitle D Regulations, Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR Part 257, Subpart A. These regulations are primarily siting requirements that limit the disposal of solid waste in certain locations. While the Selected Remedy does not include permanent on-site disposal of water treatment residuals, these regulations are relevant and appropriate to short-term management and disposal of such materials. The regulations require facilities in floodplains to not restrict the flow of the base

flood, not reduce the temporary water storage capacity of the floodplain, result in washout of solid waste; or cause or contribute to the taking of any endangered or threatened species. Facilities must not cause a discharge of pollutants into waters of the U.S. that violates the requirements of the NPDES program and must not contaminate an underground drinking water source beyond the solid waste boundary.

Licensing Requirements for Land Disposal of Radioactive Waste (40 CFR Part 61). These regulations contain performance objectives and technical requirements for Nuclear Regulatory Commission (NRC) licensing of land disposal of radioactive wastes containing byproduct, source and special nuclear material received from other persons. As above, these regulations are relevant and appropriate to short-term on-site management of water treatment residuals (byproduct) and rock containing uranium at levels that qualify the rock as source material. Subpart C of the regulations provides the following performance objectives for radioactive waste disposal facilities:

- Protection of the general population from releases of radioactivity (an annual dose not to exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ).
- Protection of individuals from inadvertent intrusion.
- Protection of individuals during operation.
- Stability of the disposal site after closure.

Subpart D provides technical requirements for near-surface disposal facilities, including disposal site suitability requirements, disposal site design, disposal site operation and closure, and environmental monitoring.

Endangered Species Act (ESA) Regulations, 50 CFR Parts 17, 402. The ESA and implementing regulations make it unlawful to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect” any federally designated threatened or endangered species and/or its habitat. The ESA and implementing regulations are applicable to remedial actions that could affect federally designated threatened or endangered species that may be present within the Midnite Mine Site area.

The United States Fish and Wildlife Service (USFWS) has indicated that gray wolf (federal endangered) and the bald eagle, bull trout, Canada lynx, grizzly bear, and Ute ladies’-tresses (all federal threatened) may occur in the vicinity of the project and could be affected by it (USFWS September 5, 2001). Consistent with ESA Section 7, if any federally designated threatened or endangered species are identified in the vicinity of remediation work, and the action may affect such species and/or their habitat, EPA will consult with USFWS to ensure that remedial actions are conducted in a manner to avoid adverse habitat modification and jeopardy to the continued existence of such species.

EPA will work with USFWS to address any concerns that arise and to meet the requirements of the Endangered Species Act. The selection of this remedial action does not make any irreversible or irretrievable commitment of resources that has the effect of foreclosing the formulation or implementation of any reasonable and prudent measures. If potential effects are identified during the remedial design, EPA will consult with USFWS. In the event that the USFWS propose reasonable and prudent alternatives for the remedial action and/or conservation recommendations, EPA will work with USFWS to implement such measures and will evaluate the need for modification to the Selected Remedy through an ESD or amendment to this ROD.

Fish and Wildlife Coordination Act (16 USC 661 et seq.) This statute requires federal agencies to consider the effect projects may have on fish and wildlife and to mitigate loss or damage to these resources. This statute is applicable to the Selected Remedy.

Migratory Bird Treaty Act (MBTA) (16 USC 703 - 712). The MBTA makes it unlawful to pursue, capture, hunt, or take actions adversely affecting a broad range of migratory birds. The MBTA and its implementing regulations are applicable to remedial activities that could affect any protected migratory birds. The Selected Remedy will be carried out in a manner that avoids taking or killing of protected migratory bird species, including individual birds or their nests.

Protection of Floodplains, Executive Order 11988 (40 CFR Part 6, Appendix A). This executive order mandates that response actions taken by federal agencies must be designed to avoid adverse impacts to floodplains. Specifically, if remediation activities are located within a 100-year floodplain, the activities must be designed to avoid adversely impacting floodplains wherever possible. If remedial activities take place in a floodplain, such as within the Blue Creek floodplain, these requirements will be applicable.

Protection of Wetlands, Executive Order 11990 (40 CFR Part 6, Appendix A). This executive order mandates that response actions taken by federal agencies must be designed to avoid long- and short-term impacts to wetlands. If remediation activities are located near/in wetlands, the remediation activities must be designed to avoid adverse impact to the wetlands wherever possible, including minimizing wetlands destruction and preserving wetland values. If remedial activities take place in wetlands, such as in certain areas along the Blue Creek and East Drainage riparian areas, these requirements will be applicable.

Clean Water Act, Section 404 – Dredge or Fill Requirements Regulations, 33 CFR Parts 320–330; 40 CFR Part 230. The Army Corps of Engineers implements the Section 404 permit program which provides guidelines for the identification of wetlands and implements protective requirements for actions involving wetlands. Section 404 is applicable if regulated wetlands are identified and potentially impacted by the Selected Remedy.

Native American Graves Protection and Repatriation Act (NAGPRA), 25 USC§3001 et seq. 43 CFR Part 10. NAGPRA regulations protect Native American graves from desecration through the removal and trafficking of human remains and “cultural items” including funerary and sacred objects. To protect Native American burials and cultural items, the regulations require that if such items are inadvertently discovered during excavation, the excavation must cease and

the affiliated tribes must be notified and consulted. This program is applicable to ground-disturbing activities such as soil grading and removal.

American Indian Religious Freedom Act, 42 USC§1996 et seq. This program is applicable to ground-disturbing activities such as soil grading and excavation at the Midnite Mine Site. It protects religious, ceremonial, and burial sites and the free practice of religions by Native American groups. If sacred sites are discovered in the course of soil disturbances, work will be stopped and the Spokane Tribe will be contacted.

National Historic Preservation Act (NHPA) Regulations, 36 CFR Parts 60, 63, and 800.

NHPA regulations require agencies to consider the possible effects on historic sites or structures of actions proposed for federal funding or approval and are applicable to remedial actions at Midnite Mine. Historic sites or structures are those included on or eligible for the National Register of Historic Places, generally older than 50 years. If an agency finds a potential adverse effect on historic sites or structures, such agency must evaluate alternatives to “avoid, minimize, or mitigate” the impact, in consultation with the Tribal Historic Preservation Officer (THPO). The NHPA and implementing regulations are applicable to selected remedial activities such as building demolition or excavation activities which could disturb historical sites or structures.

Office of Solid Waste and Emergency Response (OSWER) Directive No. 9200.4-18,

Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination

(August 2, 1997). This directive presents clarifying guidance for establishing cleanup levels protective of human health for radioactive contamination at CERCLA sites. The cleanup levels are expressed as a risk, exposure, or dose level and not as a soil concentration level. The directive clarifies that the appropriate risk range for radionuclides, which are all carcinogens, is 10⁻⁴ to 10⁻⁶ (some NRC regulations do not achieve this range and are therefore not sufficiently protective). The directive further states that cancer risk at a site from both radiological and nonradiological contaminants should be summed, and CERCLA decision documents should provide an estimate of the combined risk to individuals presented by all carcinogenic contaminants.

Attachment A to this directive lists potential federal radiation ARARs and indicates whether the ARARs are likely to be applicable or to be relevant and appropriate. Attachment B indicates that EPA has consistently concluded that levels of less than or equal to 15 mrem/yr effective dose equivalent (corresponding to an excess lifetime cancer risk of approximately 3 x 10⁻⁴) are protective and achievable.

Office of Solid Waste and Emergency Response (OSWER) Directive No. 9200.4-25, Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites

(February 2, 1998). This directive addresses the use of soil cleanup criteria in 40 CFR Part 192 when setting remediation goals for subsurface soil. The guidance clarifies the extent to which 40 CFR Part 192, Subpart A standards are potentially relevant and appropriate.

As Low As Reasonably Achievable (ALARA) Referenced in 10 CFR 20.1402 and Other Radiation Guidance:

- **10 CFR § 20.1402 Radiological Criteria for Unrestricted Use.** A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.
- **The 1960 Federal Radiation Council Radiation Protection Guidance (5/18/1960)** does not use the acronym ALARA, but recommends the concept:

“It should be general practice to reduce exposure to radiation, and positive effort should be carried out to fulfill the sense of these recommendations.”
- **National Council on Radiation Protection and Measurements (NCRP):** NCRP Report No. 116, Limitation of Exposure to Ionizing Radiation, March 31, 1993 states:

“Actions to reduce exposure should not be limited by or to the remedial action level and, following the ALARA principle, levels substantially below the remedial action level may be obtainable and appropriate.”

13.3 COST EFFECTIVENESS

The Selected Remedy is cost effective. In making this determination, the following definition set forth in the NCP was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness” (40 CFR 430[f][1][ii][D]). Of those alternatives that are protective of human health and the environment and comply with ARARs, the Selected Remedy provides “overall effectiveness” in terms of balancing the long-term effectiveness and permanence, short-term effectiveness and reduction in toxicity, mobility, and volume. The “overall effectiveness” of the Selected Remedy was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this Selected Remedy represents a reasonable value for the money spent.

The estimated present worth cost (30 years/7.1 percent discount rate) of the Selected Remedy is \$133,000,000. The capital cost of the Selected Remedy is higher than most of the other alternatives because it involves moving more waste material. However, the selected alternative will substantially reduce ARD, which reduces the long-term costs and risks associated with treating water and disposing of the sludge.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment and disposal and considering Tribe and community acceptance.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The Selected Remedy utilizes alternative treatment (or resource recovery) technologies to the maximum extent practicable for this Site. The remedy utilizes treatment of contaminated surface water and groundwater that has been impacted by metals leaching from source materials. Treatment of the remaining threats, waste rock, and tailings was not found to be practicable due to the large volume.

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the cleanup levels are protective and that the remedy is, or will be, protective of human health and the environment.

SECTION 14 – DOCUMENTATION OF SIGNIFICANT CHANGES

The Selected Remedy has not significantly changed from the Proposed Plan. However, some remedial elements described in the Proposed Plan as not fully resolved have now been finalized, as described below.

14.1 DISPOSAL OF WATER TREATMENT RESIDUALS

As described in Section 12.2.3, sludge from the lime precipitation process will be disposed of at a permitted commercial off-site facility. On-site residuals disposal is often appropriate at mine sites with perpetual water management obligations. However, on-site disposal of sludge would not comply with HSCA. The cost estimates for on-site disposal included in the FS do not account for lease fees, administrative oversight, and other costs for on-site disposal, which would likely reduce the apparent cost advantage of on-site disposal. EPA also considered the comments of the Spokane Tribe, BIA, and others regarding on-site disposal.

14.2 WATER TREATMENT PLANT DISCHARGE

Prior to containment of the mine waste, the water treatment system will continue to discharge water on-site. As described in Section 12.2.2, interim discharge limits will apply to WTP effluent discharged on-site during this period.

Treatment volumes and influent characteristics are expected to change following containment of mine waste. A final treatment system will be designed and constructed with an off-site discharge location. Off-site discharge will comply with an NPDES permit issued by EPA under the Clean Water Act.

14.3 CONTINGENT SEDIMENT REMEDIATION IN BLUE CREEK AND DELTA

The Proposed Plan indicated that sediment remediation may be needed in Blue Creek and the delta where Blue Creek joins the Spokane River Arm of Lake Roosevelt. The timing and triggers for such contingent remediation of the Selected Remedy are provided in greater detail in Section 12.3. Additional specificity will be provided in a monitoring plan.

APPENDIX A

The Spokane Tribe Letter of Concurrence



Spokane Tribe of Indians

P.O. Box 100 • Wellpinit, WA 99040 • (509) 258-4581 • Fax 258-9243

CENTURY OF SURVIVAL
1881-1981

September 26, 2006

Daniel D. Opalski, Director
Office of Environmental Cleanup
Region 10
United States Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Re: Spokane Tribe of Indians' concurrence on the selected remedy for the Midnite Uranium Mine Superfund Site

Dear Mr. Opalski:

This letter is in response to the U.S. EPA, Region 10's, recent request for concurrence on the remedy selected for the Midnite Uranium Mine Superfund Site. The request represents a positive example of your agency's effort to honor our government-to-government relationship and the United States' trust responsibility to our people. These efforts are appreciated, and because implementing any cleanup action carries obvious benefits, the Spokane Tribe generally concurs with and supports the cleanup activities included in the selected remedy.

This concurrence is based on our understanding that the remedy will be protective of our people and of our Reservation environment. There remain, however, a number of concerns that were not fully resolved during the remedy selection process. These issues center on our Reservation's Congressionally recognized purpose of providing a permanent homeland for our people.

In the exercise of sovereignty, our Council sets the policy for Reservation cleanups. Importantly, our Council approved an exposure scenario specific to the uses our people make of our Reservation's resources. While it appears the remedy selected will achieve protectiveness for our people generally, questions remain because EPA declined to fully incorporate our scenario. Additionally, Tribal leadership for decades opposed remedies that rely on perpetual water treatment, but as you know, the selected remedy assumes the need for long term water treatment. While we appreciate EPA's effort to minimize this need, the water treatment component of the remedy represents to us a perpetual risk, with a perpetual need for funding. Should funding fail at some future time, that risk will threaten the health of our people and our Reservation environment. Also, the remedy we supported more aggressively controlled the sources that

Daniel D. Opalski
September 26, 2006

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contaminate our ground and surface waters. Specifically, threats associated with the backfilled pits that will remain buried under the selected remedy, would generally have been eliminated in our proposed remedy. Nonetheless, we appreciate the attempt to address this critical aspect of cleanup, and hope that the long term monitoring reveals no problems with the remedy's effectiveness. Finally, we also appreciate EPA's effort in the remedy to minimize the areas lost to use by our people, but because the backfilled pits will remain buried, and because a water treatment facility will be perpetually present, many acres that were promised to us forever will be unuseable. Not only will these remnants of the Midnite's legacy be inconsistent with our Reservation's purpose of providing a permanent homeland for our people, but they will also impede our anticipated future uses for the affected areas.

Beyond the cleanup actions to be taken, the Spokane Tribe appreciates the commitment in the Record of Decision to perform additional work on our Reservation related to mining contamination from the Midnite. In particular, further evaluation of the potential for our subsistence users to be exposed by contaminated resources in the Blue Creek Bay area is both necessary and welcome. Threats to human health and the environment identified through those and similar activities, including the statutory five year review, should then be addressed by future response actions in coordination with our Tribe, as a government. It is to your agency's credit that the Record of Decision commits to such efforts; and further, that Region 10 generally has sought to achieve the level of protection required by our standards.

Despite our continuing concerns for issues Tribal representatives detailed during the remedy's development, the work to be accomplished under the selected remedy is viewed as a positive step. It is in that spirit, and in the spirit of future cooperation between our governments to address the enormous challenges presented by the Midnite, that the Spokane Tribe sends this letter. Again, we appreciate the work performed by Region 10 to date on this difficult cleanup, and look forward to continued coordination and cooperation between our governments on future activities to protect our people and Reservation from the Midnite Mine's contamination.

Sincerely,



Richard L. Sherwood
Chairman
Spokane Tribal Business Council

cc: Rudy Peone, Director, Natural Resources Department
Shannon D. Work, Special Counsel
Fred Kirschner, Ph.D., AESE
Randall Connolly, Superfund Coordinator

APPENDIX B

Responsiveness Summary

RESPONSIVENESS SUMMARY

Response to Public Comments on Midnite Mine Proposed Plan

The U. S. Environmental Protection Agency (EPA) issued the Midnite Mine Proposed Plan for public comment on October 5, 2005. The comment period was extended twice and ended January 18, 2006, after a total comment period of 105 days. EPA received written comments on the Midnite Mine Proposed Plan via hand delivery, mail, and e-mail. In addition, comments were delivered orally at two public meetings and were transcribed by a court reporter. Copies of all of the comments are included in the Administrative Record. EPA considered all of the comments in selecting the remedy.

EPA's responsiveness summary is organized according to an outline of comment topics (see below). This responsiveness summary summarizes significant comments under each outline heading and provides a summary response. In some cases, paraphrases of individual comments are included and an individual response is provided.

EPA prepared a more detailed response to comments submitted jointly by Dawn Mining Company and Newmont USA Limited (the Mining Companies), which is included in Attachment A. The Spokane Tribe (Tribe) provided a letter and technical comments on the Feasibility Study (FS) previously submitted. EPA's previous response to these comments is included in Attachment B. The Washington Department of Health (WDOH) resubmitted comments previously provided on the Human Health Risk Assessment. EPA's previous response to these comments is included in Attachment C.

Comment topics include:

- I. Adequacy of the RI/FS**
- II. Cleanup Alternatives**
- III. Blue Creek Surface Water and Sediments**
- IV. Borrow Materials**
- V. Coordination**
- VI. Construction Impacts**
- VII. Decision Process**
- VIII. Engineering and Design Considerations, Contingencies**
- IX. Environmental Justice and Equity**
- X. Funding**
- XI. Ecological Concerns**
- XII. Human Health Concerns**
- XIII. Long-Term Actions – Institutional Controls, O&M, Monitoring, Water Treatment**
- XIV. Regulatory Requirements, Water Discharge, Sludge Disposal, Radiation Protection Requirements**
- XV. Timing of Cleanup**
- XVI. Tribal Context: Land and Resource Uses**
- XVII. Area of Land Use Restrictions**

I. ADEQUACY OF THE RI/FS

Spokane Tribe, Mining Companies, and SHAWL (Sovereignty, Health, Air, Water, Land) Society provided detailed comments on Remedial Investigation/Feasibility Study (RI/FS) documents. The comments and EPA responses are grouped by specific aspects of the RI/FS.

A. Background Levels

(Summary) Comments expressed concern about EPA's determination of background levels of metals and radionuclides. The Mining Companies commented that background concentrations are lower than concentrations at the site prior to mining. SHAWL Society voiced concerns as to whether background levels are protective of human health and the environment.

Response: *The terms "pre-mining conditions" and "background" are related, but not interchangeable. "Pre-mining conditions" are conditions at the site prior to mining. "Background" approximates pre-mining conditions, but is based on current conditions in nearby unimpacted areas. Where site conditions were not characterized prior to mining, current background conditions are used as a surrogate for pre-mining conditions. As much as possible, background areas are similar to what is known of pre-mining conditions at the site.*

EPA evaluated existing information for the region before selecting and characterizing the background area for Midnite Mine. The area includes upper Blue Creek and Sand Creek, their tributaries, and two areas of Spokane Mountain. These areas include areas with known uranium deposits and share geology, geohistory, topography, climate, and other features. They are not, and are not claimed to be, identical to Midnite Mine pre-mining conditions.

EPA collected data in the background areas to evaluate background metals and radionuclide levels in groundwater, surface water, sediment, soil, radon and radiation. Because natural environmental conditions are not uniform, any background data set can only be used to approximate the true range and distribution of concentrations. Statistical values developed from the data are used to distinguish natural variation from site impacts. EPA believes the data collected for this purpose and the statistical approach used provide a reasonable basis for defining impacts from mining activities at Midnite.

As discussed in RI/FS documents and the Record of Decision (ROD), constituent concentrations in soil, sediments, surface water, and groundwater at the site before mining began are not well documented. The best approximation is developed based on data from a nearby undisturbed area with similar geology to determine whether the site has been impacted. During the RI/FS, the Tribe commented that EPA's estimated background levels are higher than pre-mining conditions at Midnite, because the predominant rock type in the background area is not as prevalent at the Midnite Mine site, particularly on the west side of the Mined Area and throughout the Mining Affected Area.

The Mining Companies assert that site radon and radiation levels at the surface were higher than background even before mining and that using background data to assess site impacts is not valid. However, photographs and the surrounding landscape indicate that, apart from localized rock outcrops, most of the area that was mined was previously covered with a soil layer and vegetation. Conditions changed dramatically once mining began, because unweathered rock was broken up and brought to the surface. The rock surfaces now interact with air and water to form acid mine drainage, and radon and radiation are emitted at the ground surface over a large area, rather than from rock covered by soil for most of the site. Acid rock drainage has accelerated the mobilization of metals and radionuclides to ground water, surface water, and sediments.

The remedial alternatives in the FS focused on controlling the exposed rock (the source of acid drainage and high radiation levels). Cleanup levels for risk drivers at Midnite Mine are generally based on background, because risks from exposures at the site to contaminants above background levels are outside EPA's acceptable risk range, and pre-mining data are not available. In controlling the source, risks from radiation and impacts to other media will be reduced greatly. The Selected Remedy addresses these impacts. Assuming the Selected Remedy effectively isolates material exposed by mining, the conditions in surface water, sediments, and groundwater should improve to as near to pre-mining conditions as possible. The Selected Remedy is protective of human health and the environment.

B. Ecological Risk Assessment

(Summary) Most comments regarding the ecological risk assessment were provided by SHAWL (or technical reviews provided by TOSNAC [Technical Outreach Services for Native American Communities] on SHAWL's behalf) and The Lands Council. The comments were largely supportive of EPA's methodology, but expressed concerns on the following topics:

- The need to better address radiation risks to ecological receptors.
- The potential cumulative effect of multiple metals.
- The potential for contaminants to interact or interfere with each other.
- The toxic effects of aluminum, iron, and magnesium.
- The need for further investigation and long-term monitoring of Blue Creek ecological conditions.
- The need to better understand the effect of metals concentrations in wetland plants and potential uptake by herbivorous animals.
- The potential role of the community in assessing environmental impacts, uncertainties in the use of terrestrial plant benchmarks to assess wetland plant risk.
- The need for clarification about remediation and verification sampling for sediments.

- EPA reliance on Dawn Mining Company tissue sampling results.
- Concerns about dermal exposures to fish and amphibians, dermal and inhalation exposures to mammals and birds, and the need for additional investigation of metals bioaccumulation in Blue Creek receptors.
- Concern that the use of central tendency radiation exposure values underestimates risks.
- The lack of metals speciation data to understand metal toxicity.
- The need to better assess molybdenum and copper deficiencies in ruminants which may be caused by high sulfate levels.
- Support for the use of factor of ten to identify risk drivers.
- Need to work with Tribal community to develop risk management strategy.

Response: EPA recognizes that there are unanswered questions about the ecological risks related to the site. The Baseline Ecological Risk Assessment (BERA) provides extensive information about risks to numerous ecological endpoints. It also discusses uncertainties in assessing ecological risks, including many of the points raised above. Though the uncertainties may overestimate or underestimate risk, the BERA provides enough information to support the need for remedial action. During design of the Selected Remedy, EPA expects to collect additional data in the drainages and Blue Creek to confirm baseline conditions, refine cleanup needs, monitor for construction impacts during cleanup, and assess changes and remedy effectiveness following mine waste containment. Sufficient information regarding ecological risks is available to support the Selected Remedy.

C. Site Hydrology and Hydrogeology

(Summary) Comments from the Tribe, The Lands Council, and the Mining Companies include the following concerns:

- Pits 3 and 4 hydrogeology may allow groundwater to flow eastward from the pits.
- Deeper groundwater from recharge areas upgradient of the mined area may currently be contributing to seeps. As a result, containment of the waste may not lead to seep flow reductions as great as anticipated.
- Current site hydrologic conditions reflect recent drought years. Remedial plans need to account for potentially wetter years to come.
- EPA has overestimated expected reductions in groundwater flow into the pits. This affects the comparison of costs for long-term water treatment and sludge disposal.

Response: Groundwater flow in fractured bedrock is highly complex. EPA gathered and evaluated extensive hydrologic data in the RI and appendices. These data provide appropriate

information to support remedy selection. Additional information will be gathered as cleanup proceeds. For example, pre-design testing will refine information to support the development of construction plans and specifications. Long-term monitoring and remedy reviews every five years will indicate whether changes are needed to ensure the effectiveness of the remedy.

To the extent possible, hydrologic information is based on a period that is not limited to drought years. The FS estimates for water treatment and sludge generation are based on data that were available in 2004. EPA has assessed the potential cost impact of higher groundwater flow rates into the pits and the results are within the uncertainty of the estimate. Long-term monitoring will be designed to assess changes in seep flow, location, and quality.

D. Human Health Risk Assessment

(Summary) Comments about the adequacy of the Human Health Risk Assessment (HHRA) were submitted by the Mining Companies, SHAWL Society, the Washington Department of Health, and The Lands Council. The comments varied widely, some raising concerns about possible underestimation of site risk, others about the possible overestimation of risk.

- EPA should have obtained and reviewed documentation the Tribe asserts supports tribal exposure assumptions used in the risk assessment;
- The tribal exposure assumptions are not supported by past or more recent ethnographic information;
- By not defining reasonable maximum and central tendency exposures, EPA did not follow risk assessment guidance;
- EPA did not adequately address uncertainties in the risk assessment and, by making conservative assumptions where data were not available, greatly overestimated risk;
- EPA underestimated background levels and therefore overestimated the site's contribution to the total risk (see response to "background");
- EPA may have underestimated risk by not addressing exposure to multiple contaminants that may interact antagonistically or synergistically;
- Lead exposure at the site may be of concern to children, particularly due to potential interactions with other metals that increase its toxic effects, as well as other factors;
- EPA did not account for Environmental Justice considerations or exposure from other local sites, such as Dawn Mill, Sherwood Mine, and Lake Roosevelt;
- EPA document reference lists are not always complete enough;
- The HHRA should include concise descriptions of the data objectives and sample results underlying the risk assessment, including background characterization;

- EPA used 1998 SMI radiation survey results rather than getting up-to-date, comprehensive, and reliable survey measurements, particularly for Blue Creek;
- EPA did not adequately characterize areas such as the mouth of Blue Creek. Such areas are used by tribal members and the risks should have been better characterized;
- EPA appropriately performed risk based screening;
- Educational, health, and land-use planning documents should reflect how people should use land and resources when radiation levels are twice the national average radiation levels (i.e. in background areas) or four times (as in the Mining Affected Area);
- Community risk management planning would benefit by additional data, foraging information, and risk information regarding subsistence consumption of fish, moose and other animals that may have contaminant exposures different from the modeled meat from cattle raised on site;
- If sweat lodge exposures (associated with very high hazard index from manganese) were not considered, what metals other than manganese would be risk drivers?
- It is unclear what cancer risk is associated with non-residential sweat lodge use with Blue Creek water rather than MAA water?
- Technical review comments on the HHRA resubmitted by Department of Health underscored the likely overestimation of risk due to the following factors: reporting of total risk rather than risk related to concentrations in excess of background levels, assumption that radon resistant construction would not be used in buildings on site, use of high soil ingestion assumptions, assuming all meat ingested is from animals raised on site, use of surface water for drinking water supply, assuming all plant ingested grow at the site, use of root data to represent concentrations in plants ingested, possible overestimation of exposure to and site-related radionuclide concentrations in Blue Creek sediments, the ability of site wells to support residential uses, the use of radiation levels estimated from soil concentrations rather than measured radiation, sampling bias, sweat lodge use assumptions, the need for a quantified uncertainty analyses with respect to Spokane Tribe exposure assumptions, and insufficient documentation of risks under more standard, non-tribal scenarios.

Response: *The purpose of a human health risk assessment is to establish whether cleanup is needed at a site and, if so, to develop site-specific risk-based cleanup levels where appropriate. Since Midnite Mine is located on an Indian reservation, EPA appropriately considered tribal land use and exposure assumptions. These assumptions may overestimate risk due to uncertainties in traditional and subsistence tribal exposure assumptions, such as meat and plant ingestion and sweat lodge use. To assess the impact of these uncertainties, EPA estimated risk using EPA standard default exposure assumptions for residential and commercial land use. This analysis indicates that, without regard to tribal exposures, risks at the site warrant remedial action. Because background levels of key risk drivers are above risk-based levels and ARARs, addressing site-related risk requires cleanup levels equivalent to background levels of these risk drivers.*

Under CERCLA, EPA does not address past exposures (for example, mine workers exposed at Midnite Mine in the past) or risks that are not related to the Superfund site (for example, risks due to background conditions or to other sites that may affect the community).

More detailed and accurate determinations of risks from specific exposure pathways not quantified in the HHRA are possible and may be helpful in determining health education or advisory needs for the affected community. EPA does not have plans to refine tribal exposure assumptions or to assess animal tissue, dermal exposures, cumulative effects, or other uncertainties. While doing so could lead to more precise risk-based levels, it is unlikely to alter the need for cleanup to background levels.

E. Feasibility Study

(Summary) In addition to resubmitting detailed technical comments previously provided to EPA on the Feasibility Study report, the Tribe provided general comments that expressed concern that the RI/FS characterization of site conditions and how various cleanup alternatives were predicted to affect these conditions was insufficient. Comments were also provided by the Mining Companies, SHAWL Society, and others that focused on technical issues with key remedial elements, such as backfilling, use of liners, etc.

This section summarizes the comments and provides responses. (See also II a, b, c.)

Reduced water volumes contacting waste rock may be offset by increased contaminant concentrations in the water, such that overall loading may not be reduced as predicted.

Response: *EPA did not predict concentrations in water contacting waste rock, but used reductions in sludge generation rates to reflect expected volumes and characteristics of water entering the treatment system. For example, for the Preferred Alternative, the sludge generation rate was reduced to reflect anticipated reductions in the relative volumes of water to be pumped from the Backfilled Pit Area and from the engineered drainage layers of Pit 3 and Pit 4, and to reflect the fact that Pit 3 and Pit 4 water will not contact waste rock backfill. These assumptions are reasonable estimates.*

Waste management areas – The FS should discuss waste management areas consistently, and in particular should indicate that Alternative 5c would not have a “waste management area” (an area where groundwater is not required to meet groundwater cleanup objectives) as the waste would be completely isolated from groundwater.

Response: *The concept of waste management areas applies to groundwater only. Alternative 5c could reduce the waste management area by eliminating the backfilled pits waste management area, but would not eliminate a waste management area where the waste is contained in Pits 3 and 4. Engineering controls under various alternatives may isolate the waste from groundwater sufficiently to allow water quality to meet cleanup objectives.*

Waste resulting from water treatment (either ex situ or in situ) may constitute principal threat waste, NRC source material, or material of importance under the Homeland Security Act.

Response: Chapter 11 of the ROD addresses principal threat waste. Designation of sludge as source material under the Atomic Energy Act affects substantive requirements of an on-site water treatment system. Waste designations, such as the determination that sludge would be low-level radioactive waste, affect disposal options on site and off site and are addressed in the FS. The Homeland Security Act does not apply to the on-site response actions in the selected remedy. To the extent that it may apply to offsite transportation requirements, the remedy will comply with all applicable regulations.

The assumption that only volumetric flow rates will change and that water quality (entering the water treatment plant) will remain constant over time for each alternative is a fatal flaw.

Response: A single estimate of water quality changes is adequate for purposes of describing an alternative and estimating its cost. The WTP design and monitoring will ensure that changes in water quality are addressed.

If the water table drops below the bottom of the backfilled pits, the pits will no longer function as a “sink” where water can be collected. Contaminated water entering the area from exfoliated and unconsolidated material higher on the pit walls may flow through waste and down to the backfilled pit bottom, where it may then enter groundwater through pit bottom fractures. This is not an issue if you remove the waste from these pits (as in Alternative 5c).

Response: Removal of the waste from the backfilled pit area would not eliminate shallow groundwater flow from exfoliated and unconsolidated material, and this water would still contact oxidized pit walls and is expected to require collection and treatment. In addition, a lowered water table is favorable as it minimizes the flow of groundwater from bedrock fractures into the backfilled pit area. Concerns about shallower groundwater flow into this area can be addressed by diverting shallow groundwater upgradient of the pit. EPA expects to include such diversion trenches where appropriate (for example, upgradient of the backfilled pits) as part of the Selected Remedy.

The commenter correctly notes that the Tribal Surface Water Quality Standard for uranium isotopes was incorrectly listed in Table 5-7 (value in footnotes is correct). The commenter incorrectly states that the uranium concentration in mass units is incorrect. Commenter states that the values in FS Table 5-8 should be adjusted to reflect the hardness of the receiving water body, which for Blue Creek may be as low as 25 mg/L.

Response: HSCA groundwater standards are appropriately considered as potential surface water cleanup standards, and Section 8 of the ROD does so. Adding HSCA standards to the tables would not change what the tables demonstrate, which is that background concentrations are above numerical standards for this medium. Table 5-8 notes the hardness basis for the numerical standards. The use of a hardness value other than the assumed 100 mg/L hardness may be appropriate for determination of discharge limits for water treatment system discharge to the Spokane River Arm and will be considered as part of the NPDES permit process.

Comment notes that in-situ water treatment, such as permeable reactive barriers (PRBs) or a “pit bioreactor”, produces waste that remains on site but is not contained as reliably as it would be in a landfill engineered for containment of solid or hazardous waste. Such alternatives are thus less protective than ex situ treatment with disposal at a commercial landfill.

Response: *EPA agrees that while there are benefits to in-situ treatment, it can be less reliable and harder to control than ex-situ treatment. In comparing the alternatives, this fact was considered in the context of overall protectiveness.*

Comment states that Alternatives 4d and 4e are like a large scale leach process, and the addition of lime and subsequent in situ precipitation of contaminants generates waste that must be managed.

Response: *See comment and response regarding waste management. Lime addition is only contemplated for Alternative 4d. Organic amendments and nutrients would also be added to prevent the dissolution of metals into groundwater by creating anoxic conditions in the saturated zone where waste rock would be in the pits. In the case of Alternative 4e, water would be drained from the pits and would not contact the waste. For Alternative 4d, the metals in the waste rock backfill would not be mobilized to water, but captured seep water would be treated in the pits. If treatment was effective, precipitate volumes would be low and unlikely to clog pore spaces in the backfill.*

Comment observes that the use of passive drains (boreholes) to keep pits dewatered (as in FS Alternative 5a) poses issues such as potential collapse, clogging of drain and pit drainage layer, difficulty in repairing or replacing, need for multiple drains to address backfilled pit area. Comment suggests that passive horizontal drains are costly, difficult to maintain, and could allow contaminated water to flow into bedrock.

Response: *While passive drains have some benefits (e.g., they avoid the need to actively pump water from the pits), the issues of maintenance and long-term effectiveness are serious issues. The Selected Remedy does not include passive drains.*

Comment asks 1) if geological, bacterial, or chemical solutions were evaluated for addressing the contamination and 2) whether creative use of the waste was considered.

Response: *The alternatives carried forward for evaluation included a variety of biological and chemical treatment elements. The potential uses of water treatment sludge and waste rock would be as a source of uranium. Ore prices continue to change, and it may be possible to recover uranium separately from the lime precipitation process. However, the lack of a nearby facility for processing the sludge, ion exchange units, or ore means high transportation costs which are not, at this time, outweighed by the benefits.*

Comment recommends the use of organic material (Edible Oil Substrate) for in situ treatment of acid mine drainage.

Response: While the specific formula recommended in the comment was not evaluated, the addition of organic and inorganic materials to a backfilled pit was considered (Alternative 4d). In situ treatment of this nature can significantly reduce contaminant concentrations, but it works only for waste in the saturated zone of the pit. Since the waste at Midnite Mine exceeds the capacity of the saturated zone of the pits, much of the waste would not be treated. In addition, it would be difficult to ensure that groundwater cleanup levels are achieved uniformly and sustained over time. Reapplication of the organic material would be needed, and unless cleanup levels were met in the pit, an ex-situ treatment system would likely be needed for water removed to control water levels or collected from above-grade waste containment areas.

Comment states that to safely and successfully install a liner in the open pits, excavation of the pit wall to reduce the slopes would be necessary. This would generate more waste and cost much more.

Response: EPA's technical assessment is that such a step is not necessary. The pit walls are sufficiently stable and a variety of installation approaches can be used. During remedial design, installation details will be developed that address worker safety and implementability. EPA does not expect that these issues will affect the costs significantly, based on existing information.

Comment questions whether a liner will be effective over the long term.

Response: Synthetic liners have a limited lifespan, while liners made of geologic materials (clay, for example) have other issues. The primary purpose of placing a liner below the waste is to protect the drainage layer in the backfilled pits while construction is underway. Properly installed, it should not be subject to damage from physical stresses or water pressure. Exposure to ultraviolet radiation can damage a synthetic liner, but the liner will be covered by waste rock, so UV exposure will be limited. The liner above the waste (as part of the soil cover) can be readily installed and will serve an important purpose while revegetation is occurring.

Regarding FS Alternative 4b (this alternative was not carried forward for detailed evaluation), SHAWL asks how liner rupture will be prevented and whether more permanent materials than synthetic flexible membrane liner (FML) could be used.

Response: See response in this section to similar comments related to the Preferred Alternative.

Comment questions whether, if the upper liner ceases to function, the cover material for Alternative 5a will perform as predicted in reducing infiltration and associated water treatment and sludge disposal costs.

Response: The upper liner is expected to greatly reduce infiltration from above the waste. This is particularly important while vegetation is becoming established on the soil cover. A vegetated evapotranspiration cover uses evaporation and plant transpiration to keep water from moving through the soil into the waste. The FS assumed that this reduced infiltration rate would continue, even if the liner becomes less effective. Barring severe degradation of the liner due to UV exposure (which is not anticipated as the liner

will be covered by soil), EPA anticipates only localized damage to the liner, if any. The liner is expected to last long enough that the revegetation and the weathering of cover materials to clay will provide water retention. The Selected Remedy does not specify a synthetic or FML liner, as other materials may be shown to be more appropriate during remedial design.

Community needs more information about the likely success of the remediation technologies, particularly the “drainage blanket” at the base of the waste backfill. Technical literature and references to where this technique has been used successfully should be included, and the cost of failure should be built into the total cost estimate.

Response: *The Rabbit Lake tailings repository in Canada uses a drainage blanket concept. Uranium tailings are dewatered and stored in pits, with a drainage layer to capture water from the tailings and to keep clean groundwater from contacting the tailings. While the circumstances are not identical (for example, tailings are finer than waste rock, and the cover is not a soil cover but a layer of water), the concept of keeping materials dewatered by pumping water from a basal drainage layer is being successfully applied.*

F. Cost Estimates

(Summary) Comments regarding the Feasibility Study cost estimates were submitted primarily by the SHAWL Society, the Tribe, and the Mining Companies. Tribal comments supported the present worth estimating assumptions used in the FS, while the Mining Companies were critical of EPA’s approach. The Mining Companies asserted that EPA’s technical assumptions biased the estimates in favor of Alternative 5. The Tribe asserted that the FS cost estimates likely underestimated costs for use of Spokane Tribe resources. SHAWL and others noted sources of uncertainty in costs, such as water treatment system replacement cycle, water treatment method, and water quality.

Response: *EPA cost estimates in the FS included two sets of present worth cost estimating assumptions and two sets of assumptions to account for uncertainties in borrow material quality and transport distance, and in sludge disposal methods.*

EPA guidance calls for present worth estimates based on a 7% discount rate and 30 year evaluation period to support comparisons with other sites nationally. It also allows for adjustments to these assumptions where appropriate. For a containment remedy where perpetual water treatment and residuals disposal are anticipated, a longer evaluation period is reasonable. In addition, use of a discount rate that considers recent economic data gives a more clear picture of the likely costs. Inclusion of alternative assumptions does not indicate a bias.

The FS also indicates that the cost estimates do not reflect costs related to the use of tribal resources, such as borrow material, land for disposal sites, and other fees and costs that could be imposed by the Tribe. Estimated costs for these resources were not quantified for EPA by the Spokane Tribe.

With regard to the Mining Companies’ concern that remedial assumptions created a bias, EPA did not bias the evaluation and does not view the cost impacts as the sole factor in its preference.

Specifically, a layer of soil over excavated areas is likely to be necessary to enhance surface runoff and limit erosion. The FS assumed that waste excavation may not result in exposed bedrock in all cases and that some areas may support vegetation without soil addition. In the absence of subsurface data, an assumption was necessary to estimate volumes. The impact of adding a foot of soil to the entire excavated area under Alternative 5a is an additional \$4 million dollars, as noted in the comment. If less than 50% requires a soil cover, the impact is to lower the cost. Without a basis for a different assumption, EPA acknowledges that there is uncertainty in this cost estimate. Sediment remediation methods were varied for the different alternatives, not solely for the two referenced in the comment. The cost impact of \$1 million is less than 1% of the total cost for either Alternative 5a or 3c, well within the acceptable certainty for cost estimates.

The FS cost estimates assumed that the current water treatment method would be used in future. While the quality of the water to be treated is expected to change over time, a cost estimate based on a single set of reasonable assumptions is sufficient to support the comparative evaluation of alternatives. The estimates assumed replacement of the water treatment system every thirty years, which is the standard assumption and reflects the typical design life for a water treatment plant.

II. CLEANUP ALTERNATIVES

A. Differences between Alternatives 5a and 5c and Preferred Alternative

(Summary) Several comments indicated that the Proposed Plan was not clear that the Preferred Alternative was different from the Feasibility Study Alternative 5a. Overall, comments supported Alternative 5a, 5c, or the Preferred Alternative. The Tribe noted that Alternative 5a and the Preferred Alternative were preferable to other alternatives, with the exception of Alternative 5c. A number of comments indicated that because Alternative 5c was the Tribe's preference, EPA should select it or better justify not selecting it. Comments noted favorable aspects of Alternative 5a, but noted that Alternative 5c would further reduce areas requiring land use controls and would more reliably control acid rock drainage (ARD) control by removing waste from the Backfilled Pits Area. Comments concluded that relative to the other FS alternatives, Alternative 5a, Alternative 5c, and the Preferred Alternative all provided a better balance between capital and O&M costs.

Response: *In the Feasibility Study, differences between Alternatives 5a and 5c were described (FS p. 5-113) and include the following: Alternative 5c would remove the waste from the Backfilled Pits Area, while Alternative 5a would not remove the waste but would cover it and keep it dewatered. While both alternatives would completely fill the open pits with waste, Alternative 5c would keep the waste dewatered using wells, while Alternative 5a would use passive drains both to dewater the Backfilled Pits Area and Pits 3 and 4. Alternative 5c included liner material in the cover system and above the basal drainage layer, while Alternative 5a did not. Alternative 5a assumed on-site discharge of treated water, while Alternative 5c would discharge water to the Spokane River Arm of Lake Roosevelt.*

The Proposed Plan presented a modified version of Alternative 5a as the Preferred Alternative. The Preferred Alternative adopted several features of Alternative 5c, such as the use of a liner for the drainage system and the cover system. However, it did not include excavation of the Backfilled Pits Area. EPA does not believe that the additional cost of excavating the waste, combined with the potential for ARD, concerns about capacity in Pits 3 and 4, and other issues associated with re-exposed pit walls in this area warrants including this element.

B. Preference Among Alternatives

(Summary) The Proposed Plan used a footnoted designation “Alternative 5a” in referring to the Preferred Alternative. As a result, it may have been unclear whether comments were supporting Alternative 5a (as described in the FS) or the Preferred Alternative (Alternative 5a as modified in the Proposed Plan).

Nevertheless, the majority of comments identifying a preference among alternatives expressed support containment of mine waste in the open pits (EPA’s Preferred Alternative, Alternative 5c, or Alternative 5a). Support for this approach came from the Spokane Tribe, state and federal agencies and the Colville Confederated Tribes, the local community group, and several environmental organizations. The reasons given for the support included advantages described in the Proposed Plan, such as reduced water treatment, reduced sludge generation, a smaller area requiring permanent institutional controls, and others. A number of commenters felt that EPA should have selected Alternative 3c because it was preferred by the Spokane Tribe.

The Mining Companies commented that the Preferred Alternative was fatally flawed. Their comments indicated a preference for above-grade waste containment and ex-situ treatment (along the lines of Alternative 3c). Several other commenters opposed backfilling the pits, for reasons that include concern about the effectiveness of the remedy and concern about access for mining purposes.

Four tribal members signed a comment letter stating that cleanup would deprive the Tribe of uranium and that mining this resource would help the Tribe. A similar comment from a non-tribal member noted that the uranium might be needed by the United States, as an alternative energy source which does not impact global climate change. Some commenters supported Alternative 2 (current conditions with added access restrictions and institutional controls) to ensure that mining would not be foreclosed.

Response: *Under CERCLA, EPA must consider state or tribal acceptance, one of the nine evaluation criteria for remedy selection. EPA alone is responsible for selecting the remedy, after evaluating the alternatives using all of the nine criteria.*

EPA continues to believe that, compared to the other alternatives, including the Spokane Tribe’s preferred Alternative 5c and the Mining Companies’ preferred Alternative 3c, the Preferred Alternative is protective of human health and the environment and provides the best balance of tradeoffs among the evaluation criteria. Although Alternative 2 includes institutional controls, it would not address the source of ARD and is not protective of ecological receptors.

Re-initiating mining would require an interested party with resources to address ongoing environmental impacts, develop an EIS and approved mining and reclamation plan, and assure long-term funding for perpetual care. It would also require the acceptance of the landowners, the Tribe, and BIA. To EPA's knowledge, this opportunity has not been of sufficient interest to mining companies. The uranium will remain on site, with the exception of uranium in water treatment sludge. If at some point in the future all of the conditions are right, mining could be done at Midnite, in the context of a completed cleanup.

C. Recommendations and Questions Regarding the Preferred Alternative

(Summary) Several comments provided suggestions to improve the Preferred Alternative or questions regarding aspects of it included the following:

- use a ring of wells in bedrock around the pits,
- grout pit wall fractures
- use non-reactive rock to fill the portion of the pit below static water level
- re-initiate mining
- remove and process the ore and proto-ore
- recontour the pit walls
- make less steep soil cover slopes
- recontour the waste piles and manage waste in place
- do not dewater the Backfilled Pits Area

Comments also included requests for more detailed information about how Blue Creek and mine drainage sediments would be addressed, whether the gravel haul roads on site would be paved, what specific surface water and erosion controls would be used, how the drainage layer and liner would be constructed, and where a drainage layer has been used successfully.

Response: *Adding a ring of wells in the bedrock around the pit would not be as effective at uniformly lowering the water table as it is in some settings, such as in sandstone. Grouting fractures in the pit wall may be effective at reducing groundwater inflow, and this option will be further assessed during the remedial design phase. Recontouring the waste piles and managing the waste in place was assessed in Alternative 3, which did not address a number of issues and did not provide the best balance of tradeoffs among the nine criteria.*

EPA intends to use non-reactive on-site waste as much as possible for the lower portion of the waste backfill. However, if additional material is obtained for this purpose, the capacity of the pits will be diminished. EPA assessed the time it would take for the non-reactive drainage layer in each pit to fill with water and estimated six months for Pit 4 and three years for Pit 3. EPA believes that the risk of re-saturating the waste is low and can be minimized with careful design and construction.

In light of recent increases in prices for uranium, EPA evaluated removal of stockpiled ore and proto-ore for processing at a mill. The nearest mill is in White Mesa in Utah, and costs to transport the material would be greater than income from the processed uranium. While removing the stockpiles would reduce the amount of radiation and radon and reduce the volume of ARD generating materials, these issues can be addressed through containment on site. Containment is in any case needed for the uranium-bearing, ARD generating waste rock that would remain.

Minor recontouring of the pit walls to allow safe and effective construction of the remedy will be necessary before backfilling. However, recontouring the pit walls as a means of making the slopes permanently stable without backfilling would be very costly and would create additional ARD waste. The location of the pits on a steep slope means that “flattening” the slopes on the uphill side would require removal of a huge volume of material. Because both Pits 3 and 4 are partially below the water table, recontouring the downhill side would leave an opening for seepage on the uphill side to flow out of the pits.

Specific construction plans will address the details of liner and drainage layer installation. It is likely that after the base layer, successive lifts of liner will be installed, with successive liner segments. As described above (see Section 1E) a drainage layer has been used successfully at the Rabbit Lake tailings disposal area in Canada. Construction was done in lifts.

The ROD provides clarification of how the Blue Creek and drainage sediments will be addressed. The ROD also states that gravel and construction materials from the gravel haul roads and adjacent soils will be removed to cleanup levels and placed with other waste in the pits.

III. BLUE CREEK SURFACE WATER AND SEDIMENTS

(Summary) Many comments focused on Blue Creek, which was not discussed in depth in the Proposed Plan. Some comments indicated that no action is necessary, while others felt that additional sampling and analysis should be done to better understand the role of groundwater sources and human and ecological risks. Some recommended that cleanup be performed concurrent with, rather than after, source control. The Tribe indicated that water is a more significant vehicle for contaminant loading than particle transport. Community based approaches to studying the area, answering questions about risks, and developing health advisories and community education were emphasized in comments the community and environmental groups, particularly in light of the importance of the area to the tribal community.

Response: *The Selected Remedy emphasizes the importance of controlling contaminant sources to Blue Creek and evaluating improvements in Blue Creek conditions over time. This approach makes sense. Contaminant levels in Blue Creek are low relative to the mined area, the creek is dynamic, and the risk assessments do not indicate severe ecological or human health risks, particularly if this area is not the sole source of food for subsistence and if the water is not supplying domestic water or being used for daily sweat lodges.*

The Selected Remedy outlines a phased process to address information gaps and avoid unnecessary impacts to this physically undisturbed natural area. Human health risks can be addressed through education and a health advisory. EPA agrees that close work with the

community and with the Tribal government will help make such controls effective. Following source control and any necessary remediation of Blue Creek sediments, monitoring will be conducted to evaluate whether the anticipated recovery is underway.

It is likely that both particulate transport and water chemistry affect Blue Creek. To be effective, any remedy must address sources of both. With regard to the importance of overall loading as compared to localized impacts on contaminant levels, the loading leads to elevated contaminant concentrations at various locations. Contaminant concentrations measured at individual locations are combined for development of an exposure concentration over an area relevant to the receptor for which risk is being assessed. Ultimately, reduced loading can be combined with removal of contaminated media hotspots to address the current exposure and prevent recontamination.

IV. BORROW MATERIALS

(Summary) The source of soil cover materials will affect the cost of cleanup. Mining Company comments suggested that a source may be available on or near the site. The Tribe's comments indicated that the Tribe opposes use of reservation materials, that available volumes may not be sufficient, that the costs for such materials should not be underestimated. Comments noted that Alternative 5a or 5c has the advantage of using less cover material than other alternatives.

Response: *EPA expects that soil cover construction will require the use of multiple borrow sources. During remedial design, the material volumes needed for the cover will be refined, as will information about available sources. Information regarding potential on-site sources will be reviewed, although EPA does not believe on-site sources are sufficient. If on-reservation sources are available at competitive costs, EPA will seek the Tribe's support for the use of such materials. Potential impacts to the community from transporting material from elsewhere could be minimized, and remedial costs could be reduced.*

V. COORDINATION

A. Coordination with Other Agencies

(Summary) The SHAWL society comments noted a need for better inter-agency coordination to address community concerns. Comments asked that EPA better educate the community about effects of exposure to heavy metals and radionuclides. Information also was requested on exposures associated with harvesting and handling plants grown in contaminated soil. EPA was asked to coordinate with the Agency for Toxic Substances and Disease Registry (ATSDR), federal, state and local health providers to address impacts of uranium mining and heavy metals on community health. Short-term impacts associated with construction of the remedy, as well as long-term exposure impacts are of concern to a number of commenters.

Response: *EPA is coordinating with ATSDR on health issues associated with uranium mining and heavy metals. EPA will continue to consult with ATSDR and the Spokane Tribe on health issues. ATSDR is the federal health agency with the lead role for developing environmental health education materials and health consultations for Superfund sites. EPA has the lead role for the cleanup action.*

ATSDR is developing a health assessment which will address health issues associated with the Midnite Mine site itself as well as with Blue Creek and the Blue Creek Delta. The assessment looks at all exposures and contaminants, including medicinal uses of plants and traditional practices such as hide tanning. ATSDR generally uses existing data rather than collecting and analyzing samples. The health assessment will be shared with the community. The assessment looks at all hazardous substances and human exposures, including those associated with traditional tribal practices and subsistence activities.

In addition to developing the health assessment, an ATSDR environmental health educator periodically works with health care professionals on the Spokane Indian Reservation. EPA will request that ATSDR's health educator meet with the community to address health issues of concern, including impacts of heavy metals exposure on women and children and those who may bear a disproportionate share of the impact.

B. Coordination with the Public

(Summary) Comments from SHAWL Society and the environmental groups indicated a desire for more transparency and ongoing coordination regarding Midnite Mine following the ROD. This includes the design phase, construction, and long-term actions, including the reviews that occur every five years at sites where contamination is left in place. They specifically sought information regarding sources of cover material, human and ecological exposure and risks related to Blue Creek during construction.

Response: *Under CERCLA, EPA is required to provide opportunities for public input at key milestones. Following remedy selection, EPA must notify the public of changes in the remedy, and seeks comments if the changes are significant. Every five years following a ROD, EPA is required to review the protectiveness of sites where wastes remain on site above levels that allow for unrestricted use and unlimited exposure and must provide notice to the community regarding the reports.*

Beyond these minimum requirements, EPA guidance establishes an expectation for a community involvement plan that addresses the specific needs of a community affected by a Superfund site, taking into account environmental justice issues where applicable. EPA plans to conduct community interviews and to update the community relations plan following the ROD.

In addition to community involvement, EPA coordinates and consults with the Spokane Tribe on a government-to-government basis. EPA encourages members of the community to contact the project team members or request a meeting when they have concerns or questions. Community concerns may also be expressed to EPA through the Tribal government.

EPA will work with the Spokane Tribe and ATSDR to develop advisory information for the community. EPA will also hold public availability sessions and develop signs, notices, fact sheets or other mechanisms to help the community prepare for upcoming cleanup activities that may affect publicly accessible areas such as Blue Creek. Monitoring to assess construction impacts and to minimize releases to Blue Creek will be required. Detailed monitoring plans will be developed during remedial design.

EPA believes that the decision process set forth in Superfund law, regulations, and guidance is clear and transparent. EPA presents information in the Feasibility Study and other site documents to make the tradeoffs among the alternatives clear and to facilitate public input. Public meetings are held to answer questions the public may have about the decision process and information being considered. Documents considered or relied upon in the selection of the remedy are in the Administrative Record, which is housed at the Tribal College Library on the Spokane Indian Reservation and at the EPA Records Center in Seattle.

The Community Involvement Plan (CIP, updated in 2003) will be revised after the ROD is published and will describe anticipated community involvement activities during remedial design. CIPs are developed based in large part upon interviews with community members. Public input to the CIP is always welcome, and EPA can update the CIP at any time. CIPs are generally reviewed by the project team, management in the Community Involvement program, and EPA Region 10's Environmental Justice Coordinator as appropriate. If you are interested in being interviewed for the revised CIP or in seeing the current version, please contact Renée Dagseth, the Community Involvement Coordinator for Midnite Mine, at 206-553-1889 or dagseth.renee@epa.gov.

EPA will coordinate with ATSDR and the Spokane Tribe regarding health issues in the affected community and will request that the ATSDR health educator work with the community to develop risk management strategies.

VI. CONSTRUCTION IMPACTS

(Summary) Concerns were raised regarding construction impacts to the environment and risks to workers and the community. Concerns included the potential for increases in ARD during and after construction, pit wall stability during backfilling or liner installation, the potential “attractive nuisance” of hay or straw runoff controls, and impacts of hauling materials. Details were requested for temporary control measures for surface water runoff, sediment, and soils during construction, and for monitoring requirements.

Response: *EPA agrees that issues of construction impacts must be addressed. Specific control measures and monitoring requirements will be identified as part of the remedial design process (in a construction quality assurance plan), and worker safety will be addressed in a site-specific Health and Safety Plan in compliance with OSHA. While soil erosion and surface water runoff may be minimized, it is expected that disturbance of the waste will cause an increase in the generation of ARD. Impacts to groundwater and surface water will be minimized using best management practices, such as covering or otherwise isolating ARD materials during construction and capturing, containing, and treating ARD.*

VII. DECISION PROCESS

(Summary) Comments, largely from the community and environmental groups, included concerns about the transparency of EPA's decision process, the role of cost and litigation risk in this process, why EPA did not defer to the Tribe's preference for Alternative 5c, and whether the Mining Companies had influenced the decision. These commenters sought a greater role in

decisions. The Mining Companies' comments stated that EPA's preferred alternative was driven by the Tribe, was based on flawed land use and risk assessment assumptions, was presented in a way that was biased in the Tribe's favor, and overlooked the role of the Tribe and landowners in approving of the mining. They also commented that EPA was subverting public input on significant technical issues by deferring certain decisions until the remedial design phase. The Tribe's comments noted that EPA had developed alternatives before land use planning was completed, and that as a result most of the FS alternatives developed would not be protective.

Response: EPA makes CERCLA cleanup decisions using evaluation criteria set forth in the National Contingencies Plan (NCP). Two of the criteria are state (or tribal) acceptance and community acceptance. The CERCLA process includes public involvement at key milestones, including the proposal of a site cleanup plan. Site records are subject to the Freedom of Information Act.

With regard to the role of the Tribe, federal policy and guidance set forth requirements and expectations for EPA interaction with Tribes. EPA Region 10 and the Spokane Tribe signed an environmental agreement and entered into a memorandum of understanding with regard to Midnite Mine.

In recognition that cleanup decisions may have to be with incomplete technical information or imperfect knowledge, CERCLA provides a process for public input following remedy selection. CERCLA requires a formal public comment period if fundamental changes are made following remedy selection in the ROD. For non-fundamental but significant changes warranting an Explanation of Significant Differences (ESD), EPA may voluntarily hold a public meeting or provide a public comment period.

EPA expects that key site documents will continue to be placed in the information repository and on the website for public review, that staff will be accessible by phone and email, and that the site-specific community relations plan will reflect community input regarding the frequency of public meetings, fact sheets, and other modes of public involvement.

VIII. ENGINEERING AND DESIGN CONSIDERATIONS, CONTINGENCIES

(Summary) A number of comments were submitted on the need for careful engineering, construction, monitoring, maintenance and contingency planning. Comments sought greater detail regarding specific elements of the preferred alternative, such as drainage systems, methods for preventing water from entering the pits, methods to minimize the effect of water accumulation, liners, waste compaction, revegetation, water treatment, erosion, slope stability, compaction, temporary water storage.

Response: Many of the issues raised by commenters are most effectively addressed through pre-design characterization and detailed design. EPA agrees that careful design and planning are essential. In addition to construction plans for backfill, compaction, surface grading, slope stability, and revegetation, the remedial design will address material staging, management of water during construction, and the sequencing of construction elements such as removal of contaminated sediment from the mine drainages and water treatment system construction. Where

additional information is needed to support this, pre-design information gathering will be performed. The Selected Remedy includes some flexibility as to pit liner material and anticipates pre-design studies to refine site hydrologic information and mechanisms to minimize groundwater inflow and clogging of the drainage system.

Inflow Reduction Methods: The Selected Remedy does not specify mechanisms to further limit groundwater inflow to the pits, but indicates that such mechanisms will be evaluated, as will the site hydrology. If the benefits of reducing inflow can be realized without significant overall cost impacts, EPA will include them in the remedy through modification of the Selected Remedy under CERCLA.

Surface Water Impoundments: As indicated in the FS, the Selected Remedy will likely require seasonal water impoundment during the construction phase. The specific performance requirements and location will be determined during remedial design, in coordination with the Tribe, Bureau of Indian Affairs (BIA), and land owners.

Pit Backfilling: Specific construction methods and sequencing will be developed during remedial design. The FS assumed compaction of backfill to minimize excessive or uneven settlement of the fill material and to maximize waste capacity. Construction planning will ensure that compaction of the waste fill is sufficient, but that it has minimal impact on the performance of the liner and drainage layer. It is likely that the pit will be filled in lifts, with incremental construction of the drainage layer with each lift. Unlike the Preferred Alternative, the Selected Remedy does not specify a plastic liner. Rather, it allows for selection of appropriate liner materials as part of the design process. A protective layer of finer material may be necessary to protect the liner.

Grading and Soil Covers: Erosion can become an issue for slopes greater than 3:1, particularly if soil cover vegetation is lacking or in areas where extreme precipitation/runoff events occur. At Midnite Mine, specific slopes will be determined in design and will account for planned revegetation and local runoff conditions.

Water Treatment: The Selected Remedy does not call for modification of the water treatment system to address sulfate levels. Control of the mine waste is expected to reduce sulfate levels in groundwater collected for treatment, but treated water is unlikely to achieve the Tribe's Water Quality Standard of 250 ppm without a mixing zone. Discharge of treated water to the Spokane Arm of Lake Roosevelt will be protective of aquatic life and will ensure that humans and ruminants (deer, elk, cattle) will not be exposed to sulfate at levels of concern to the Tribe.

EPA considered treatment methods that could achieve the Tribe's sulfate standard. Available methods have a number of issues, including the impact of significantly increased sludge waste volumes, maintenance requirements, issues with management of highly concentrated "reject water" and others. The FS includes a table showing the cost impacts for the increased sludge volume.

The Selected Remedy does not require use of ion exchange resins to remove uranium in the water treatment process, provided the treated water meets the discharge limits. Removal of the uranium from the waste stream would not make it possible to eliminate off-site disposal, and based on current ore prices, the savings in off-site disposal costs are not greater than the cost to implement and maintain an ion-exchange process. Ion exchange is technically feasible, however,

and may be cost-effective, particularly if uranium prices remain stable in the period before water quality improvements are observed. This decision is therefore kept open as a design decision.

If an ion exchange step is added to the ex situ treatment system, it is likely that a mechanism to avoid fouling associated with sulfate loading will be considered. The Selected Remedy does not require ion exchange, however, as the water treated in the WTP will be discharged to the Spokane Arm of Lake Roosevelt pursuant to a NPDES permit.

Groundwater: EPA does not anticipate using in-situ ion exchange or permeable reactive barriers as part of the Selected Remedy, although these technologies were considered in the FS. With regard to the impact of disruptions in pit water removal, EPA assessed the time it would take for water to fill the void space in the drainage layers and determined that technical issues that may arise with water removal (well fouling, for example) can be addressed within the time it would take several months for the water to rise within the drainage layer to the level of the waste.

The small volume of groundwater flowing into the pit and the porosity of the drainage layer means that, provided the surface cover is effective, it should take at least six months to fill the bottom drainage layer. The extraction well (or wells) will likely be designed to remove more than the average inflow volume, to avoid water accumulation during spring runoff and to extraction well maintenance or other down-time.

Drainage Sediments: The Selected Remedy calls for inclusion of the mine drainage sediments with other wastes in the pit. The sequencing of drainage sediment controls and sediment excavation will consider the ability to prevent sediments from migrating to Blue Creek, the severity of ongoing ecological effects in the drainages, and the need to avoid recontamination of the drainages after cleanup.

Blue Creek Sediments: The Selected Remedy describes the overall plan to assess Blue Creek conditions during construction and to monitor the progress of natural recovery following control of site sources. Specific construction monitoring plans will be developed that the frequency and nature of monitoring. The Selected Remedy also calls for monitoring following construction (in accordance with an EPA approved plan to be developed) and contingency actions for Blue Creek if recovery does not occur.

IX. ENVIRONMENTAL JUSTICE AND EQUITY

(Summary) Comments on the topic of Environmental Justice and equity came from the SHAWL Society and environmental groups. The comments recommend that environmental justice principles be incorporated into the Midnite Mine cleanup plan and that the burden of site impacts and cleanup be borne not by the Tribe or the community but by those who benefited from the mining.. The Mining Companies comment that EPA overlooked the fact that mining was an acceptable use to the Tribe and allottees, who leased the land for this purpose.

Response: *Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.*

EPA is aware of Environmental Justice issues in this community. As described in Section 4 of the ROD, in addition to public meetings and fact sheets, EPA has reached out to the community by setting up an information kiosk, presenting information in local schools, meeting with elders, coordinating with the SHAWL society, and attending the community health fair. The EPA-funded Technical Outreach Services for Native American Communities (TOSNAC) program was engaged to provide technical advisors to the community, and TOSNAC advisors held a workshop on the Reservation to help residents understand about Superfund, risk assessment, and how to reduce their exposure to potentially harmful substances. Three public meetings were held to take comments and answer questions about the cleanup plan.

EPA understands that SHAWL Society seeks increased transparency and community participation in future. As noted previously, following the ROD, EPA will modify the community involvement plan based on interviews with community members, including SHAWL society members.

Regarding the burden of site risks and cleanup costs, CERCLA includes enforcement provisions to ensure that the “polluter pays” where possible. Litigation is currently underway to resolve the liability of potentially responsible parties.

X. FUNDING

(Summary) Several commenters raised concern about sources of funding to ensure the long-term effectiveness of the remedy. One comment suggested that a reserve fund be set aside in the event that the remedy fails. One suggested that information about the impact of funding discontinuities be developed and used to support funding prioritization. Several commenters emphasized concern over who would pay for the cleanup and whether the Tribe will be required to pay some of the costs. Several commenters noted uranium recovered from the water treatment process could be used to offset some of the costs.

Response: *EPA agrees that long-term funding must be assured. In pursuing Potentially Responsible Parties (PRPs), EPA will make long-term funding a high priority. While discontinuous O&M has been evaluated to some extent (estimates of drainage layer fill rates if water removal is suspended), EPA will work with enforcement tools and with other federal agencies and the Tribe to avoid discontinuities and ensure that long-term O&M is addressed. EPA will seek funding for cleanup and long-term O&M from the Potentially Responsible Parties. If a decision to use ion exchange is made during remedial design, EPA expects that available income from uranium sales would be applied toward cleanup costs.*

XI. ECOLOGICAL CONCERNS

(Summary) In addition to the concerns raised regarding Blue Creek (Section IV), a number of comments raised concerns about specific PRGs, whether the Preferred Alternative would address certain ecological issues, or whether the risk assessment underestimated risks.

Response: *The cleanup plan for Midnite Mine is intended to address site-related risk by achieving cleanup levels based (for the most part) on background levels. Background concentrations of many ecological risk drivers are higher than risk-based concentrations. EPA*

characterized the background area using a systematic and scientific approach and believes that its background levels are appropriate. The ROD allows for additional data to be used to refine areas where background is uncertain.

The cleanup will contain waste rock under a clean soil cover. This will immediately reduce risk to animals such as birds and mammals that may be exposed through direct contact with the waste rock and pit walls, water, and sediment and through dietary exposures (since the plants, animals or insects they eat will live in clean soil). Over time, the waste containment will result in improved conditions in the mine drainages and Blue Creek. This will reduce risk to aquatic, riparian and wetland animals and plants, and animals that eat these plants. Under Superfund, EPA focuses on risks posed by a site and does not seek to address natural conditions.

Although EPA did not identify a preliminary remediation goal PRG for selenium and its background-based cleanup level for aluminum is significantly higher than the risk-based concentration for aluminum, these contaminants are not risk drivers in Blue Creek. Blue Creek concentrations of aluminum are lower than background.

Following waste containment, site related contaminant loading is expected to improve. Contaminants elevated as a result of mining impacts should show decreasing concentrations as a result of source control, even if they are not risk drivers. Monitoring will be performed following waste containment to evaluate changes in water quality.

For animals that may be attracted to salts in seeps and groundwater discharge areas before groundwater quality has improved to background levels, EPA will not specify risk reduction strategies in the Selected Remedy. Monitoring plans may include assessment of this issue, however, and the Tribe's Department of Natural Resources may want to consider herding behavior, alternate salt licks, or other strategies to reduce animal exposure.

XII. HUMAN HEALTH CONCERNS

(Summary) A number of comments, mostly from the SHAWL Society, focused on whether the remedy would protect tribal health, worker safety, past exposures, uncertainties in the risk assessment, and whether EPA could work toward a community-based approach to characterizing and addressing human risks.

Response: *The Human Health Risk Assessment was used to support remedy selection. However, EPA acknowledges the community's concern about uncertainties or gaps in data, risk information, and health advice, particularly with regard to traditional activities in areas such as the mine drainages and Blue Creek, where water and sediment quality and plant and animal tissue may continue to be affected for some time. EPA plans to work with the Spokane Tribe and health agencies to develop advisories and risk management strategies. Funds for additional data collection, if necessary for this purpose, may be available from other entities.*

When cleanup levels are achieved in primary media (soil, water, sediments) and when secondary media (plant and animal tissues) reflect these improvements, site-related risks will have been addressed. Under CERCLA, EPA does not address risks from background concentrations. The Tribe may want to consider information about background concentrations in considering land use and outreach, recommendations, or advisories for the tribal community.

In accordance with OSHA, workers on site must have appropriate health and safety training. EPA will work with the community and health agencies to assess whether local health providers or first responders need specialized training or information to address potential worker or community exposures during construction or sludge transport.

Under CERCLA, EPA can seek to recover from the potentially responsible parties costs it has incurred for response actions. While the health concerns of this community are acknowledged, improved health care for past workers and their families is not a CERCLA response action, and EPA does not anticipate seeking funds for this purpose from potentially responsible parties (PRPs).

XIII. LONG-TERM ACTIONS – INSTITUTIONAL CONTROLS, O&M, MONITORING, WATER TREATMENT

(Summary) A number of comments were made regarding the importance of long-term actions following waste containment, such as institutional controls, monitoring, water treatment O&M, and sludge disposal. Comments emphasized the importance of these actions and requested more detail regarding EPA plans.

Response: *EPA agrees that monitoring and maintenance are necessary to ensure the effectiveness of the remedy over the long term. Specifics of monitoring and maintenance and a procedure to change the requirements as appropriate will be developed during remedial design and construction planning.*

CERCLA requires that EPA review cleanups where waste remains on site every five years following a cleanup decision. The review generally uses monitoring data, inspections, and interviews to assess whether remedial actions, including institutional controls and access restrictions, are protective of human health and the environment. EPA guidance (OSWER No. 9355.7-03B-P) calls for community notification at least twice: at the beginning and at the conclusion of a five year review. This notification should provide information regarding how the community during the review process.

Changes in land use would be revealed through the five year review. However, to prevent certain land uses that could impact the remedy or lead to exposures, institutional controls are included in the Selected Remedy. The ROD identifies the objectives of institutional controls and appropriate mechanisms for implementing them. Specific mechanisms will be selected and implemented following the ROD.

Manned security was not considered for any of the alternatives, although Alternative 2b would leave waste at the surface and Alternative 3 and 4 would leave some exposed rock that may contain ore. Undetected removal of uranium ore from the site in quantities of concern would be difficult. Under the Selected Remedy, all of the waste rock will be covered, and monitoring and inspections should detect disturbances of the cover.

XIV. REGULATORY REQUIREMENTS, WATER DISCHARGE, SLUDGE DISPOSAL

(Summary) A variety of comments were received on regulatory requirements (ARARs), cleanup goals, water treatment discharge locations, disposal of water treatment sludge.

With the exception of the Mining Companies' comments, most comments regarding sludge disposal expressed opposition to on-site sludge disposal. Similarly, the Mining Companies challenged the use of Tribal standards and ordinances as ARARs, while other comments supported EPA compliance with Tribal standards. The Mining Companies commented on whether surface water and groundwater cleanup goals are achievable, and also commented on regulations such as UMTRCA, the Tribe's HSCA, and other regulatory requirements.

Some comments were opposed to discharging treated water from Midnite Mine to the Spokane River Arm, while others conditionally supported it, as a temporary measure or with the appropriate coordination and environmental evaluation. The Washington Department of Health provided comments specific to requirements for disposal of radioactive waste.

Because comments on this topic were generally focused on a specific point, they are individually listed below with EPA responses to each.

A. Regulatory Requirements

The Tribe's Hazardous Substance Control Act is not an Applicable or Relevant and Appropriate Requirement (ARAR), because the section of CERCLA that references CERCLA provisions under which a tribe should be treated as a state, it does not reference the ARAR provisions.

Response: See ROD and separate response to comments from the Mining Companies.

EPA should uphold tribal sovereignty by acknowledging and incorporating tribal regulatory standards such as the Tribal Historic Preservation Office policies, the Spokane Tribe Cultural Preservation Ordinance, and the Cultural Advisory Committee.

Response: EPA acknowledges the sovereignty of the Tribe and consults with the Tribe in a government-to-government relationship. EPA addresses Tribal regulatory requirements for the Selected Remedy in the ROD. In coordinating with the Tribe during design and implementation of the Selected Remedy, EPA expects that the Tribe will work with EPA to identify policies and advisory recommendations that may be important for successful remedy implementation.

Were the Spokane Tribal Risk Assessment Scenario and EPA documents that included cultural information reviewed by the THPO [Tribal Historic Preservation Officer] or the Cultural Advisory Committee?

Response: EPA cannot respond as to coordination among Tribal entities regarding the Spokane Subsistence Exposure Scenario (Harper et al. 2002). Representatives of the Culture program met with EPA during the scoping of the HHRA, and the draft HHRA documents were provided to the Tribe for review. Cultural information included in the HHRA is publicly available.

The radon standard for uranium mill covers is not appropriate for Midnite Mine. The dose standard of 15 mrem/year is protective for land uses other than residential or unrestricted use.

Response: *See separate response to comments from the Mining Companies.*

The standard for radium in soil at uranium mills is not appropriate because they are premised on unrestricted (residential) uses, which are not likely at Midnite Mine.

Response: *See separate response to comments from the Mining Companies.*

The cleanup objective for Blue Creek should be to meet Washington State and Spokane Tribe Water Quality Standards.

Response: *Generally, EPA considers applicable or relevant and appropriate requirements (ARARs) such as water quality standards as potential cleanup levels. At Midnite Mine, the water quality standards for the contaminants that contribute most to risk were below background levels established based on data from unaffected upper Blue Creek, Sand Creek, and their tributaries. For such cases, EPA selected background for the cleanup level, which will address risks related to contamination related to environmental releases from the site.*

Given the natural mineralization in the mine area, soil and water cleanup standards may not be achievable in the waste rock footprints.

Response: *EPA disagrees with this comment. Impacts from mining disturbances are expected to decrease significantly due to removal of waste from these areas, revegetation, and gradual flushing of the groundwater system. What is unclear is how long this recovery will take and, if the standards are not achieved, whether further action is warranted. Long-term monitoring will be planned to address this question.*

In using background as a cleanup level for contaminants of concern, did the statistical value represent an upper part of the range of background measurements, or more of a mean or average value?

Response: *The 95% UTL uses measured values to project the distribution of metals in unimpacted areas and to project a statistical background value. If the value is exceeded in a site sample, there is a 95% chance that the exceedance reflects site impacts rather than natural conditions. The 95% value is in the upper part of the background range. If a mean or average value were used, such as a 50% UTL, there would be a greater chance that an unimpacted sample would be mistaken for an impacted sample, increasing the potential for cleanup of unimpacted areas.*

B. Discharge of Treated Water to Spokane Arm

Discharge of treated water into the Spokane River Arm of Lake Roosevelt should not be a permanent solution, but is acceptable to alleviate contaminant loading in the Blue Creek drainage. Best available technology should be used as soon as it is affordable.

Response: *The Selected Remedy calls for interim discharge of treated water on site in compliance with interim discharge limits established in the ROD. Treated water will be discharged to the Spokane River Arm pursuant to a future NPDES permit. The permitting process will include an evaluation of the protectiveness of the discharge limits, treatment methods, and an opportunity for public comment.*

The Colville Confederated Tribes (CCT) comment that they do not support discharge of treated water in Lake Roosevelt in compliance with a mixing zone. Sulfate should be reduced through modifications to the water treatment process.

Response: *The Selected Remedy calls for discharge to the Spokane Arm of Lake Roosevelt under a federal NPDES permit. Using a mixing zone approach, the discharge will be protective of aquatic life and will eliminate exposure to humans and large mammal receptors above levels established in the Spokane Tribe Surface Water Quality Standards. Modifications to the water treatment process to achieve the sulfate standard were evaluated in the FS; however, the resulting sludge volume increases, capital costs, operational issues, and maintenance requirements associated with achieving this standard at the point of discharge did not support such an approach.*

How will EPA address the loading or mass transport of contamination to Blue Creek from groundwater and surface water? It appears that EPA's loading estimate in the FS includes only discharge of treated water and doesn't include groundwater seeps and surface water flow.

Response: *As indicated in Appendix F of the FS, the loading estimates take into account seeps and groundwater, as well as discharge of treated water. The loading from these sources depends on the alternative.*

EPA should work with the U.S. Fish and Wildlife Service (FWS) and evaluate potential effects on the Spokane River aquatic system prior to adopting discharge of treated water to this location. The evaluation should address sulfate and other contaminant concentrations at the end of pipe, their potential effects on sensitive aquatic species, and factors that influence the response of aquatic species such as timing, location, and depth of discharge location with respect to species habitat, river flow, temperature, and other factors.

Response: *Information will be gathered and coordination with appropriate resources agencies will be required to support the development of a permit.*

Because the discharge limits for treated water are expected to be low enough to be protective for discharge to the Spokane Arm of Lake Roosevelt, and given the support of the Tribe for protecting Blue Creek from discharges high in sulfate, the Sierra Club supports the discharge of treated water from Midnite Mine to the Spokane Arm.

Response: *Comment noted. The permit process will provide another opportunity for public input.*

C. Sludge Disposal

BIA supports the disposal of sludge at a licensed off-site facility, consistent with concerns regarding long-term O&M and institutional and engineering controls on the Spokane

Reservation. The Colville Confederated Tribes do not support on-site disposal of sludge due to the radioactive nature of the waste.

Response: *The Selected Remedy calls for off-site disposal. However, if a sludge disposal facility could be sited at Midnite Mine in compliance with the Spokane Tribe HSCA, EPA would not rule out on-site disposal, as an on-site disposal facility could be engineered to be protective of human health and the environment. FS cost estimates would be refined to reflect additional costs referenced by the Spokane Tribe, and this change would have to be documented by amending the ROD.*

Under CERCLA, if a Tribal law results in disposal of sludge reservation-wide prohibition, the Tribe would have to arrange for and assure payment of the incremental cost of a disposal facility off-reservation. The siting criteria of the Tribe's Hazardous Substance Control Act do not, in any case, rule out on-site disposal.

Response: *See separate response to comments from the Mining Companies.*

Technically, construction of an on-site disposal facility for water treatment sludge is straightforward. A relatively flat area of sufficient size is available near the water treatment plant, and the facility would include perimeter embankments, bedding, two liners with a leak detection system between the liners, leachate collection, and a soil cover.

Response: *See separate response to comments from the Mining Companies.*

The Proposed Plan should provide more detailed information about costs and the long-term availability of off-site disposal facilities.

Response: *The Proposed Plan was less detailed than the Feasibility Study to make it accessible to most readers. More detailed information is available in the FS. See Section 5.3.1.4 Water Treatment and Sludge Disposal.*

In transporting sludge off site, EPA should commit to consulting with entities responsible for protecting residents along the transportation route.

Response: *Off-site transport of sludge will be subject to DOT regulations. The specific requirements depend on the waste classification. Requirements may include placards on the vehicle to identify the nature of the waste being transported.*

The FS should incorporate the addition of an ion-exchange step to remove uranium from water treatment sludge.

Response: *A discussion of potential for adding ion-exchange to the water treatment process was included in the FS, with estimates of its effect on costs for each alternative.*

EPA should defer to the Tribe's judgment and preference and work with the Tribe to find suitable off-site disposal locations for water treatment sludge.

Response: EPA has identified off-site commercial disposal locations for the current sludge waste stream, which is low level radioactive waste. Such sites are limited in number.

The Tribe opposes the use of the site for disposal of water treatment sludge. The site is unstable, does not meet the Tribe's siting criteria under HSCA, would not be approved under state or federal siting laws, and places a cost and health risk burden on the Tribe.

Response: EPA acknowledges the Tribe's opposition and concerns about the cost and health risk burden. The FS includes a discussion of HSCA, and EPA agrees that an on-site disposal facility would not comply with its siting criteria. EPA has not concluded that the site is unstable or that federal siting laws would prohibit such a facility.

The cost of on-site sludge disposal would be significantly higher than estimated in the FS, due to Tribal costs for regulatory capacity development and the need to contract technical services for oversight.

Response: EPA does not have information to estimate and include the costs referenced by the Tribe.

The Tribal Council has consistently opposed on-site sludge disposal. Tribal land is finite and scarce, and disposal facilities pose a risk to Tribal surface water and groundwater. These resources must serve the Tribe in perpetuity.

Response: EPA acknowledges the Tribe's opposition and concern over Tribal land and resources.

For any alternative, onsite sludge disposal results in a greater risk than off-site disposal, because the concentrations in the sludge would raise the exposure point concentration and resulting risk estimate.

Response: EPA does not fully agree. While on-site sludge disposal may pose a residual risk at the site in the event of remedy failure, the risk of an effectively operated on-site facility would not differ significantly, since an on-site facility would use access restrictions and best management practices to minimize public, worker, and environmental exposures.

D. Radiation Protection Requirements

To use the Dawn Mill beyond 2008, EPA would need to involve Dawn Mining Company and obtain concurrence from the Department of Energy, the U.S. Nuclear Regulatory Commission, and the Northwest Interstate Compact on Low Level Radioactive Waste Management.

Response: EPA agrees. The regulatory process is described in detail in the FS, which acknowledges uncertainty in whether the use of the Dawn Mill is possible beyond 2008.

Solidification of sludge prior to disposal at US Ecology is referenced in the FS. Such solidification must comply with Appendix B of the US Ecology radioactive materials license.

Response: EPA agrees.

Reference is made to dewatering water treatment sludge to 40 to 50 percent solids by weight. This may not be sufficient to meet the US Ecology radioactive materials license.

Response: Comment noted. The FS describes further dewatering necessary “at a minimum” and notes that solidification may be needed of more than a “de minimis” amount of water remains. This is consistent with License Condition 29 regarding wet sludges. Specific requirements for disposal will be refined to ensure compliance with acceptance criteria for the facility.

The US Ecology facility operator may be able to accept more than the current limit of 4.7 Curies of U-238 if DOH approves a performance assessment that demonstrates that additional disposal would comply with the regulations.

Response: Comment noted. At this time, EPA has not requested such a performance assessment.

The correct reference for restrictions on radium disposal in a solid waste landfill is WAC 246-232-130, not WAC 246-232-120. The WAC 246-232-130 limits radium in solid waste to 1.0 E-7 microcuries per gram.

Response: Comment noted. EPA believes that both the restriction on total radium disposal and the unit radium restrictions may apply.

Weight limits for the box and road will need to be observed if sludge is solidified with concrete in B-25 boxes

Response: EPA agrees with this comment.

The costs should reflect the 3.3% Washington State B&O tax and 1.0% Commission Regulatory Fee.

Response: See Appendix D, Table D-5. These costs are included in the estimated unit costs for sludge disposal, rather than as a separate line item.

XV. TIMING OF CLEANUP

(Summary) Some commenters expressed concern about the timing of actions to address the site. One commenter felt that government delays made prevented the better solution of milling the remaining ore and proto-ore at the Dawn mill (which is now decommissioned). The Tribe commented that though the Preferred Alternative may take longer to implement than some other alternatives, it is most important that the cleanup be protective of the Tribe, its people and resources. The community group voiced a need for immediate institutional controls and better risk communication for the tribal community. They also wanted information about a reasonable timeframe for active cleanup of Blue Creek and Blue Creek Delta sediments.

Response: Timely decommissioning of the milling operations at the Dawn Mill was an important step towards compliance with a statutory closure deadline and environmental protection. Milling

the ore and protore produces acidic tailings. It is not clear that, had the Midnite Mine study been completed while the Dawn Mill was still functional, EPA would have considered the milling of stockpiled materials a better solution, particularly in light of low ore prices and ongoing environmental impacts.

EPA plans to work with the BIA, the Tribe, and individual land owners to establish institutional controls described in the Selected Remedy as soon as possible. EPA will also work with the community, health agencies, and the Tribe to develop appropriate health advisories and community outreach, particularly with regard to potential exposure to contaminants in riparian areas outside the Mined Area. EPA acknowledges the work of SHAWL and CURE in performing outreach related to community health concerns and hopes to plan a coordinated effort for the coming years.

As noted in the Selected Remedy, EPA believes that ten years is an appropriate time to allow for natural recovery once mine drainage sediment sources and loading from waste to groundwater have been addressed. This is consistent with the State of Washington sediment management standards and is expected to prevent unnecessary disruption to this physically undisturbed habitat.

XVI. TRIBAL CONTEXT: LAND AND RESOURCE USES

(Summary) Comments under this topic area included concerns raised by the Tribe and others that EPA consider the Tribe's sovereignty, traditional knowledge and practices, and reliance on reservation resources in selecting a remedy, identifying future land uses and restrictions, and protecting tribal health. Blue Creek is one of only two free flowing creeks on the Spokane Indian Reservation. Given the importance of tribal natural resources, it is important that EPA select a remedy which will accommodate traditional uses and ensure that water, soil, plants, and animals which Tribal members rely on are safe. The cleanup must as defined by the Tribally-sanctioned or generated risk scenario.

Some commenters were concerned that EPA's risk assessment did not evaluate tribal exposure pathways related to certain cultural practices, such as tanning deer hides, hunting, gathering roots and berries, using reeds, and camping. The Mining Companies raised concerns about whether EPA had allowed the Tribe to drive cleanup actions with unreasonable land use and exposure assumptions.

Response: *This Superfund site is located on trust lands within the Spokane Reservation boundaries. Under the provisions of CERCLA and the NCP, Indian Tribes are generally treated as states. In addition, EPA has a government-to-government relationship with the Spokane Tribe, in accordance with the EPA Region 10 Tribal Environmental Agreement with the Tribe and EPA's Memorandum of Understanding with the Tribe, as well as federal orders and policies regarding Tribes. In making environmental decisions, EPA is expected to consult with the Tribe.*

While the Tribe has rigorously protected proprietary cultural resource information, they have also provided input to the RI/FS, including the health risk assessment, regulatory requirements, land use planning and restrictions, and technical issues to ensure that cleanup decisions at Midnite Mine follow meaningful tribal involvement. EPA's risk assessment used simplifying

assumptions which generally coincide with the Tribe's scenario and is likely to overestimate the risk of the pathways evaluated. Some exposure pathways of concern were accounted for in these pathways (for example, soil ingestion associated with hunting and gathering was encompassed in the overall soil ingestion rate), while others (such as hide tanning) would have required additional assumptions and would have increased both the risk and the uncertainty. For specific exposure pathways of concern to the tribal community, the Tribe may wish to collect exposure information and additional data. Additional information is unlikely to change EPA's conclusion that site-related risks that warrant remedial action.

XVII. AREA OF LAND USE RESTRICTIONS

Comments from several citizens, BIA, FWS, and the Sierra Club felt that the remediated area footprint should be as small as possible. Reasons for this were varied but include the following: it minimizes long-term access restrictions and institutional controls, cover material volumes needed, and long-term cover maintenance. The Mining Companies commented that EPA overstated the differences among the alternatives in area and duration of institutional controls among the alternatives and that the incremental land available for (unreasonable and unprofitable) use by the Tribe was not worth the cost of minimizing the waste footprint.

Response: *EPA agrees that the benefits of a smaller footprint include those listed. EPA considered the benefits of a smaller footprint to the extent that they fall under the nine evaluation criteria. See separate responses to the mining company comments.*

RESPONSIVENESS SUMMARY – ATTACHMENT A

**Response to Comments from
Mining Companies**

RESPONSIVENESS SUMMARY – ATTACHMENT A

EPA Response to Comments from Dawn Mining Company and Newmont USA Limited on Midnite Mine Superfund Site Proposed Plan, Issued October 5, 2005

Dawn Mining Company (“Dawn”) and Newmont USA Limited (“Newmont”) jointly submitted comments on the Proposed Plan by letter dated January 17, 2006. Dawn and Newmont (“the Mining Companies”) submitted a letter summarizing issues further discussed in the attached exhibits. Seven of the exhibits were reviews or technical memoranda prepared by consultants. The exhibits are itemized as follows:

1. Midnite Mine Liner System Design Review (Golder Associates)
2. Unanticipated Releases of ARD to Groundwater at the Midnite Mine: Consequences of EPA’s Alternative 5a. (Donald Langmuir, PhD)
3. Critical Assessment of RME Subsistence Scenario (Harper et al. 2002): Spokane Tribe History, Economy, and Land Use (Praxis Research Associates)
4. Technical Review Comments, Final Midnite Mine Human Health Risk Assessment Report (Integral Consulting, Inc.)
5. Land Use Assessment – Midnite Mine Site (Dwight J. Hume, Land Use Planning Consultant)
6. Technical Memorandum - Background Calculations Utilized by EPA for Proposed Midnite Mine Remediation Plan (MFG Consulting Scientists and Engineers)
7. Technical Memorandum - Review of EPA’s Predictions of Water Treatment Volumes for Midnite Mine Remedial Alternatives (MFG Consulting Scientists and Engineers)
8. A list of documents the Mining Companies provided for inclusion in the Administrative Record.
9. A list of documents referenced in RI/FS reports that the Mining Companies believed were not included in the Administrative Record. The CDs included electronic versions of the comment letter and exhibits (CD-A), key references for the consultant reports (CD-B), and copies of the documents listed in Exhibit 8 (CD-C).
10. A copy of EPA’s response to a Freedom of Information Act from Temkin, Wielga, Hardt and Longenecker request for documents used to support Spokane Tribe exposure assumptions.
11. EPA Cyndy Mackey letter to Shannon Work, counsel for Spokane Tribe.
12. BLM comments on draft IRMP regarding Sherwood Mine land use.
13. Correspondence regarding wildlife use of the mine site.
14. Table of meteorologic data.

Three CDs were submitted under separate cover on January 18, 2006, and included CD-A, an electronic copy of the hard copy submittal; CD-B, containing key references from the consultant reports, and CD-C, which included electronic copies of documents listed in Exhibit 8. The Mining Companies' submittals have been included in the Administrative Record, in accordance with §113(k)(2)(B) of CERCLA.

This memorandum to the file responds to the comments submitted by the Mining Companies. Comments are included as written, except for added text in brackets or ellipses where transitional phrases were deleted. At the end of each comment, an alphanumeric code in brackets indicates the number used to identify comments for the responsiveness summary. Similarly, the bracketed code at the end of the response indicates the outline heading under which the comment was addressed in the responsiveness summary.

Comment: "...DMC's ultimate conclusion is that, for multiple reasons, selection of Alternative 5a as the Midnite Mine remedy would be arbitrary, capricious, irresponsible and not in accordance with the law." [M1]

Response: *EPA disagrees with this conclusion and addresses the specific issues raised by the Mining Companies in this memo and referenced technical documents. [IIB]*

Comment: "... EPA's real rationale for selecting Alternative 5, and particularly Alternative 5a,¹ is because this alternative is acceptable to the Spokane Tribe of Indians (the 'Spokane Tribe' or 'Tribe'). Proposed Plan, p. 17. Simply put, EPA is letting the Tribe drive remedy selection.

Footnote: ¹Alternative 5a in the Proposed Plan is a hybrid of FS Alternatives 5a and 5c. As such, most of the comments directed herein to Alternative 5a are also applicable to Alternative 5c." [M2]

Response: *EPA is not letting the Tribe drive remedy selection. EPA is required by CERCLA and its implementing regulations to select remedies that are protective of human health and the environment and that comply with ARARs. These two criteria are among nine evaluation criteria EPA considers when selecting a remedy. State/Tribal acceptance is also one of the criteria, and is considered a modifying criterion. In the Proposed Plan, EPA is required to address the nine criteria. Page 17 of the Proposed Plan, identified by the Mining Companies, simply addresses whether the Tribe accepts EPA's preferred alternative.*

Comment: "In addition, DMC has compiled a list of documents referenced or referred to in the RI/FS and other key documents supporting EPA decision making that DMC could not find in the Administrative Record. Exhibit 9. EPA should add a copy of each of the documents referenced on this list, which is attached hereto, to the Midnite Mine AR, and make these documents available for review and comment." [M3]

Response: *EPA has added to the AR the references listed in Exhibit 9, as well as additional documents referenced in key reports, with some exceptions. Documents that are readily available to the public (for example, census data, laws, regulations) are incorporated in the AR by reference only. Documents listed in Exhibit 9 that were already in the AR (see list) were not added. The Mining Companies' reference to "Cultural Resource information not made available purportedly supporting the Tribe's subsistence exposure scenario" in Exhibit 9 was addressed by the addition of specific references 1–3 in Harper et al. [VIII]*

Comment: “There purportedly is a body of so-called ‘Cultural Resource’ information available to the Tribe to support the subsistence exposure scenario outlined and discussed in the ‘Spokane Tribe Subsistence Scenario Memorandum’ (AESE 2001) and in Harper, et al., ‘The Spokane Tribe’s Multipathway Subsistence Exposure Scenario and Screening Level RME [Reasonable Maximum Exposure],’ *Risk Analysis*, Vol. 22, No. 3 (2002). These two documents, and their assumptions and contentions as to Tribal subsistence activities, essentially, with minor ‘tweaks,’ drive EPA’s Human Health Risk Assessment for the Midnite Mine Site, and the characterization of ‘Site Risks’ and cleanup needs in the Proposed Plan. The Spokane Tribe claims the ‘Cultural Resource’ information as proprietary and confidential and apparently, on that assertion alone, EPA has not included this critically important information in the Midnite Mine AR. Even more egregious, EPA itself apparently has never even assembled or reviewed this information to determine if the Tribe’s proposed exposure scenario is credible, as this information is not even in EPA’s files, apart from the Midnite Mine AR. [References Exhibit 10]. This further abdication to the Tribe of EPA’s responsibilities and decision making authority under CERCLA and the NCP as to these critical components of the CERCLA remedy selection process is also inexplicable and impermissible.” [M4]

Response: *EPA applied critical scientific judgment in reviewing and selecting exposure assumptions proposed by the Tribe. EPA rejected exposure factors proposed by the Tribe if available information clearly indicated that the proposed values were implausible or beyond the range of exposures encountered in relevant scientific studies. Some of the Tribe’s proposed exposure factors were used in the risk assessment but were qualified as upper bound contact rates (i.e., consumption rates based on caloric needs).*

Excerpted from the Human Health Risk Assessment (U.S. Environmental Protection Agency, Region 10, 2005):

“Two types of modifications were made to the exposure scenario developed by AESE and the tribe. In the first case, if sufficient information was available from Agency sources or peer reviewed literature to support a revised value, then the AESE point estimate exposure factor was replaced with a revised point estimate. These included the following exposure factors: soil ingestion, inhalation rate, sweat lodge water vapor volatilization factor, and the duration of sweat lodge use by children. In the second case, some exposure factors provided by AESE represent upper-bound values (i.e., what is possible, but not necessarily reasonable), but insufficient information is available to define an alternative RME point estimate. Examples include an exposure frequency of 365 days per year over a lifetime exposure duration of 70 years, meat ingestion of 1,185 grams per day, plant ingestion of 1,600 grams per day, and two hours of daily sweat lodge use by adults. For these exposure factors, the RME likely occurs below the values provided by Harper (2002).”

Because future land use and associated exposure scenarios were identified as a large source of uncertainty in the Risk Assessment, risks were re-examined using EPA standard default residential and work scenarios (U.S. Environmental Protection Agency, 1991; U.S. Environmental Protection Agency, 1993). The default exposure scenarios, and associated risk estimates, will be included in the Record of Decision. The default scenarios re-affirm that site risks warrant remedial action, whether they include risks from Tribal subsistence activities or not.

Comment: "... the Midnite Mine AR only contains a truncated excerpt of the Presentation Package that EPA delivered to the National Remedy Review Board (NRRB) (June 10, 2005), ending inexplicably at p. 30, two pages into a discussion of Alternative 3c. The entire Presentation Package should be included in the Midnite Mine AR..." [M5]

Response: *The Midnite Mine AR contains both a complete and an excerpted copy of the NRRB presentation package. The excerpt excluded portions of the package that were pre-decisional. Following issuance of the Proposed Plan, the complete package was made available to the public and a copy provided to the Mining Companies. [VIII]*

Comment: "I. EPA's Proposed Remedy for the Mine Area is Fatally Flawed from an Engineering Perspective. EPA proposes to line Pits 3 and 4 and backfill those pits with the protore, ore, and waste rock materials piled elsewhere on the site. EPA would also install, in advance of the liner, a groundwater collection system to control water levels and pressures in these pits as they are and once they have been backfilled. In endorsing this alternative, EPA ignores its earlier decision, in the Midnite Mine Feasibility Study Report (2005) ('Midnite Mine FS') to eliminate a similar liner and backfill option, Alternative 4b, because of concerns about the effectiveness and implementability of lining the pit walls. Midnite Mine FS p. 4-13; see also Midnite Mine FS p. 4-11 ('the liner may not be fully effective due to the difficulty of installing a liner adjacent to the steep pit highwalls, including possible breaching of the liner due to hydrostatic pressure differentials between the inside and outside of the liner and differential settlement of materials inside and outside the liner.')

In fact, the Proposed Plan does not even acknowledge these concerns." [M6]

Response: *The purpose of the underliner in the Preferred Alternative and Selected Remedy is primarily to protect the basal drainage layer from water and particulates moving downward through the backfilled waste during construction. As such, once the cover is in place, breaches due to settling are not a significant issue. The liner is not expected to extend to the top of the pit, and installation of the liner and fill in lifts is one of several mechanisms that will be considered in remedial design to address implementation challenges. Hydraulic pressure on the liner under the Selected Remedy is not expected due to the waste cover, the drainage layer, and the removal of water.*

The referenced section of the FS was related to Alternative 4b. Alternative 4b was among the alternatives that were not carried forward for detailed analysis. The screening of alternatives is intended to reduce the number of alternatives carried forward for further development and comparative analysis. A liner was assessed as part of Alternative 5c and was ultimately included with the Preferred Alternative for the reasons described above.

Comment: "...Dr. Lupo and Mr. Bronson [consultants to the Mining Companies] conclude that EPA's proposal is not implementable and, even if the remedy could somehow be constructed as proposed, it would not be effective either in the short- or long-term. These experts also conclude that EPA's analysis of the alternative is woefully deficient and irresponsible from an engineering perspective." [M7]

Response: EPA disagrees with this conclusion. See responses to comments below.

Comment: “EPA’s proposed remedy is fatally flawed. The liner EPA proposes to install in Pits 3 and 4 will fail and the safety of the workers tasked to construct the remedy will be seriously compromised during installation on the steep pit walls.” [M8]

Response: EPA disagrees with this statement. See responses to comments below.

Comment: “The successful and safe installation of a liner in Pits 3 and 4 would require substantially greater slope setbacks and pit footprints many times the size of the existing footprints and require the expenditure of vast sums of money, far beyond and at many times the costs EPA posits for this Alternative in the Proposed Plan. Just flattening the pit walls and managing the waste rock generated by that excavation work adds over \$235 million to EPA’s \$152 million cost estimate for Alternative 5a.” [M9]

Response: EPA disagrees with this statement. See responses to detailed comments below.

Comment: “...EPA has acted arbitrarily and irresponsibly in selecting this critical component of its preferred alternative while dismissing to ‘RD/RA’ the basic design and engineering considerations addressed in this report.” [M10]

Response: EPA has not acted arbitrarily or irresponsibly. The FS addresses the basic design and engineering considerations at a level appropriate for remedy selection. It is appropriate and accepted practice to refine conceptual information following remedy selection to support detailed design.

Comment: “The few circumstances where liners have successfully been installed on near vertical walls involved conditions vastly different from circumstances at the Midnite Mine. Even assuming the liner could be properly engineered and constructed, EPA’s Proposed Plan remains fundamentally flawed in presuming the liner or the associated groundwater collection system can perform effectively over the long-term.” [M11]

Response: The Selected Remedy provides for some flexibility as to the specific low-permeability liner material required. The primary function of the liner below the waste is to protect the drainage layer from contaminated water during construction, when it will be difficult to keep meteoric water from entering the pits. Liner placement can be safely and effectively performed in a variety of ways, such as adding liner material in lifts. While EPA believes that an FML liner cannot be relied on to function indefinitely, if ultra-violet radiation is kept to a minimum, material degradation will take a very long time. Physical stresses may cause localized liner damage. However, once the waste is contained under a soil cover, the lower liner is not essential to the functioning of the remedy.

Due to the potential for liner degradation or damage, the soil cover thickness above the waste is approximately 2.7 feet, enough to minimize infiltration and prevent exceedance of radon and radiation cleanup levels should the liner cease to be effective.

The effectiveness of the groundwater collection system depends on keeping poor water quality from entering the drainage layer. The soil cover system is expected to keep infiltration and percolation through waste to a minimum. The quality of water entering from the pit walls is expected to improve over time once the waste is contained. Provided water levels are kept below the waste, the nonreactive drainage layer is expected to have few problems from chemical or biological fouling, regardless of whether the lower liner continues to function. Issues of this nature can be addressed by appropriate well design, monitoring, maintenance, and repair/replacement. See Technical Memorandum, Parametrix, September 20, 2006.

Comment: “In sum, Alternative 5a is not protective of human health and the environment and presents insurmountable safety issues associated with its construction. Leaving these issues, as EPA does, to some future date, long after any public comment requirements have expired, is unconscionable, illegal, and subverts the purpose of public input into EPA’s remedy selection process.” [M12]

Response: *EPA believes that issues of protection of human health and the environment and worker safety are sufficiently described to facilitate public input for consideration in remedy selection. Worker safety issues are paramount but not insurmountable.*

In addition to the public comment period on the Proposed Plan, CERCLA requires a public comment period if fundamental changes are made following remedy selection in the ROD. For non-fundamental but significant changes warranting an Explanation of Significant Differences (ESD), EPA may voluntarily hold a public meeting or provide a public comment period.

Comment: “II. EPA’s Proposed Remedy is Fatally Flawed from a Geochemical Perspective. ...Dr. Langmuir [Mining Company consultant] concludes that implementation of EPA’s proposal would seriously destabilize site geochemistry and dramatically increase ARD production at the mine site in both the short and long-term. More specifically, Dr. Langmuir concludes Alternative 5a will: Create a major surge of ARD contamination leaving the site, associated with disturbing, excavating, and moving existing piles of waste rock, ore, and protore to Pits 3 and 4. This surge can be expected to peak during the 6–7 years of construction and continue up to 3 years after its completion.” [M13]

Response: *Although excavating and relocating the waste in the pits will temporarily expose unoxidized waste rock surfaces to air, this effect is expected to some degree under any active remediation alternative, given that the waste rock must be consolidated and graded prior to the addition of a soil cover. However, the Selected Remedy will lead to reduced exposure of the oxidized rock surfaces once containment is complete. ARD volumes are expected to decrease rapidly as a result, and any ARD is expected to be readily captured and removed from the pits for treatment.*

Comment: “[Dr. Langmuir concludes that Alternative 5a will] result in significant and increasing long-term production and releases of ARD generated: a) by filling Pits 3 and 4 with waste rock and protore; b) by the fluctuation of groundwater levels in Pits 2, 3, and 4 and Boyd Pit when they are pumped; and c) by induced groundwater recharge entering these pits as the proposed groundwater pumping system attempts to control groundwater levels in the pits;” [M14]

Response: This comment appears to be based on a misunderstanding of the remedy for Pits 3 and 4. For Pits 3 and 4 “control of the groundwater levels in the pits” means that water entering the pits will be diverted around the waste rock and will not be allowed to rise above the base of the waste rock. This will minimize the formation of ARD. For the Backfilled Pit Area (including Pit 2 and the Boyd Pit), a drainage layer will not be constructed below the waste, but infiltration/percolation from above will be minimized by a cover. “Control of the groundwater levels” means that water entering from the pit walls will be removed continuously to assure minimal contact time with waste rock. Fluctuation of water levels in the backfilled pits will be considered during design and a water level fluctuation tolerance (e.g. maximum and minimum water level) identified to ensure that fluctuation is minimized. ARD produced or captured in any and all pits will be treated, and because all of the waste will be contained within the pits, ARD production outside the pits is not anticipated.

The term “induced groundwater recharge” suggests that preserving a low water elevation within the pits will increase the rate of groundwater inflow from the pit walls. While drawdown of pit water elevations may increase pit inflow under unreclaimed conditions, reclamation is expected to significantly decrease the amount of inflow. Estimated reductions in inflow rates were inclusive of changes that may result from increased drawdown within the pits. See Parametrix technical memorandum dated September 28, 2006.

Comment: “[Dr. Langmuir concludes Alternative 5a will] produce far greater releases of ARD from the mine site than predicted by the EPA as the groundwater pumping system fails because of probable clogging and/or corrosion. Following well failure, groundwater will rise in the pits and generate additional ARD as it leaches acid salts from the sulfide-bearing rock within the pits.” [M15]

Response: Appropriate design and careful monitoring and maintenance of the wells are essential to assure the continued effectiveness of water removal from the pits used to contain waste. Fouling of wells is not an uncommon problem, and it is one for which engineering solutions have been developed and continue to be refined. The design and O&M plan will seek to prevent such problems, and if they occur, engineering solutions (well cleaning, replacement) will be used as necessary. With effective pit water removal, the releases Dr. Langmuir refers to are not expected to occur.

Comment: “Dr. Langmuir also concludes, based on his review of all the available site water quality data, that the only acceptable approach to managing ARD at this site is to not disturb the surface piles of waste rock, ore, and protore and to not pump groundwater out of the existing backfilled pits. Instead, the only viable alternative is to manage these materials in place and collect and treat groundwater ex-situ.” [M16]

Response: Alternative 3 (the alternative closest to that described in the comment above) is not the only viable alternative. EPA develops alternatives for detailed evaluation such that all remedial alternatives other than No Action have the potential to be selected. After evaluating the alternatives using the FS evaluation criteria, EPA did not find that Alternative 3 provided the best balance among the criteria. Issues with Alternative 3 include the following:

Water would accumulate in the pits, including meteoric water that is directed away from the pits by the waste cover under the Preferred Alternative. Water passing through the above-grade waste containment area would likely be stored in a pit, also. Ex situ treatment could be used to keep the pit lake low, but human and ecological exposure to contaminated pit water and/or pit walls, as well as radiation and airborne radon, would be possible. Under the Selected Remedy, these exposure pathways will be eliminated. Omitting meteoric water contributes to the reduced long-term water treatment and sludge disposal cost of the Preferred Alternative.

Comment: “III. EPA’s Failure to Propose a Remedy Along the Lines of Alternative 3 is Arbitrary and Capricious. The Golder report and Dr. Langmuir’s report...lead to a remedy along the lines of Alternative 3 as the only approach to Midnite Mine Site cleanup that is not arbitrary and capricious.

In this regard, it is telling that EPA’s Proposed Plan concludes that Alternative 3 in fact will meet CERCLA’s threshold criteria; i.e., that this alternative is protective of human health and the environment and will comply with applicable or relevant and appropriate requirements or ARARs. As between Alternatives 3 and 5, EPA does suggest that Alternative 5 will result in ‘the shortest duration of surface water and groundwater use restrictions outside the mine waste containment areas,’ Proposed Plan, p. 14. There is no data or analysis in the Midnite Mine AR to support this conclusion. Meanwhile, elsewhere, EPA sets the same meaningless timeframe of ‘one to several decades’ for water quality improvement outside the mine area under either Alternative 3 or 5. Proposed Plan, p. 11.

Particularly in the face of Dr. Langmuir’s analysis and conclusion that Alternative 5a will only exacerbate ARD generation at the mine site, EPA certainly cannot claim, and has no basis to claim, a shorter water quality recovery timeframe for Alternative 5.” [M17]

Response: *EPA disagrees that only a remedy similar to Alternative 3 would not be arbitrary and capricious. While Alternative 3 met the threshold criteria of protectiveness, it did not provide the best balance of tradeoffs among the evaluation criteria. See responses to previous comments. EPA has followed a technically rigorous process in investigating the site and developing cleanup alternatives and has evaluated the alternatives using the evaluation criteria in the NCP. EPA has provided opportunities for stakeholder input throughout this process.*

Regarding the timeframe for water quality improvements under different alternatives, the FS presents the timeframe of one to several decades as there are significant uncertainties that apply to all of the alternatives. Within this timeframe, however, qualitative analysis supports the determination that the alternative that best isolates the waste from contact with water would be expected to result in the shortest recovery timeframe for groundwater affected by ARD. Each alternative offers a different degree of isolation of the waste. EPA’s Preferred Alternative provides greater control over ARD sources to groundwater than Alternative 3. Under Alternative 3, the waste is spread over a larger area than Alternative 5. Given equal cover performance, waste containment over a larger footprint will generate more ARD. Under Alternative 3 (or any above-grade waste containment without a liner or drainage layer below the waste), this ARD would not be captured as effectively as under the Preferred Alternative. Water collecting in the open pits also could affect groundwater quality. Depending on whether the Backfilled Pit Area

was allowed to flow to surface seeps (as suggested by Dr. Langmuir) or actively addressed under Alternative 3, the degree of control over this ARD source could also differ. Such differences support the qualitative statement that groundwater recovery would likely occur sooner under the Preferred Alternative than Alternative 3.

Comment: “Whether or not the groundwater quality improves in the near-term or mid-term, land use restrictions and institutional controls will be necessary over the long-term and for generations at the mine area (MA) to address waste-containment-related radiation risks under any alternative. Proposed Plan, p. 17. The difference between applying institutional controls in the MA to a 171³ acre restricted area, with 2.5:1 slopes, as opposed to a 310 acre restricted area for a cover in place remedy, on a 155,000 acre reservation land mass, can hardly be deemed significant enough to drive EPA to an Alternative 5, particularly given its true, enormous cost.

Footnote: ³Golder estimated the area of the Pit 3 and Pit 4 footprint, with 2.5:1 slopes, at 154 acres, plus 17 acres for the backfilled pits footprint, for a total of 171 acres.” [M18]

Response: *EPA agrees that areas of the MA used for waste containment under the Selected Remedy will require permanent institutional controls. Groundwater and surface water use restrictions are expected to be shorter term, however, and are expected to vary with the effectiveness of ARD controls under the different alternatives.*

We note that the acreage of restricted land use cited in the comment is different from that in the FS and Proposed Plan, as it is premised on further excavating the open pits to make the pit walls less steep (see Mining Companies comment M9 and EPA response). EPA does not believe additional excavation is necessary to this degree, if at all.

However, the restricted surface area relative to the Tribe’s land base did not drive EPA to select Alternative 5a. The acreage of restricted land area where waste is contained is relevant to the long-term effectiveness of the institutional controls. Institutional controls in this area are needed both to minimize the risk of exposure and to protect the integrity of the remedy. A smaller area is easier to monitor and restrict.

There are additional benefits to an alternative that completely backfills the open pits. The reduction of the surface area where waste is contained is relevant to the reduction in ARD generation and requires less soil cover material. In addition, backfilling the pits eliminates the pit wall and surface water exposure pathways. To the extent that this alternative accelerates improvements in groundwater and surface water quality outside the pits, this also shortens the duration of institutional controls for these exposure pathways.

EPA believes the cost estimates in the FS are adequate for selection of a remedy and provide a basis for balancing cost with the four other balancing criteria of long-term effectiveness and permanence, reduction of toxicity, mobility, and volume through treatment, short term effectiveness, and implementability.

Comment: “EPA also states that Alternative 5a entails a ‘shorter recovery period for sediments.’ Proposed Plan, p.8. EPA only identifies sediments as an issue in the mine affected area or ‘MAA.’ The remedy for the MAA is the same under either Alternative 3 or 5, so there can be no basis for concluding the latter alternative will result in a quicker sediment recovery time.” [M19]

Response: *The MAA includes both mine drainages and Blue Creek. The statement cited above refers to recovery of sediments in Blue Creek, where the sediment contamination and associated biological impacts are less severe and sediment quality is expected to recover following the control of mine drainage sediments, surface water, and groundwater sources. Given the same sediment remedial action in the mine drainages of the MAA, alternatives that improve groundwater and surface water quality sooner would be expected to support faster recovery of downstream sediment quality. EPA believes that the Selected Remedy will achieve such improvements earlier than Alternative 3c (see comment M-17 and EPA response).*

Comment: “IV. EPA’s Comparative Analysis of Alternatives in the Proposed Plan is Improperly and Incorrectly Biased Towards Alternative 5a in Other Ways. The EPA has not compared alternative performance and cost effectiveness consistently. Instead, EPA’s comparisons bias the Agency’s evaluation in favor of Alternative 5a.” [M20]

Response: *EPA disagrees with this statement. EPA responses to specific statements in support of this comment are provided below.*

Comment: “EPA repeatedly utilizes the best case condition in estimating costs for Alternative 5a even though there is considerably more uncertainty and greater probability of cost overruns for Alternative 5a given the complexity, magnitude and timeframe for construction of this alternative.” [M21]

Response: *With regard to the potential for cost overruns, EPA used the same percentage to reflect such uncertainties. However, different alternatives may be at risk for overruns for different key reasons. Alternative 3c has a greater potential for overrun impacts related to obtaining and importing cover material, operating the water treatment plant, and transporting and disposing of sludge. These factors affect Alternative 5c less, but Alternative 5a has the potential for overruns in the earthwork stage and potentially maintenance of the drainage system. Adjusting the estimates to reflect variable overrun factors was considered, but to do so would be subject to bias. The nature of overruns is speculative, and EPA determined that an across the board value was appropriate.*

Comment: “Cost Comparison Bias - As required by CERCLA guidance for cost estimation, EPA provides in the FS present worth costs for each alternative assuming a discount rate of 7 percent and a 30-year period. The EPA also provides estimated costs in the FS assuming a discount rate of 3.1 percent and a 140-year period. (The 140-year period, which is not consistent with CERCLA guidance, represents seven generations of the Spokane Tribe, p. 5-9 of the FS.) In the Proposed Plan, however, EPA compares the estimated costs of the alternatives based on only the 140-year present worth costs. The present worth costs for Alternative 5a and 3c based on the 140-year period are both \$152 million. The Proposed Plan does not provide an estimate of the 30-year present worth cost for the preferred Alternative 5a, but the cost is estimated to be

approximately \$133 million. The 30-year present worth cost estimate for Alternative 3c is \$101 million, \$32 million less than Alternative 5a. By providing only the 140-year present worth costs in the Proposed Plan, EPA biases the comparison of alternatives in the Proposed Plan in favor of Alternative 5a in two ways. First, it biases the comparison because the long time period and lower discount rate favors Alternative 5a, which has lower annual operating and maintenance costs but much higher initial capital costs; and second, it biases the comparison because the lower, 30-year present worth cost estimates are, EPA guidance notwithstanding, not utilized.” [M22]

Response: *With regard to the discount rates and analysis periods presented, the Proposed Plan referenced alternative assumptions provided in the FS. The FS includes the 7 percent and 30-year assumptions, as well as a table of factors that can be applied to reflect numerous variations in the present worth cost assumptions. EPA referenced estimates using other discount rates and analysis periods in the FS.*

EPA guidance does not require that EPA base its decisions on an assumed 30-year analysis period; rather, it recommends that EPA evaluate costs using timeframes appropriate to the site. The discount rate of 7 percent is not a requirement. It is generally used to provide consistent cost data to support national reviews of site costs. To avoid confusion in the summary provided by the Proposed Plan, only one set of cost estimates was included. EPA believes that the Proposed Plan estimates are based on a timeframe appropriate for this site, which will require perpetual O&M, and on a discount rate that reflects the current knowledge and practices of the federal government.

Comment: **“Cover Material Unit Cost Bias** – In the FS, the soil evapotranspiration cover was used by EPA to evaluate the performance (including reduction in radon flux and water percolation) and cost of each alternative, except for Alternative 5a. For the evapotranspiration cover, the EPA uses a conceptual soil thickness of 2.7 feet for the thin cover and 5.7 feet for the thick cover. For estimating costs, the EPA assumes a round-trip haul distance of 56 miles to obtain ‘more suitable’ (p. 5-15 of FS) earthen materials for construction of the evapotranspiration cover. In contrast, the EPA uses the FML [flexible membrane liner] cover to evaluate the performance and cost of Alternative 5a. With the FML cover, the EPA uses a ‘less suitable’ (p. 5-14 of FS) sand material with a thickness of 2.7 feet and for estimating costs assumes a round-trip haul distance of 15 miles to obtain the sand for the construction of the FML cover. The unit cost used by the EPA for the sand material used in the FML cover is significantly less than the unit cost for the earthen materials used in the evapotranspiration cover, due to the difference in the haul distance.

If the FML cover was used in Alternative 3c under the same performance assumptions used by the EPA for the FML cover in Alternative 5a, the water volume requiring treatment and associated treatment and sludge disposal costs would be reduced for Alternative 3c. If a FML [flexible membrane liner] cover was used for Alternative 3c, then the volume of water requiring treatment would be reduced by about 11.9 million gallons per year. This reduction would result in a net costs savings of about \$12 million dollars (140-year present worth cost), with a total cost for Alternative 3c of \$140 million, as compared to an Alternative 5a cost of \$152 million. On the other hand, if an evapotranspiration cover is used for Alternative 5a, the amount of water requiring treatment would increase and therefore the cost of water treatment and sludge disposal

would increase. If the evapotranspiration cover is used for Alternative 5a, the estimated 140-year present worth cost would increase by about \$4.5 million. [M23] Thus EPA's inconsistent use of remedial cover systems for the alternatives unfairly biases the comparative analysis in favor of Alternative 5a." [M24]

Response: *The comment reflects some confusion between Alternative 5a in the FS and the Preferred Alternative (a modified version of Alternative 5a, see Page 14 of Proposed Plan). In the FS, an evapo-transpiration cover was assumed for all active alternatives (including 5a), with the exception of Alternative 5c. In the Proposed Plan, an FML cover is assumed for the Preferred Alternative. Also, contrary to the comment above, in the Proposed Plan "more suitable" material with a round-trip haul distance of 56 miles was assumed for the Preferred Alternative. The estimated unit cost of the FML cover using more suitable material is \$134,000/acre; the unit cost using less suitable material would be \$108,000/acre.*

In sentence 7, the comment suggests EPA should have evaluated an FML cover under 3c. This is misleading. Under 5a (in the PP) and 5c, an FML cover with limited cover material thickness was evaluated because mine waste materials with high radon release rates could be buried under tens of feet of material with lower radon release rates. In this way, radon protection could be achieved over the long term even if the FML deteriorated. This would not have been the case for Alternative 3c, because of above grade containment of the ore and protore stockpiles.

The analysis presented by the Mining Companies demonstrates the importance of infiltration reduction to reducing ARD and associated long-term costs. Use of a low-permeability layer, such as a synthetic liner, over the larger containment area of Alternative 3c would entail additional costs, but would also reduce ARD generation. It would not address radon over the long term and would not eliminate exposure pathways associated with pit walls and pit surface water.

Comment: **"Cover Performance Bias** – The EPA concludes that the FML cover would further limit water percolation and radon flux compared to the evapotranspiration cover (p. 5-14 of FS). However, the FML has a finite life. The EPA admits that over the long-term, the FML would be subject to deterioration, and reducing percolation and radon flux would primarily be accomplished by the soil cover (p. 5-14 of FS). Yet, the EPA evaluates the reduction in water percolation of the FML cover for Alternative 5a by assuming that the FML is effective over the long-term. In reality, water percolation will become more and more of a problem as the FML deteriorates, particularly given that Alternative 5 assumes 'less suitable' sand material overlying the FML cover. The water percolation through this cover will over time actually exceed the water percolation through Alternative 3c's 'more suitable' cover." [M25]

Response: *See response above. This comment continues to reflect inaccuracies regarding liner use and the type of cover material assumed for Alternative 5a in the FS and Proposed Plan. Alternative 5a and the Preferred Alternative both assume the use of "more suitable material," but the Preferred Alternative included the addition of a liner. As a result of the inaccuracies identified in the previous two responses, the statement "The water percolation through this cover will over time actually exceed the water percolation through Alternative 3c's 'more suitable' cover" is inaccurate.*

Comment: “As a result, the water volume requiring treatment would increase significantly for Alternative 5a, and the associated costs for water treatment and sludge disposal would also increase. As such, the use of the FML cover for only Alternative 5a, and EPA’s assumptions about its long-term performance, unfairly biases the performance and cost of Alternative 5a compared to the other alternatives.” [M26]

Response: *Regarding the performance of FML liners, recent studies estimate that an FML cover will not deteriorate for a relatively long time (well over 100 years) if protected from UV radiation. Given the nature of present worth analysis, increased water treatment volumes and costs that might occur with this timeframe would not significantly affect the estimated present worth costs used to compare the alternatives.*

Comment: “**Cover Area Cost Bias** – Alternative 5a involves the excavation of all waste rock and protore stockpiles and placement of that material into Pits 3 and 4. In the FS (Appendix C), the EPA provides for a one-foot over-excavation of the waste material footprint (263 acres)⁴ and the placement of a one-foot layer of suitable soil to enhance revegetation of the excavated area. For cost estimation, however, the EPA arbitrarily assumes that the one-foot soil cover only needs to be placed over a 120-acre area, which is less than 50 percent of the excavated area. The cost estimate for Alternative 5a should include placement of the one-foot soil cover over the entire excavated area (420,000 yd³ of soil), which increases the capital cost of Alternative 5a by approximately \$4 million.”

Footnote: “⁴EPA simply assumes that the one-foot over-excavation will be sufficient to achieve potential ARARs. Soil and/or bedrock concentrations beneath the excavated waste rock may exceed the preliminary remediation goals (PRGs) for surface materials (i.e. EPA-defined background concentration of COCs). The PRG for Ra-226 is based on 40 CFR Part 192, Subpart B. These regulations require that Ra-226 activity concentrations in unrestricted areas not exceed background by 5 pCi/g over the first 15 cm of soil below surface and 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below surface. Presumably, EPA would want to excavate soil or bedrock from the waste rock footprint to a depth where the 5/15 pCi/g Ra-226 standard are achieved. More than one-foot of soil/bedrock excavation and soil cover may be required to achieve this result, which could significantly increase the cost of Alternative 5a. EPA also suggests that surface water runoff may contain COCs at concentrations exceeding background in areas where mine waste is excavated to bedrock, particularly in areas where bedrock consists of schists (p. 5-99 of FS). However, EPA assumes in the FS that surface water would not require treatment, but that use restrictions would be implemented if the surface water exceeds background COC levels.” [M27]

Response: *Regarding the cost for a one-foot soil layer to support revegetation in areas exposed when waste piles are removed, the Mining Companies do not present a basis for their alternative assumption of soil cover over 100 percent of the excavation area. The FS relied on a reasonable engineering estimate for both thickness and area. During design, revegetation needs, excavation depths, material volumes and costs will be refined. Four million dollars is about 5 percent of the capital cost, and less than 4 percent of the total cost estimate for FS Alternative 5a.*

Comment: [Footnote 4, continued]

“...Given the natural mineralization in the mine area, both soil and water cleanup standards for the relevant COCs may not be achievable in the waste rock footprints; therefore, use restrictions would be required. EPA fails to address these uncertainties and the implications associated with these footprint issues in its evaluation of Alternative 5a.” [M28]

Response: *The cleanup levels for soil and water are largely based on background. The current waste rock footprints will be cleared of waste rock and of soil above the cleanup levels, if soil is present below the waste rock. The removal of bedrock below the waste is not anticipated. Placement of a layer of clean soil, as anticipated in the FS to support revegetation, will likely achieve surface soil cleanup levels. If appropriate technical information demonstrates that contaminant concentrations in the water within the current waste rock footprint are not the result of site-related contaminant loading (e.g. from the waste rock piles or upgradient areas), EPA can amend the ROD to modify the background-based cleanup levels.*

Comment: **“Sediment Remediation Cost Effectiveness Bias** – The remedial measures for sediments in the Mine Affected Area (MAA) considered by the EPA include both bioremediation and physical removal. Both remedial measures are equally effective but bioremediation is more costly. Rather than making its comparison of alternatives using the same sediment remediation measure, the EPA used the more expensive bioremediation measure of \$1,500,000 in Alternative 3c and the less expensive physical sediment removal of \$410,000 in Alternative 5a. By so doing, the comparative analysis of the alternatives is unfairly biased in favor of Alternative 5a.” [M29]

Response: *EPA compares all of the retained alternatives, not only the two referenced in the comment. The FS varies remedial elements among the alternatives, as is usually done. Alternative 3c is not the only alternative that includes the more costly sediment cleanup measure (biostabilization), and the less costly removal is not limited to Alternative 5a. In all cases, the sediment cleanup cost is less than 2 percent of the capital cost.*

Comment: **“V. The Spokane Tribe’s Hazardous Substance Control Act Does Not and Cannot Prohibit On-Site Sludge Disposal, and On-Site Sludge Disposal Is Technically Feasible and Implementable.** EPA’s September 27, 2005 response to the National Remedy Review Board Recommendations for the Midnite Mine Superfund Site (‘EPA’s Response to the NRRB’) categorically states at p. 2, ‘The Tribe’s Hazardous Substances Control Act, which ...is a potential ARAR, would rule out on-site disposal of water treatment residuals as they are currently generated.’ In a similar vein, the Midnite Mine FS at p. 5-149 notes the Tribe’s opposition to on-site sludge disposal and states, ‘The Tribe’s HSCA includes siting criteria that would prohibit onsite disposal.’ If these statements were true and assuming for this purpose that a tribal enactment has the same impact under CERCLA as a state enactment,⁵ then under CERCLA §121(d)(2)(c)(ii), the prohibition is not applicable. See also 4/20/04 Letter from C. Mackey, EPA to S. Work (‘Mackey Letter’) pp. 5-6, attached as Exhibit 11. Meanwhile, the HSCA on its face does not prohibit on-site disposal of Midnite Mine related water treatment sludge. Rather, the Act precludes location of a disposal facility in certain sensitive locations, requires compliance with certain construction standards and requires an approved closure plan and performance bond. HSCA §34-1.12(a) and (b). None of these requirements are inherent obstacles or otherwise prohibitory of locating a sludge disposal facility at the mine site.

Footnote: ⁵The propriety of EPA’s treatment of the Spokane tribe as a state is addressed in Section XIII of these comments.” [M30]

Response: *HSCA, on its face, does not prohibit onsite disposal. However, application of the HSCA siting criteria to the Midnite Mine Site prohibits on-site disposal. HSCA limits disposal of hazardous substances in sensitive locations. Based on the evaluation of the site with respect to proximity to these sensitive areas (groundwater recharge areas, surface water, and wetlands), there is no area of the Site where these distance limits are met. See Parametrix technical memorandum dated June 14, 2006. However, the Tribe has indicated that other areas are available on the Spokane Reservation that meet these siting requirements, thereby addressing CERCLA 121(d)(2)(c)(ii).*

Comment: “From a technical perspective, siting, design and construction of an on-site sludge disposal facility, presumably in the mine area, is a relatively straightforward and simple undertaking. Based on projections of sludge production, a disposal cell of approximately 250 ft. by 250 ft. would provide sufficient capacity for 30 years of operation. Relatively flat areas near the water treatment plant could accommodate a disposal cell this size. The conceptual plan for a disposal cell would be excavation of the footprint, using the excavated materials for perimeter embankments. The base of the cell would include two synthetic liners with a leak detection system between liners and a leachate collection system above the upper liner. Sand for covering and bedding the synthetic liners would be from sources off of the mine area. The cover for the cell would include clay liner, synthetic liner, and plant growth media components.” [M31]

Response: *Notwithstanding HSCA limitations, EPA agrees that an on-site disposal facility could likely be constructed with adequate capacity and appropriate mechanisms for leachate detection and collection, and for that reason, EPA included on-site disposal as a possibility under all active cleanup alternatives. The specific requirements of the design would have to be developed in view of RCRA and UMTRCA standards.*

As to location of such a facility, the relatively flat areas near the water treatment plant, referenced in the comment, are on top of a waste rock pile. When the waste is excavated, the pre-mining slope may not be appropriate for construction of a sludge disposal facility. The Tribe has also indicated that lease fees and administrative oversight costs would be imposed for any on-Reservation disposal facility. Again, based on the evaluation of the site with respect to proximity to sensitive areas identified in HSCA (groundwater recharge areas, surface water, and wetlands), there is no area of the Site where the distance criteria established by HSCA to protect these sensitive areas are met.

Comment: “EPA’s preference for Alternative 5a is premised in part on its analysis that one of the benefits of Alternative 5a is significantly less wastewater treatment sludge generation than under other options. In turn, the purported imperative for sludge minimization is the high cost and risks associated with off-site and off-Reservation transport and disposal of water treatment sludge. Properly and fairly considered though, on-site disposal can be equally protective and much less expensive. See NRRB Comment No. 3 as quoted in EPA’s Response to the NRRB (‘At other mine sites, water treatment sludge is typically disposed of on-site to reduce disposal costs.’) Plus, as discussed in Section VI, EPA’s analysis of the amount of water requiring treatment, and therefore the amount of treatment sludge to be generated, under Alternative 5a, is flawed and not reliable. The waste minimization advantage to be realized from Alternative 5a

over other alternatives is much less than EPA suggests, and disappears entirely with on-site sludge disposal.

In this circumstance and, given the noted dictates of CERCLA §121, EPA must select on-site sludge disposal as its preferred option. See 55 Fed. Reg. 8666, 8727 (1990 NCP Preamble) ('if all the remedies are equally feasible, reliable and provide the same level of protection, the lead agency will select the least expensive remedy.')

 [M32]

Response: EPA addresses the Mining Companies' comments regarding water treatment sludge generation in response to comment M13, M14, M33, and others. The FS evaluation of water treatment volumes and associated waste disposal costs is based on available information and reasonable assumptions.

Regarding on-site disposal, on-site and off-site disposal are evaluated in the FS, as part of each active remediation alternative (see also Table 5-26). Cost estimates for both options are presented. These cost estimates do not account for costs for the use of Tribal lands, regulatory oversight, and other resources. Nevertheless, the higher unit costs for off-site disposal shown in the FS have a significant impact on O&M costs for alternatives that generate greater waste volumes and favor alternatives that reduce waste generation.

EPA continues to assert that the waste minimization advantage of alternatives that contain the waste in the pits is significant, not only due to lower O&M costs but to the timeframe for improvements in groundwater quality. As shown in FS Table 5-26, on-site and off-site sludge disposal differ in their long-term effectiveness and permanence and their short-term effectiveness. While all are feasible, the alternatives also differ in terms of compliance with ARARs and implementability. These and other advantages and disadvantages are documented in the detailed evaluation and comparative analysis of the FS. EPA believes the Selected Remedy is the best balance of tradeoffs among the evaluation criteria.

Comment: "VI. EPA's Analysis of the Amount of Water Requiring Treatment Under Alternative 5a is Flawed and Unreliable. EPA claims that less water treatment will be required under Alternative 5a and, therefore, less treatment sludge requiring management and disposal will be generated. As noted above, this purported benefit would be significant if off-site disposal of treatment sludge was necessary, which it is not. Further, EPA's conclusion that Alternative 5a would generate 6.5 million gallons of water yearly for water treatment (and thus only 1,000 ft³/year of sludge) is incorrect. Whatever analysis EPA presumably conducted to support that conclusion is flawed and unreliable; and that analysis is nowhere clearly developed in the FS or the Midnite Mine AR. Given its importance, this omission is in of itself inexplicable and unacceptable.

As detailed in Attachment 7, EPA's assumptions about post-remediation groundwater inflow reductions, which drive the 6.5 million gallon calculation, are incorrect and arbitrary. Using accurate figures, the volume of water to be treated under Alternative 5a is approximately 23.7 million gallons per year, rather than 6.5 million, an increase in volume of 265 percent. This in turn drives the cost for Alternative 5a to \$175 million, rather than \$152 million, under EPA's ill-conceived 5a. The true cost of EPA's concept, accounting for proper liner construction, rises to more than \$415 million. In contrast, again with the correct inputs for water treatment volumes, the corrected Alternative 3c cost is \$163.5 million, or two and a half times less costly than the cost of Alternative 5a, properly constructed.⁶ Even these, much more accurate calculations do not

account for the volume and cost implications of managing the massive increase in ARD generated during and following Alternative 5a remedy construction (Langmuir 2006).

Footnote: ⁶In addition, because EPA overestimates the current volume of water being treated by 30 million gallons, the actual reduction in the volume of water to be treated under Alternative 5a post-remediation is 54 percent, not 92 percent.” [M33]

Response: *EPA’s estimates for groundwater inflow to the pits under the different scenarios are supported by RI/FS documents and technical data. As further detailed in Parametrix technical memorandum dated September 30, 2006, the Mining Companies’ estimates are based on an approach and assumptions that are different from EPA’s approach and reflect significant inaccuracy. In both cases, the actual change in water inflow is unknown. Based on the costs included in the above comment (and omitting the claimed costs related to liner installation, which are addressed elsewhere in this response) the different inflow rates result in an overall cost impact of 10 percent or less.*

Comment: *“VII. Borrow Material Is Available On-Site. There are materials available near the mine area that would be suitable for cover material. The materials most amenable for cover materials are located in moderately sloping areas west and southwest of the mine area. This area is underlain by weathered quartz monzonite, an igneous rock that weathers to variable depths and can be excavated and prepared for use as a cover material. From drilling and seismic refraction work by SMI in 1995 south of the mine area (in an area of quartz monzonite), there was a mantle of unconsolidated soil (alluvium or colluvium approximately 10 feet thick) underlain by a zone of weathered quartz monzonite (of variable thickness up to 50 feet). Midnite Mine Reclamation Plan (SMI, 1996). The test plot work by Dr. Redente at the Midnite Mine has shown that these materials can support vegetation with organic and moisture-holding amendments (MFG, 2005). The areas of excavation would require some tree removal and clearing, and then grading and revegetation at the completion of the excavation.” [M34]*

Response: *EPA expects that some construction materials may be available on and near the site. The Mining Company comment does not specify whether the referenced materials in nearby areas are available in sufficient volume to complete any of the FS alternatives. Previous review of the referenced documents indicates that the volume would be insufficient for Alternative 5a, and would be even more so for Alternative 3c. The Mining Company comments do not address potential costs associated with acquiring materials from an undeveloped area on or near the site, including studies to refine volumes and characteristics of material and to evaluate and address environmental impacts of developing the site, or potential costs associated with processing, excavating, and amending the material. The comment does not address administrative, regulatory, and legal steps or associated costs.*

To the extent that local material is available for use, EPA would expect that efforts would be made by all parties to find the most cost-effective source or sources of material.

Comment: “IX. The Spokane Tribe’s ‘Subsistence Scenario,’ which Drives EPA’s Characterization of Site Risks and Cleanup Requirements, is Incorrect and Not Supported by Either the Tribe’s Ethnohistory or recent Ethnographic Information.

...Dr. Reimer and Mr. Chartrand [the Mining Companies’ consultants] found:

- The claim by Harper, et al. (2002) that a significant proportion of the Spokane Tribe population currently participate in subsistence activities is not supported by recent ethnographic information and trends.
- Partly as the result of the Spokane Tribe’s efforts to generate off-reservation and commercial sources of employment and revenue, tribal members have become increasingly involved in the conventional labor force and wage employment. These developments direct the tribal economy away from a large scale return to a subsistence lifestyle.
- The ethnohistorical evidence does not support a subsistence scenario in which tribal members lived from subsistence activities conducted within a confined location such as the mine site. Instead, families engaged in a regular yearly cycle of subsistence activities that occurred over a large geographical area.
- The claims of Harper, et al. (2002) as to the frequency of cultural activities and as to the participation and frequency of sweat lodge use are not supported by either the ethnohistoric or ethnographic literature. Nor does the mine site have any apparent cultural significance.” [M36]

Response: *The risk assessment prepared by EPA acknowledged large uncertainties associated with the tribal exposure scenarios. Similarly, information about current trends and practices contains uncertainties and is of questionable relevance, since future practices may be affected by changes in site conditions. Past practices also may have changed to accommodate changes in the Tribe’s resource base.*

To examine the effect of such uncertainties on Agency decisions, risks were re-examined using EPA standard default residential and worker scenarios (U.S. Environmental Protection Agency, 1991; U.S. Environmental Protection Agency, 1993). The default exposure scenarios and associated risk estimates will be included in the Record of Decision. The results re-affirm that site risks warrant remedial action, without regard to uncertainties in Tribal subsistence activities.

In response to specific points listed by the Mining Companies’ consultants, the following should also be noted

- *The Tribe has indicated that some of its members currently live off the land (as reaffirmed in the Tribe’s Proposed Plan comment letter).*
- *The duration of daily sweat lodges may be overestimated by a factor of two in the risk assessment, as indicated by a telecommunication from Dr. Harper (Harper, 2005). This does not have a significant effect on the risk estimates.*

- *A risk assessment does not require a demonstration that a specific percentage of the receptor population fits the reasonable maximum exposure assumptions.*
- *Due to concerns about contamination in the area, current use and practices may not reflect normal or future use patterns.*
- *While the historic Spokane Tribe lifestyle described in the ethnographic literature included food gathering in extensive areas outside of the Spokane Reservation, changes in the availability of or access to these areas has increased the importance of resources located within the Spokane Reservation.*
- *EPA questions the relevance of comments regarding the cultural significance of the Mined Area. Blue Creek is likely to have more cultural significance than the Mined Area, and its importance has likely increased given loss of other historically used areas along the Spokane River.*

Comment: “In sum, the Praxis experts conclude, based on an extensive review of the relevant literature, that the Spokane Tribe’s subsistence scenario is, at most, an aspiration, dependent on the future and long-term success of any cultural revitalization efforts. Further, the Praxis analysis substantiates that EPA’s blind endorsement of the Tribe’s Subsistence Scenario is unwarranted and unjustifiable.” [M37]

Response: *The Tribe has indicated in correspondence to EPA that members of the Tribe are currently practicing a subsistence lifestyle on the Reservation. EPA has no way to know how successful cultural revitalization efforts will be in the coming years. However, the Tribe has stated its intention to preserve and restore its cultural heritage. Although Praxis concluded that some exposure assumptions may be aspirational in nature, these aspirations should not be precluded by Agency actions.*

Comment: “X. The Spokane Tribe’s Apparent Current Land Use Preferences Cannot Properly Drive the Mine Site Cleanup.⁷ The Praxis analysis effectively kicks the legs out from under the Tribe’s Subsistence Scenario. Nonetheless EPA, which has never itself evaluated the issue, told the NRRB that the Mine Site ‘is intended to support the tribe and its traditional lifeways in perpetuity. Presentation Package, p. 13. But See Mackey Letter (‘EPA will consider reasonably anticipated future uses for the site. This includes consideration of the current zoning for the property, the condition of the site, and nearby uses of property. It does not include consideration of historic potential uses or the property prior to the development of the mine.’) (emphasis added). DMC has previously addressed the issue of reasonable future land use at pp 2-3 of DMC’s Comments on EPA’s Presentation Package. Those comments are already in the record and need not be repeated here.

Footnote: ⁷ Approximately one-half of the mine site is owned by allottees. The Midnite Mine AR suggests some effort by EPA to contact these individuals as the Proposed Plan was developed. March 1, 2005 Letter from E. Hale to Midnite Mine Allottees. There is not record of these contacts in the AR and no information more generally is provided on these individuals’ land use and development preferences.” [M38]

Response: EPA's NRRB presentation package (p. 5-1) states "The site is located within a reservation on tribal trust and tribal allottee land. This land is intended to support the Tribe and its traditional lifeways in perpetuity." The Tribe has passed a resolution that identifies this area for use "to support commercial enterprises consistent with the Blue Creek Basin's character as designated in the IRPM, including a hunting /cross-country ski lodge and appropriate additional supporting facilities..." (Spokane Tribal Resolution 205-180). This essentially zones the mined area for such uses and is consistent with uses of adjacent drainages and Blue Creek for hunting, timber, and wildlife management. EPA contact with the Midnite Mine allottees has been limited, but attempts to contact allottees to determine land use preferences in advance of the Proposed Plan are now documented in the AR.

Comment: "...Mr. Hume's report describes standard land use planning methodology for assessing the feasibility and viability of alternative future land use scenarios. There is no evidence in the record that EPA has followed that methodology or, for that matter, undertaken any sort of evaluation of the likelihood of any particular land uses occurring in the future at the Midnite Mine.

Mr. Hume also concludes that future development of the mine site for residential use is unlikely because of the Site's history, cleanup-related controversies, and the Site's remoteness from services. Further, cleanup, without residential development, would be consistent with the Tribe's non-consumptive use objectives and improve view-sheds. See also Integral (2006) as to the significance of background concentrations relative to likely land use scenarios. Future development of the mine site as a hunting/cross-country skiing lodge is also unlikely because of the availability of better, more competitive venues elsewhere, particularly proximate to population centers, that do not have the site's mineralization and history." [M39]

Response: CERCLA and the NCP guidance do not define or require use of a particular land use planning methodology. EPA efforts to determine a reasonably anticipated future land use employed key tools (discussions with local jurisdictions, review of planning documents) discussed in OSWER Directive 9355.7-04, which outlines the types of information sources and input that should be considered but recommends against an "extensive independent research project."

Comment: "...Historically development of the mine site as a uranium mine obviously was acceptable to the Tribe and the allottees, all of whom entered into leases authorizing this use. Consistent with this authorization, until about the time EPA moved toward listing the Midnite Mine on the National Priorities List in the late 1990's, the designated future land uses for the mine site, pursuant to the *Integrated Resource Management Plan for the Spokane Tribe Indian Reservation*, 1996⁸ were timber production, wildlife, and/or commercial use.⁹ Other federal regulatory agencies approved or concurred with this characterization. There is no evidence that any real change in circumstances other than the prospect of Superfund dollars led the Tribe, which is not just a government here but is also a self-interested landowner, to effectively inflate its land use expectations, first to unrestricted use, Draft IRMP 2005, and then to a hunting and cross-country ski lodge scenario. Tribal Res. 2005-180.

Footnote: ⁹DMC has had to rely on quotes from and references to the 1996 IRMP, rather than the document, because it could not locate or find a copy of this document. EPA should add the 1996 IRMP, and particularly Volume I, to the Midnite Mine Site AR." [M40]

Response: *Use of the land for a hunting and cross-country ski lodge is consistent with commercial/industrial use in the earlier IRMP, and is narrower than unrestricted use. Although it includes a residential component, the development will not be in areas used for waste containment.*

The Tribe and allottees entered into leases that included a return of the land to the uses for which it was available prior to mining: “in as good condition as received, excepting for ordinary wear and tear and unavoidable accidents in their proper use”.

Relevant excerpts from the 1996 IRMP are included in the AR. The 1996 IRMP is publicly available and a complete copy can be obtained from the Spokane Tribe Natural Resources Department or Bureau of Indian Affairs.

Comment: “The Sherwood Uranium Mine Site, also located on the Spokane Reservation, was reclaimed in the late 1990’s. The tribe claims this mine site was returned to the Tribe ‘for unrestricted use (which means that it is suitable for any use from habitat to housing.)’ 2005 Draft IRMP, p. 85. This statement is untrue. The approved post mining land use for the Sherwood uranium mine is actually limited to support of wildlife and/or other domestic grazing. 2/23/05 Letter from J. Buising (sic), District Manager, BLM to M. Teters, Acting Superintendent, BIA, attached as Exhibit 11. The Sherwood Mine does not provide a precedent for unrestricted land use at the Midnite Mine.” [M41]

Response: *EPA is not considering land use statements in the IRMP for Sherwood Mine as a precedent for Midnite Mine land use.*

Comment: “Deer and elk do periodically occasion the site during the night, likely attracted by the availability of water and salts, and also as they move to other areas from the wooded areas to the north that provide cover during the daylight hours. January 17, 2006 Letter from B. Nelson to T. Shepherd, attached as Exhibit 12, Dawn Mining Company reports to BLM on wildlife sightings (2/14/00–5/2/01). These attractions will be eliminated in the course of remediation. There are much better and equally accessible areas of the Reservation with better big game habitat (i.e., cover and browse). The human presence required post-remediation for ongoing water management and treatment activities will also discourage use of the area by deer and elk. The site’s proximity to designated wildlife habitat and winter range actually dictates against placing a hunting lodge on or proximate to the mine site.” [M42]

Response: *This comment is internally inconsistent and of questionable relevance to remedy selection, except in that the attraction of contaminated water and metallic salts, which will be eliminated under the Selected Remedy and would not be eliminated under Alternative 3c, the alternative preferred by the Mining Companies. EPA believes eliminating this attraction is one of the positive features of Alternatives 4 and 5. Given the proximity of the site to land set aside for wildlife habitat, it is unclear why the Mining Companies conclude that animals will be less likely to move through the area. The presence of a lodge and a water treatment system are not likely to deter the use of the area. EPA notes that the observations of wildlife provided in the Exhibit were made during the day.*

Comment: “Nor is the mine site attractive as a cross-country skiing venue. The mine site sits on a south facing slope, with limited snow accumulation during the winter months and with average temperatures just at or above freezing through the winter season. Exhibit 13 presents that relevant temperature and precipitation data.” [M43]

Response: *The potential use of the area for cross-country skiing was not a factor in selection among the FS alternatives. In addition, the potential economic success of such use is not part of EPA’s considerations.*

Comment: “Finally, CERCLA Section 121(c) provides its own safeguards if the Tribe’s aspirational and hypothetical future uses ever come to be. Section 121(c) provides for a review of CERCLA remedial action at a site ‘no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.’

EPA’s guidance on Five-Year Reviews (June 2001) highlights the importance of determining, among other things: whether exposure assumptions remain valid, p. 3-7; whether land use or expected land use on or near the site has changed (e.g., industrial to residential, commercial to residential), p. 4-5; whether any human health or ecological routes of exposure or receptors have changed or been newly identified, p. 4-5; and whether any issues affect current or future protectiveness, p. 37. This Five Year Review mechanism is clearly intended to address changes in land use that could not reasonably be anticipated at the time of remedy selection. It also obviates the need for and highlights the inappropriateness of EPA tying its remedy decision to hypothetical and aspirational land uses that the evidence suggests are not likely to ever occur.” [M44]

Response: *This comment mistakenly implies that the five year review is intended as a mechanism to adjust to changes in land use. EPA determines reasonably anticipated land uses before selecting remedies that are protective for the reasonably anticipated land use where possible and that employ institutional controls where necessary to ensure land uses for which the remedy is protective and which preserve the integrity of the remedy. The Tribe has followed a public process regarding land use planning and has issued a resolution that plans for the use of Mined Area surfaces where waste has been removed for development. The planned uses are compatible with institutional controls that will be imposed in containment areas to protect the integrity of the remedy.*

At the time of remedy selection, EPA includes in the Record of Decision institutional controls that define acceptable land uses for which the remedy is protective. The CERCLA five year review process is not intended as a mechanism to facilitate changes in land use. Rather, it is a mechanism to ensure that activities or land uses that would affect the protectiveness of the remedy are identified and addressed.

Comment: “XI. EPA’s Human Health Risk Assessment Ignores EPA’s Guidance and Dramatically Overstates the Health Risk Associated with the Mine Site. ...The Mining Companies asked Dr. Schoof to determine if EPA’s HHRA complies with EPA requirements and guidance and standard practices for risk assessment preparation.” [M45a]

Response: *EPA guidance provides standardized assumptions for use in risk screening and for consideration in site-specific risk assessments. The standardized assumptions do not address exposures likely for a tribal population living on a reservation and subsisting on reservation resources. EPA risk assessors are directed to adjust standard exposure assumptions to best reflect site conditions and the exposed or potentially exposed population. EPA policy affirms the role of Indian Tribes in providing input to decisions that affect tribal people or their resources.*

Comment: “DMC also asked Dr. Schoof to determine whether the exposure scenarios and assumptions used by EPA in the HHRA were reasonable and technically defensible from a toxicological perspective. Dr. Schoof’s answer to both questions was ‘no.’ On the first question, compliance with EPA guidance and standard practice, Dr. Schoof concludes that EPA failed to follow its own and generally accepted requirements for (1) establishing current and future risks; (2) defining reasonable maximum or central tendency exposures; and (3) accurately addressing uncertainties in its risk analysis.

On the second question of exposure scenarios and assumptions, Dr. Schoof identifies significant errors in EPA’s assumptions regarding the nature and extent of current and future land uses at the site. Dr. Schoof also identifies significant errors in EPA’s assumptions and analysis of metals uptake by plants, plant consumption, the sweat lodge inhalation pathway, and that the assumption that all subsistence activities and associated foraging and animal grazing would occur within the confines of the mine site is both unrealistic and inconsistent with historic Tribal practice.” [M45b]

Response: *Please see responses below.*

Comment: “In addition, DMC asked both Dr. Schoof and MFG to determine if EPA had misrepresented and, particularly underestimated background radiation risk levels associated with the Midnite Mine and, if so, the implications of that error for the HHRA analysis. Dr. Schoof concludes that EPA has substantially underestimated background concentrations. The result of this critical error is that EPA cannot reliably determine the degree of exceedances of background by Site-related exposures. (See also Attachment 6, wherein MFG documents multiple errors in EPA’s background calculations.) Further, Dr. Schoof concludes that the high background radiation levels in the MA may be so high as to preclude residential use without any consideration of any incremental impacts associated with the mine’s development.” [M46]

Response: *As acknowledged in the RI/FS, uncertainty in determining background levels of contaminants is unavoidable due to the nature of the sampled environment. EPA used a reasonable, technically rigorous approach to select background areas, evaluate background data, and conduct the comparison of site data to background. The MFG comments referenced by the Mining Companies do not document errors, nor do they posit a preferred approach for identifying more suitable background areas.*

Data from the site and from adjacent unimpacted areas demonstrate that site-related radiation levels greatly exceed background. Since the estimated risks associated with background concentrations are generally in the upper end or even above the CERCLA target risk range and site-related increments above background are readily detectable, it is not surprising that the site-related risks also exceed the CERCLA risk range.

EPA estimates that background radiation levels contribute 3 percent to 8 percent of the cancer risk from external radiation exposure, depending on the area and exposure scenario, with the incremental risk related to site gamma radiation levels contributing approximately 97 percent of the total risk. This increment is associated with a risk of $10E-2$ for residential exposures at the MA and MAA. Even considering the uncertainties in the estimates of background radiation levels, incremental risks from site-related radiation exposure still exceed the CERCLA acceptable range for risk.

For site-related risks to be within the CERCLA acceptable risk range at this site, total concentrations at the site would have to be significantly less than twice background. Exposure point concentrations (EPCs) for the site were at least four times background EPCs for key risk driving pathways. Even if pre-mining surface radiation levels could be documented and were shown to be higher than the background radiation level developed in the RI/FS, uranium bearing rock brought to the surface created an incremental level of radiation. Rock at the site was under a layer of overburden (soil, alluvium, and weathered bedrock) except for limited outcrops. It was brought to the surface as ore, proto-ore, and waste rock, which now covers hundreds of acres. This material is a source of radiation at the surface, as well as of ARD.

Generally, under CERCLA, cleanup levels are not set at concentrations below natural background levels. The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas of background. Background is defined in terms of similar areas which are nearby but have not been influenced by site releases.

In summary, mining operations have altered conditions at the site, and pre-mining data is not adequate. At Midnite Mine, EPA followed the standard practice of determining background based on similar local areas uninfluenced by site releases.

Comment: “Further, Dr. Schoof concludes that the high background radiation levels in the MA may be so high as to preclude residential use without any consideration of any incremental impacts associated with the Mine’s development.” [M47]

Response: *To respond to Dr. Schoof’s comments, this response paraphrases some of the points he raises in a separate memo prepared for the Mining Companies (Exhibit 4 of their comments). Dr. Schoof states that the HHRA reliance on soil concentrations instead of measured radiation fields is not justified or justifiable, citing Washington State DOH comments in support of his view. He notes that the radiation measurements are 2 to 4 times lower than radiation levels estimated from soil radionuclide analyses and implies that the soil concentrations are biased high. This statement is apparently based on DOH comments (see EPA response to DOH comments in Appendix *). Use of direct radiation measurements rather than soil concentrations does not alter the central fact that radiation levels at the site are much higher than background levels, using either type of measurement. Any bias in soil radionuclide analyses would apply*

equally to both background and site measurements. HHRA Table 2-11 shows that 96 percent of the radiation measurements exceeded the background UTL of 22.3 uR/hr, and the maximum reading was 16 times this background value. Nevertheless, the use of soil concentrations as a basis for risk estimates for radionuclides is consistent with standard CERCLA practice for soil contaminants both radiological and chemical.

In addition, Dr. Schoof states that the risk estimates should be presented in the context of regional population radiation risks. The high values for radiation and radon levels in eastern Washington are accounted for in background and site levels determined for the RI/FS and are the context within which radiation and radon levels at the site are compared to background. He provides information about manmade and non-geologic radiation sources, but these estimates are not site-related and do not change depending on whether a person lives at the site or in the background area.

Dr. Schoof states, “Due to the surface outcrops of uranium in the MA, background radiation exposures on-site are likely to be even higher.” This statement confuses background and pre-mining conditions. Measurements for on-site radiation exposures reflect current post-mining conditions, with uranium-bearing rock exposed at the surface to a far greater degree than pre-mining conditions. Radiation and radon levels were not documented prior to mining and must be represented by measured values from the unmined background area.

Dr. Schoof states that high radiation levels in the MA preclude residential use of that area. Again, high radiation levels in the MA are largely caused by mining. While land use decisions should consider the naturally elevated levels of radon and radiation levels in the area, these decisions would not be affected by whether the area being considered is undisturbed background or an area of the MA returned to background conditions.

Comment: “Finally, Dr. Schoof concludes that the combined impact of these errors is an implausible and inaccurate risk evaluation that has no scientific value in realistically defining site risks or cleanup needs. Premising remedy selection on this HHRA will cause EPA to grossly overestimate the amount of cleanup required at the site to address environmental impacts associated with the Midnite Mine and be protective of any probable future human use of the site and its environs.”

Response: *See above. EPA understands that the risks estimated in the HHRA are high and that they may overestimate risks for pathways which contribute significantly to risk but have high uncertainty. Uncertainties are acknowledged in the HHRA. However, EPA has demonstrated that risks based on EPA standard default RME assumptions for residential and commercial uses are sufficient to warrant cleanup action. Ecological risk is independent of land use assumptions. In other words, the need for action is not driven solely by specific Tribal risk scenarios. In addition, EPA’s preference for Alternative 5a over other alternatives is based on the nine CERCLA evaluation criteria, not simply on risk reduction specific to tribal land uses and exposure scenarios.*

Comment: “XII. UMTRCA’s Radon Standard for Uranium Mill Tailings Closure is Not An Appropriate ARAR at the Midnite Mine. EPA has determined that a dose standard of 15 mrem/year is protective relative to most radiological hazards at Superfund sites. OSWER No. 9200.4-18. This risk-based criterion addresses all sources of radiation, not just radon, and

accounts for realistic land use other than residential or unrestricted use. Utilizing this standard, remediation will allow a variety of uses, instead of precluding most, and will be protective. For example, setting aside feasibility considerations, the Tribe's interest in a hunting lodge could be realized under this dose standard by locating the hunting lodge outside the MA. This standard has also been used at other CERCLA sites. See, e.g., USDA, EE/CA for Juniper Uranium Mine, Tuolumne County, CA (July 2005)" [M48]

Response: *OSWER No. 9200.4-18 states that 15 mrem/yr corresponds to a risk of 3×10^{-4} and should generally be the maximum dose level allowed at CERCLA sites. Under CERCLA, protectiveness is determined in the context of the acceptable range of risk. Based on this guidance, EPA uses risk, not dose, as a basis for action at Midnite Mine. OSWER 9200.4-18 also indicates that at radiation sites where radon-220 or radon-222 are contaminants, UMTRCA may be an ARAR.*

Comment: "The 40 CFR Part 192, Subpart B UMTRCA standards for radium in soil are not appropriate to the Midnite Mine because they are premised on unrestricted (i.e. residential) use that is unlikely to occur at the mine site. Similarly the UMTRCA radon flux standard, 40 CFR Part 192, Subpart A, is not appropriate because it is a prescriptive standard that does not allow for any land use in the disposal area. In other words, the UMTRCA standards essentially dictate improbable or excessively restrictive land use scenarios. The UMTRCA standards do not match site circumstances and are not well suited to the site. Under EPA guidance, CERCLA Compliance with Other Laws Manual (Aug. 1988) and 'ARARs Q's and A's' (July 1991), the 15 mrem/year standard is more appropriate and should be utilized as the cleanup standard for addressing radiological hazards at the site." [M49]

Response: *As noted in the previous response, the value of 15 mrem/year is not identified as a standard under CERCLA. The basis for cleanup levels at the Midnite Mine site is the CERCLA range of acceptable risk. Compliance with ARARs is also a threshold criterion under CERCLA, and EPA guidance (OSWER 9200.4-18) identifies UMTRCA as a potential ARAR for radon emissions and for radium concentrations in soils where radium is a contaminant. UMTRCA radon flux standards are based on an assumption of residents near, but not in, capped areas. This is similar to the projected land use at Midnite Mine.*

"Relevant and appropriate requirements mean those cleanup standards [that]...address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (55 FR 8817). In the case of Midnite Mine, the similarities in the contaminants, the kind of actions, the purpose of these actions, and the context of the site are consistent with the use of UMTRCA as an ARAR.

Comment: "XIII. EPA Has Impermissibly Expanded the Tribe's 'Treatment as a State' Beyond CERCLA's Dictates. EPA's selection of the Spokane Tribe's Hazardous Substances Control Act (HSCA, Tribal Resolution 2004-085, dated December 22, 2003) as an Applicable or relevant and Appropriate Requirement (ARAR) for the Midnite Mine Site (FS at pp. 2-7, 2-9, 2-10, 2-12, 5-132; Proposed Plan at pp. 7 and 10) is both erroneous and not allowed under CERCLA's explicit provisions. CERCLA §126(a), 42 U.S.C. §9626(a) specifically limits EPA treatment of tribe's as states to §§103(a), 104(c)(2), 104(e), 104(i), and 105. The selection of ARARs is governed by

CERCLA §121, which is not mentioned in §126(a). In addition, the portions of §121 that deal with ARARs refer only to federal and state standards. Tribal standards are never mentioned.” [M50a]

Response: CERCLA Section 126 directs EPA to afford Indian tribes substantially the same treatment as states for certain specified subsections of CERCLA sections 103, 104, and 105; EPA has stated in the preamble to the NCP (55 Federal Register 8741, March 8, 1990) that it is similarly appropriate to treat Indian tribes as states for the purpose of identifying ARARs under Section 121(d)(2) of CERCLA. Further, EPA has determined that HSCA is an appropriate standard to be considered in establishing cleanup standards for this Site. The Tribe’s implementation of these cleanup standards on its reservation is similar to a state’s implementation of its standards within such state. Since this cleanup is within the Spokane Reservation, HSCA, instead of state law, is appropriate.

Comment: “In addition, even if the Tribe’s HSCA were an ARAR for this Site, it cannot result in a Reservation-wide prohibition on land disposal of hazardous substances, unless the prohibition meets the three requirements of §121(d)(2)(c)(iii), including the requirement that the Tribe ‘arranges for, and assures payment of the incremental cost of utilizing, a facility for disposition of the hazardous substances, pollutants, or contaminants concerned’.” [M50b]

Response: To evaluate the effect of the provisions of Section 121(d)(2)(c)(iii) of CERCLA, which may be applicable to Indian Tribes, EPA evaluated the question of whether HSCA is effectively a reservation-wide prohibition on land disposal of hazardous substances. The Spokane Tribe identified three areas of the reservation where the HSCA restrictions based on distance from surface water, wetlands, and groundwater recharge areas can be met. Others may also exist.

Comment: “XIV. Conclusion – For the reasons discussed here, EPA should not select Alternative 5a as the CERCLA remedy for the Midnite Mine Site. That decision would be arbitrary, capricious, not in accordance with law, and not supported by the Midnite Mine AR.”

Response: EPA disagrees with this conclusion, as described in response to comment M1.

RESPONSIVENESS SUMMARY – ATTACHMENT B

**EPA Response (dated September 23, 2005) to Spokane
Tribe Comments on the Feasibility Study**

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~~CONFIDENTIAL~~



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 10
1200 Sixth Avenue
Seattle, WA 98101

EPA Region 10 Superfund
RELEASABLE

Date _____
Initial _____

September 23, 2005

Reply to
Attn Of: ECL-115

Randy Connolly, Superfund Coordinator
Spokane Tribe Department of Natural Resources
P.O. Box 100
Wellpinit, WA 99040

Re: Responses to Spokane Tribe Comments on Chapter 5 of the Midnite Mine
draft Feasibility Study (April 2005)

Dear Mr. Connolly:

Enclosed are the U.S. Environmental Protection Agency (EPA) responses to the Spokane Tribe's (Tribe) comments on the above document. Chapter 5 of the draft Feasibility Study was provided in April 2005 for review and comment.

Detailed comments were provided on behalf of the Tribe by Fred Kirschner of AESE, Inc.. EPA's response includes the Tribe's comments in bold, with EPA's response in italic after each comment.

The Feasibility Study will be issued shortly as part of the administrative record. While EPA does not plan to re-issue a revised version of the document following public comment on the Proposed Plan, we will respond to comments in the responsiveness summary or by producing an addendum, amendment, or erratum as appropriate.

Please contact me if you have questions regarding the enclosed comment letter. As you know, I can be reached at (206) 553-1215.

Sincerely

Ellen Hale
Remedial Project Manager

Enclosure

CC: Fred Kirschner, AESE (by email only)

USEPA SF



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By memo dated May 5, 2005, AESE Inc. submitted comments on the U.S. Environmental Protection Agency (EPA) Draft Feasibility Study, Chapter 5 (April 2005). The comments were submitted on behalf of the Spokane Tribe (Tribe). EPA's responses to the Tribe's are provided below.

A number of the Tribe's comments focused on changes to Alternative 5c, primarily the addition of highwall grouting and in situ biological treatment. EPA will not change Alternative 5C as suggested, as explained below, but will include in the FS a discussion of these measures and their potential evaluation during remedial design.

The Tribe omitted a number of comments prepared by AESE prior to submitting the memo to EPA. These are noted in brackets. The Tribe's comments are in **bold** text, with excerpts from the draft FS in ***bold italic***. EPA responses to the comments are provided in *italic*, following each comment from the Tribe.

Spokane Tribe General Comments

1. [comment not submitted]

EPA Response. *No response needed.*

2. Risk is calculated based on concentrations of COCs measured at a point—not loads for an entire basin. It is quite possible that although overall loads have decreased in response to the remedy, certain locations may become higher in concentration of COCs, than under baseline conditions. This means that although loads have been reduced, risk has increased over baseline conditions. This concern is expressed in several instances for several alternatives below that have the potential to change chemistry and/or location of current groundwater to surface water discharge locations.

EPA Response. *To the extent that examples of this concern are identified in the subsequent comments, the response to this comment will be contained in the responses to these subsequent comments.*

3. The concept of the WMA is not consistent throughout the document. The different alternatives all have different sized WMA's for different media. For example after operation for a period, 5c does not have a WMA for groundwater, yet 5a always has a WMA. This concept is important for specifying institutional controls and should be discussed more thoroughly early on. Perhaps a column for this criterion could be included in the tables that compare and contrast the different alternatives.

EPA Response. *The WMA applies only to groundwater, and is limited to groundwater beneath areas where mine waste is contained. EPA does not consider it likely that Alternative 5c would no longer need a WMA after several years of operation. The pits would continue to be filled with reactive mine waste in perpetuity. As a result, EPA*

anticipates that a WMA that is the size of the footprint of the mine waste backfill would be needed for the foreseeable future.

4-5. [Comments not submitted]

EPA Response. *No response needed.*

6. Sludge generation rate is a function of WTP inflow quality, inflow quantity, and required output quality. The assumption that only volumetric flow rates will change and that water quality will remain constant over time for each alternative is a fatal flaw. Current waters treated in the WTP benefit from dilution of less concentrated sources. Although flows may be decreased, Alternative 3c, 3d, 4d, and 4e are likely to result in waters that are much lower in quality than current conditions. The goal of Alternative 5c is to reach background conditions over a very short period of time. The FS acknowledges that an intermediate quality is probably representative of Pit 4 conditions.

It is not clear how reduction of infiltration would necessarily be a reduction in mass exported from the base of a given facility. Knowledge on the degree of saturation with respect to each COC currently issuing from the base of each pile/pit would have to be known. The tribe is unaware in any work related to this type of determination. Again, it is quite likely that although flow has been reduced, mass flux may not necessarily be reduced. In fact, instances where current pore waters are not fully saturated with respect to specific COCs are likely to result in higher concentrations upon capping due to an increase in oxygen and residence time in the unsaturated zone.

EPA Response. *We agree with the Tribe that the quality of water that will require treatment in the future is uncertain; however, we disagree with the assertion that Alternative 3c, 3d, 4d, and 4e are likely to result in waters that are much lower in quality than current conditions. Rather, we believe the assumption that future water quality will be similar to current conditions probably overestimates future COC concentrations and sludge generation rates, because the alternatives address the primary sources of COCs. The seeps are the primary source of COCs in water that is treated, and outflow from the Backfilled Pits is the primary source of COCs in seep water. Rough estimates of loading from the Backfilled Pits as a percent of total load in WTP influent are 34 to 54% for uranium and manganese and 14 to 26% for sulfate. There are three sources of the water that flows into and out of the Backfilled Pits: (1) bedrock groundwater; (2) upslope groundwater that is perched on top of the bedrock surface; and (3) surface water that percolates vertically into the Backfilled Pits.*

Each of Alternatives 3c, 3d, 4d, and 4e includes recontouring and covering areas that are sources of groundwater inflow and surface water percolation into the Backfilled Pits. Alternatives 3c and 3d also include a thick cover over the Backfilled Pits that would further reduce percolation. To the extent there is still inflow into the Backfilled Pits following remedy implementation, Alternative 3c also includes direct removal (pumping) of water from the Backfilled Pits. This would reduce the residence time of water in the

Backfilled Pits and thus reduce the concentrations of COCs in this water. The overall effects of the Alternatives 3c, 3d, 4d, and 4e would include: (1) lowering the water table in the bedrock beneath the backfilled pits, which would reduce or eliminate inflow of bedrock groundwater; (2) reducing percolation through waste materials uphill of the backfilled pits, which would reduce or eliminate inflow of groundwater perched on top of the bedrock surface; and (3) reducing percolation of surface water directly into the backfilled pits.

7. Even after lengthy discussions with EPA over several years ago, EPA is still misconceptualizing the hydrogeology near Pits 3 and 4 and down gradient of the MA. The relative hydraulic conductivity (K) of the following units is believed to be as follows:

$K_{\text{waste/alluvium}} > K_{\text{contacts}} = K_{\text{faults/fractures}} = K_{\text{exfoliated monzonite}} > K_{\text{schist}} = K_{\text{calc silicate}} >> K_{\text{unfractured monzonite}}$

The contact between the monzonite and the schist units in both pits dip to the east (Figures 13, 14, and 15). The exfoliated monzonite on the east walls of the pit have been scalped and removed during mining (Figure 16). The very low K of the remaining unfractured monzonite is why springs do not occur on the western walls of either pit. The northern head wall and eastern walls of both pits, (both of which contain faulted/fractured contact rocks and the fractured Togo schist and calc silicate units) are both associated with springs. This asymmetrical distribution of K about the pits and the eastward dipping nature of the contact rocks indicate that pits are not necessarily acting as sinks under any conditions and water is probably exiting both pits to the east, down dip. URS cited the cost associated with attempting to penetrate the contact to the east as being to prohibitive to not further investigate this issue. However, this uncertainty is central to almost all alternative evaluated.

Along these same lines, the buried pits are completed almost entirely in the monzonite unit. The upper portions of the pit walls are believed to contain exfoliated granite. The lower pit walls contain predominantly unfractured granite. The remnant contact between the Togo and the monzonite, the exfoliated granite, and unconsolidated units are believed to be responsible for transport of water into the BPits under current conditions. However, if conditions change and the watertable in the monzonite drops below the base of the BPits, contaminated water will be exported out of the BPits through the same fractures.

EPA Response. *EPA agrees that outflow from Pit 3 and Pit 4 occurred in the past when the water levels in the pits were higher. The primary direction of outflow from Pit 4 was apparently to the south, as indicated by seepage on the north highwall of Pit 3. This seepage appears to have been reduced as a result of lowering the water level in Pit 4. There is some uncertainty about the direction of outflow from Pit 3. The primary orientation of the fractures in the Pit 3 area, as well as the orientation of the contact between the monzonite and the Togo, is to the south. The ground surface and the water table also generally slope downward to the south. While EPA believes the primary direction of past outflow was to the south, outflow to the southeast along the bedding*

planes may also have occurred to some extent in the past when the water level was higher.

Regardless of the direction of outflow, each alternative includes measures to limit outflow of contaminated water from Pit 3 and Pit 4. Under Alternatives 2b and 3c, the water levels in the pits would be maintained at low levels to limit outflow. Under Alternatives 3d and 4d, pit water would be treated in-situ, which, if successful, would reduce the concentrations of COCs in any outflow to acceptable levels. Under Alternatives 4e, 5a, and 5c, the pits would be drained, which would reduce outflow to essentially zero.

With respect to the potential for outflow from the Backfilled Pits, should the bedrock water table drop below the base of the Backfilled Pits, EPA acknowledges that outflow through bedrock fractures could occur to a limited extent. However, as the Tribe noted, the backfilled pits were excavated almost entirely in the monzonite unit, and the lower portions of this unit are largely unfractured. This would limit outflow of water through the lower pit walls. In addition, the volumes of water that would enter the backfilled pits would be substantially reduced. See response to Comment 6.

If Backfilled Pit water levels become high enough, outflow may also occur through unconsolidated material or weathered bedrock along former drainage channels downgradient of the Backfilled Pits. Such outflow occurs under existing conditions, and the rate of outflow would be reduced after remedy implementation. Any outflow from the pits would be either collected (as seep water or alluvial groundwater) and treated or treated in-situ. It is unlikely such outflow would occur under Alternatives 3c and 5a, because these alternatives include measures to maintain the pit water levels near the bottoms of the pits.

8. The Tribe has voiced its concerns, several times, with relying on the assumption that reducing infiltration in one location will not necessarily directly affect the groundwater flow system as measured in seeps or springs at a given location. This concern centers on the fact that much of the flow at the springs/seep is caused by interflow and deep aquifer discharge that has probably originated from areas distal to areas in which actions to reduce recharge are occurring. In other words, not all water measured in the springs/seeps originates from the area designated for capping. Without knowing the percentage of flow at springs/seeps originating from the area in which action will occur, is likely to result in falsely low estimations of reduction in flow. Subsequently, sludge production rates would also be under estimated.

EPA Response. We believe the commentor means to say that assumptions used in the FS are likely to result in falsely high estimations of reduction in flow. Contrary to the comment, estimates of the sources of water that discharges at the seeps have been made (HMTM, EPA 2002). While we acknowledge that the future seep flow estimates are subject to uncertainty, we do not agree that a large portion of the water to be treated, or of COCs in this water, comes from areas that would not be covered under Alternatives

3c, 3d, 4d, and 4e. First, based on estimates in the HMTM, 80 to 90 percent of the seep flow results from interflow; therefore, the bedrock groundwater contribution to seep flow is relatively small (10 to 20 percent). Alternatives 3c, 3d, 4d, and 4e include soil covers over nearly the entire area that contributes to interflow. Second, the Central Drainage is the largest source of COCs in seep water, and the entire area that is the source of Central Drainage seep water (HMTM Figure 6-1) would be covered under these alternatives. The HELP model used to estimate the changes in flow is based on conservative assumptions and is unlikely to underestimate reductions in flows.

9. Many of the options rely on caps to reduce infiltration into the underlying hydrogeologic units. If effective, these alternatives will lower the water table in the BPits area, reversing the currently favorable condition of movement of ground water from the bedrock into the pits. If this does indeed occur, all alternatives that rely on drains or wells to dewater the BPits will be ineffective and highly contaminated water will be exported from the fractured BPits to the bedrock aquifer system. Under this new hydrogeologic circumstance, contamination is likely to travel beyond current distances downgradient, where the bedrock flow system issues into the shallow exfoliated monzonite unit. (See also General Comment No. 7)

In other words, minimizing recharge to bedrock flow system via cover will likely depress the water table down into the fractured bedrock flow system. This would: (1) complicate the technical understanding of flow (2) not enable recovery of liquids in unconsolidated aquifer of BPits, and (3) increase the rate of transport of COCs out of the MA to the MAA due to change in effective porosity between unconsolidated units and fractured bedrock flow system (conservation of mass)—this is major difference between 5a and 5c.

EPA Response. *We believe the commentor is overstating the potential for outflow from the backfilled pits under alternatives that dewater the Backfilled Pits, should the water table be lowered beneath the base of the Backfilled Pits. See response to Comment 7. In addition to the points noted in the response to Comment 7, the cover used for the backfilled pits under Alternative 5a could be modified, if needed, to include an FML that would reduce percolation to very low levels. EPA does not agree that the rate of transport of COCs from the MA to the MAA would be increased as a result of implementation of Alternatives 3c, 3d, 4d, 4e, and 5a. First, it is likely that some water from the backfilled pits is not captured in the seep collection system under current conditions. Second, each of these alternatives includes measures to reduce the volume of water that becomes contaminated in the backfilled pits. Third, each of these alternatives (except Alternative 5a) includes collection or in-situ treatment of backfilled pit water that currently bypasses the seep collection system in the alluvium. Alternative 5a reduces outflow from the backfilled pits to a very small level such that collection of alluvial groundwater is probably unnecessary.*

10. Sediment transport and release is partially misconceptualized. Blue creek is a downcutting stream. Deposition (if any) occurs near Oyachen Creek where the gradient decreases. Sediments can become contaminated two ways in this system.

Sediments can either be: (1) eroded and transported as a solid form the source material, or (2) clean sediments can become contaminated via chemi-sorption sorption of COCs derived from the water column. Evidence suggests that the latter is probably more important in the Blue Creek basin.

***EPA Response.** EPA does not agree that sediment deposition has not occurred in Blue Creek upstream of Oyachen Creek. Although this reach is downcutting, sediment deposition has occurred in localized depositional areas. EPA concurs that contaminated sediments can result from either deposition of contaminated material or from precipitation of COCs from the water column. The potential for recontamination due to these processes will be considered in planning sediment response actions during the remedial design and remedial action phases. Regarding evidence of chemi-sorption, EPA is not aware of analyses performed at this site that would distinguish between particulate deposition and chemical sorption. If the Tribe has information to support this conclusion, EPA requests an opportunity to review it.*

11. Table 5-7 incorrectly describes RAOs for Surface water. Note the Tribal Surface Water Quality Standards (TSWQS) do not list U total separately, but the sum of all U species cannot exceed 0.3 pCi/L. Therefore, the ARAR for U total is 0.3 pCi/L (approximately 0.3 ug/L). The SDWA is incorrectly used to set the RAO for surface water as well. If EPA plans on using GW as a surrogate, then the HSCA is the ARAR (background). The values in Table 5-8 should be calculated to reflect hardness for the receiving water body, Blue Creek. The lowest hardness (4 consecutive days out of the year) for Blue Creek is more on the order of less than 25 mg/L. Because the equations used to calculate the numeric standards are not applicable for hardnesses less than 25 mg/L, the standards should be calculated using a hardness of 25 mg/L.

***EPA Response.** As a point of clarification, Table 5-7 lists numerical standards that are potential ARARs and potential PRGs, not RAOs. Table 5-7 has been revised to show the total uranium concentration (0.45 ug/L) that corresponds to the Tribe's WQS for Unat (0.3 pCi/L). The estimated background total uranium concentration (20 ug/L) is higher than 0.45 ug/L, thus, the potential ARAR is shown as 20 ug/L in Table 5-7.*

The values of hardness used in Table 5-8 to calculate numerical standards for hardness-dependent metals were selected to support an evaluation of the potential for the various alternatives to achieve compliance with ARARs. Currently, values of hardness in the mine drainages and Blue Creek below its confluence with the mine drainages are substantially greater than 100 mg/L. Actual ARARs compliance for these metals would be determined using hardness values and metals concentrations that would be measured after the remedy is implemented.

Footnotes will be added to clarify the use of background as the ARAR value and the application of the formula as an ARAR, despite the presentation of the numerical value based on the moderate hardness assumption of 100 mg/L.

12. Several methods are capable of achieving the TSWQS for Sulfate. Since it is not “technically impracticable”, an ARAR waiver seems improper and should be stricken from the document. The entire FS costing analysis hinges on sulfate production rates and concomitant disposal costs associated with meeting the Tribe’s Standard (See General Comment No. 6). The FS should be revised to reflect the realities of treating to meet the Tribe’s Sulfate standard.

EPA Response. EPA continues to work with the Tribe on the issue of WTP discharge requirements for sulfate. Treatability studies would be needed to evaluate the technical practicability of treating site water to remove sulfate if a discharge limit lower than current levels in the discharge is ultimately selected. The FS will be revised to identify the need for treatability studies to evaluate the technical practicability of sulfate removal. The cost of treatment of site water to remove sulfate to the Tribe’s spiritual and ceremonial standard (250 mg/L) will not be evaluated in the FS. However, the need to reduce the amount of sulfate discharged to the surface water system, and the associated cost, will be factored into remedy selection.

13. Onsite disposal with any of these alternatives would result in greater overall risk from the site over current conditions. This is because the onsite sludge, while arguably less bioavailable, would be the UCL₉₅ driver for the MA for all COCs including external ionizing radiation.

EPA Response. EPA assumes that the Tribe’s comment is comparing the risk between on-site and off-site disposal for each alternative, rather than between current conditions and on-site disposal of sludge.

Compared to current conditions, it is clear that uncontrolled access to ore, contaminated water, and waste rock poses a greater risk than a vegetated soil cover, ARD reductions, and water treatment sludge containment in a restricted facility with engineering and institutional controls in place. The potential risks from exposure to treatment sludge in an onsite disposal facility would be limited to acceptable levels using a combination of access controls (e.g., fencing) and engineering controls (e.g., daily cover and final cover). The access and engineering controls would eliminate the direct exposure pathway and limit radiation exposures to acceptable levels once the sludge is placed in the disposal facility. Radon emissions are not expected to be a concern because of the low concentrations of radium in the sludge.

In comparing on-site versus off-site disposal for each alternative, EPA does not generally quantify these risks but in the comparative analysis the two approaches are qualitatively compared using the FS evaluation criteria. Off-site disposal of sludge removes contaminant mass from the site, but it also increases the potential for releases in transit to a disposal site.

14. For O&M costs, the high range of the cost continuum should reflect, high WTP flow rates, high chemical loads, meeting the Tribe’s standard for sulfate, and

disposing great distances off-site in an escalating-rate market. The low-end of the range would be just the opposite.

***EPA Response.** EPA believes the “base plus incremental” costs presented in the FS capture the upper range of potential water treatment and sludge disposal costs, within an estimated accuracy of -30 to +50 percent, assuming the water treatment system is not modified. Under the base plus incremental cost scenario, the primary cost related to water treatment and sludge disposal is the cost of offsite sludge disposal. Although the offsite disposal cost used in the FS is the best available estimate using currently available information, EPA acknowledges that some potential exists that future offsite disposal costs could be significantly higher. If the cost of offsite disposal becomes very high, the water treatment process could be modified to change the characteristics of the treatment residuals and reduce disposal costs. For example, ion exchange could be used to remove uranium before the chemical precipitation step. This process train would greatly reduce or eliminate (if resin regeneration is used) the volume of low-level radioactive waste, which is expensive to dispose of. The chemical precipitation sludge could be disposed of as non-radioactive waste at a considerably lower cost.*

Regarding water treatment and sludge disposal costs to meet the Tribe’s ceremonial standard of 250 ppm sulfate, these costs have been evaluated. A table showing the various treatment options and their effect on costs will be added to the FS report as a supplemental table.

15. It is quite likely that construction will not begin for quite some time. This means that construction costs could begin to be depreciated in 2005. This is likely to reduce the costs of alternatives that involve high capital costs.

***EPA Response.** EPA guidance requires that EPA select a base year for cost estimating. While EPA does not provide definitive guidance for this scenario, the effect of such an assumption is probably within the uncertainty of the cost estimates. Unless funds were to be placed in an investment instrument in 2005, such a costing assumption would not be accurate.*

16. Alternatives that rely on insitu treatment include onsite disposal of WTP sludge without the benefit of Subtitle C or D protection. Such alternatives are less protective than current conditions because currently the concentrated mass is being hauled offsite.

***EPA Response.** The reference to WTP sludge is confusing, as WTP sludge is by definition produced by the ex-situ water treatment plant, not by in-situ treatment. Under all alternatives, any WTP sludge produced is assumed to be disposed of either off site or in an onsite repository constructed to Subtitle C standards. The Tribe may be using the term “WTP sludge” to mean in-situ treatment residuals (e.g., spent reactive media). Alternative 3d includes disposal of spent reactive media and lake sediments precipitated as a result of pit water treatment either onsite in a lined disposal area or offsite. Precipitates resulting from the pit bioreactors (Alternative 4d) would be sequestered*

within the pit backfill, and human and ecological exposures would be prevented by engineering and institutional controls.

17. Alternatives 4d and 4e are analogous to an industrial-grade, open-circuit leach process, capable of generating very large volumes of product (sludge, not cold or copper n this instance). The ultimate volume of sludge can be estimated if the chemistry and volume of the waste rock are known. If onsite disposal is considered, pits within MA cannot contain all of the sludge. This is a very inefficient means of dealing with the mass: for every mole of pyrite, up to 16 moles of lime are consumed. This means that a large amount of mass is being added into the system that must be disposed of because the chemical composition and toxicity of the COCs does not change.

EPA Response. EPA recognizes the need to reduce the amount of contaminated water produced at the site, and Alternatives 4d and 4e include containment systems that would significantly reduce contaminated water production.

EPA does not concur that the pits could not contain the sludge produced under Alternatives 4d and 4e. The FS includes estimates of volumes of sludge that would be produced under Alternatives 4d and 4e. Under Alternative 4d, the estimated volume is 3,000 cubic feet per year, or 300,000 cubic feet (11,000 cubic yards) over 100 years. Under Alternative 4e, the estimated volume is 6,000 cubic feet per year, or 600,000 cubic feet (22,000 cubic yards) over 100 years. The FS also includes estimated volumes of the pits within the MA. The estimated volumes of Pits 3 and 4 are approximately 12,900,000 cubic yards and 3,200,000 cubic yards, respectively, which is a total of 16,100,000 cubic yards. The total volume of material that would be placed in Pits 3 and 4 under these alternatives is 2,700,000 cubic yards, which would leave a volume of 13,400,000 cubic yards available for sludge disposal. Thus, the volume of sludge produced after 100 years would occupy only 0.08% and 0.16% of the total available space in Pits 3 and 4 under Alternatives 4d and 4e, respectively.

A concern implicit in the comment may be whether precipitates formed by in-situ treatment of contaminated water injected into Pit 3 under Alternative 4d would clog the pore space of the materials within Pit 3. Should this happen, in-situ treatment of contaminated seep water and groundwater in Pit 3 would not be possible. The in-situ treatment process, however, is not a lime precipitation process. Rather, it relies on changes in redox conditions that would result in precipitation of metals as sulfides. Treatability studies would be needed to evaluate the volumes of precipitates that would be produced over time.

18. Uncertainties associated with borehole drains interconnecting various pits include, but are not limited to:

- 1. long-term stability (probability of collapse is great if a liner/casing is not used, the ground is unstable, or the rocks will become decrepit over time);**
- 2. plugging of screens;**

3. cannot easily re-drill if failure occurs;
4. Only water under water table conditions will enter the drains;
5. Numerous low spots would require numerous drains. Locations of which, are not known due to poor understanding of the sub-grade topography.
6. Routing poor quality waters through the drain blanket of Pit 3 will likely foul and eventually plug the drain blanket causing major problems in the future relate to buildup of hydrostatic pressure. Also the buffering capacity of the drain blanket would be unnecessarily consumed over time.
7. One goal common to managing and treating ARD at mine sites is to segregate good quality and poor quality waters. In general this allows selective treatment reducing the cost associated with primary treatment as well as disposal of WTP sludge. Alternatives that choose to interconnect the pits, however, do not benefit from this approach.

EPA Response. It is expected that the passive drainage systems included under Alternatives 4e and 5a would be effective and reliable over the long term; however, the methods used to dewater the pits would be further evaluated during remedial design. Dewatering wells could also be used to dewater the pits. Additional factors are briefly discussed below.

- *The borehole drains include liners, which would reduce the potential for borehole collapse.*
- *It should be possible to conduct maintenance on plugged screens using standard well rehabilitation techniques (e.g., acidification), although some minor modifications to the standard techniques (e.g., use of packers) may be necessary.*
- *Should failure occur, it would be possible to redrill the boreholes. Alternatively, the boreholes could be replaced with vertical wells if the latter are more cost-effective.*
- *Data collection for design would include a drilling program to evaluate the possible presence of low spots that could accumulate water. Small pools of accumulated water would not be expected to significantly affect the effectiveness of the drains.*
- *If passive borehole drains are included in the Selected Remedy, the potential for plugging of the drainage blanket would be further evaluated during remedial design. If further evaluation suggests plugging would be a problem, additional measures to further reduce the amount of water that would enter the existing backfilled pits could be incorporated into the remedy. These measures could include shallow cutoff trenches to divert runoff and groundwater flow in the unconsolidated materials around the backfilled pits area.*
- *The usefulness of segregating waters with different characteristics depends on site-specific conditions. Currently at the site, waters with different characteristics are mixed. This facilitates operation of the WTP (i.e., chemical dosages and retention times don't need to be changed for waters with different characteristics). The water that enters Pit 3 from the bedrock aquifer may contain relatively low levels of COCs compared to other contaminated site water. However, the volume of the bedrock groundwater is expected to be small enough*

that separating its flow from other contaminated water would not be cost-effective.

19. It appears that contaminated runoff from alt 5a is considered negligible and does not require treatment; however, treatment of runoff is required for 5c. Please explain. Also note that direct runoff from waste-rock from the western portion of the mine is currently exempt from treatment, because it meets NPDES discharge standards. This may not be true for TSWQS. This means that flow quantities requiring treating may be underestimated for Alternative 2B.

EPA Response. It is assumed that runoff and seepage from areas of Togo schist exposed in the highwalls by excavation of the backfilled pits would need to be treated. These areas would be exposed by implementation of Alternative 5c, but would not be exposed by implementation of Alternative 5a.

EPA concurs that, should Alternative 2b be selected, additional monitoring would be needed to determine whether treatment of runoff from the western end of the South Spoils would be needed. In addition to runoff from the western end of the South Spoils, the Western Drainage Bypass contains runoff from a larger area northeast of the mine site that is not affected by the mine. Should treatment be needed, the runoff from the western end of the South Spoils could be isolated and collected. This would result in a small increase in the volume of water that would be treated compared to current conditions.

Specific Concerns

1-78 [comments not submitted]

EPA Response. No response needed.

79. Page 5-113; 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 1:

5.3.9.1 Description

“The description of Alternative 5c is based on material provided by the Tribe (AESE, Inc. 2003) and the Midnite Mine Natural Resources Trustees (MUMNRTC 2004). Alternative 5c includes institutional controls, excavation and consolidation of mine waste within Pit 3 and Pit 4, and water treatment, as described under Alternative 5a. The primary difference between Alternative 5c and Alternative 5a is that all waste rock in the existing backfilled pits would be excavated and placed in Pits 3 and 4 under Alternative 5c. The primary elements of Alternative 5a that are incorporated in Alternative 5c include:”

The Tribe’s thoughts on two main issues has changed since drafting these communications:

Grouting the highwall should be evaluated as a means to keep the bedrock hydrated and therefore minimizing production of ARD in background waters. A mixture of molasses and ethanol and other organic compounds should be used to minimize ARD production within the pits during construction.

The description for Alternative should include the following discussion:

“Alternative 5c works to minimize ARD by using FMLs, grout, and biotechnology; therefore, SO₄ is minimized (if produced at all). Water treatment is only necessary during construction phase, possibly small volume thereafter as bedrock flow system that feeds the pits re-equilibrates. Long-term ICs in 5a and 5c are much more easily implemented than other alternatives because ICs would be for subgrade work like excavation, drilling, etc.—not above ground fencing.”

Cost estimates to meet TSWQS (SO₄) incorrectly assumes same quality as today (See General Comment No. 6), flows are just slightly reduced from alt 5a (see estimate tables—note that FML usage alone should greatly diminish volumes, but this reduction is not reflected in URS’s work).

EPA Response: Highwall grouting and in-situ biological treatment could be evaluated during remedial design as potential measures for reducing generation of ARD. The additional cost, effectiveness, and implementability of these measures have not been evaluated in the FS under Alternative 5c.

See response to Comment 6 related to quality of water that would need to be treated after remedy implementation. See response to Comment 19 related to volumes of water that would be treated under Alternatives 5a and 5c. The FS will include a table showing cost estimates for different treatment processes and disposal options associated with meeting the TWQS for sulfate. The costs are not incorporated into the detailed cost estimates, however.

80. Page 5-113; 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 1:

- *Excavation and consolidation of all waste material, including ore and protore, waste rock, haul roads soil, and contaminated sediment, within Pit 3 and Pit 4*
- *Construction of a storm water management system*
- *Replacement of the WTP at a new location; temporary treatment units would also be used during remedy construction to supplement the treatment capacity*
- *Excavation of contaminated soil in the haul roads and adjacent impacted areas; the soil would be consolidated with the mine waste and placed in Pit 3 or Pit 4*
- *Excavation of contaminated MAA sediments; the sediments would be consolidated with the mine waste and placed in Pit 3 or Pit 4*
- *Institutional controls, including access and use restrictions and information programs*
- *Long-term monitoring and 5-year reviews”*

Should add grouting and bio-remediation to design. Also should modify construction staging with grouting being step 1 and bio-remediation/stabilization used as necessary, but also installed drip irrigation prior to installing surficial FML.

EPA Response. Highwall grouting and in-situ biological treatment could be evaluated during remedial design as potential measures for reducing generation of ARD. The additional cost, effectiveness, and implementability of these measures have not been evaluated in the FS under Alternative 5c.

With respect to the in-situ biological treatment measures described in the comment, EPA has concerns about the ability of a surficial drip irrigation system to effectively distribute the amendments to 35 million tons of backfill. In addition, EPA is concerned that adding large volumes of treatment solution to the waste rock fill appears to negate the value of the FML cover for limiting percolation into the waste rock fill.

81a. Page 5-114; 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 1:

“Alternative 5c differs from Alternative 5a in the following elements:

• Waste rock in the existing backfilled pits would be excavated and placed in Pits 3 and 4; intact rock also would be excavated from the backfilled pits to the extent needed to provide drainage of water to the Central Drainage.”

Intact Calcsilicate on southeast wall may be excavated for drain blanket material and to enlarge available disposal volume as discussed earlier.

EPA Response. The FS will identify excavation of rock from the southeast highwall of Pit 3 as a possible source of non-reactive rock for construction of drainage blankets, which could be further evaluated during remedial design. The FS assumes the drainage blanket would be constructed using rock segregated from onsite calc-silicate waste rock. Hence, this measure would not affect the analysis of pit capacity presented in the FS. The FS also does not include costs for excavation of this rock.

81b. “A flexible membrane liner (FML) would be placed in Pit 3 and 4 prior to placement of waste materials in the pits. This basal FML would cover the base of the pits and extend part way up the pit walls. The purposes of the basal FML would be to further reduce the potential for contact between water and reactive rock and further protect the drainage blanket from deposition of contaminants and fine soil that would be contained in water percolating through the waste materials (particularly during construction).”

The lower FML would be placed between drain blanket material on both sides, then waste rock. The Tribe’s thinking has changed on this design. Up-wall placement may be necessary (if necessary at all) only on the northern wall where

current seeps exist. Excavation of waste rock will re-expose armored surfaces causing ARD to be generated at rates that may be much greater the current conditions. Non-segregation of relatively good quality bedrock water and poor quality water from the waste rock has the potential of resulting in large amounts of ferri-oxihydroxides to be produced in the neutralizing drain blanket. This could cause two problems: (1) unnecessary reduction in buffering capacity of drain blanket and more importantly (2) precipitation of ferri-oxihydroxides within pile and within blanket which will change the spatial distribution of K.

EPA Response. The FS assumes basal FML liners that extend partially up the pit highwalls under Alternative 5c. The basal FML is assumed to extend to an elevation of 2600 feet above mean sea level (amsl) in Pit 3 and to an elevation of 3000 feet amsl in Pit 4. The estimated surface areas of the basal FML liners are 560,000 square feet (sf) for Pit 3 and 70,000 sf for Pit 4.

81c. “• Waste materials placed in Pits 3 and 4 would be contained using a cap consisting of an FML and 5 feet of soil.”

Need to state that this is designed to “greatly reduce water and O₂ infiltrating into the pile, thereby reducing production of ARD and (SO₄)”

EPA Response. Section 5.3.1.3 of the FS (Cover Systems) will be modified to include a discussion of the purpose and limitations of FML liners.

81d. “• Backfilled Pits 3 and 4 would be drained using extraction wells instead of passive gravity drains.”

A single drain and leaky bulkhead constructed in the bedrock but allowed to drain back into the alluvium is desirable. This would minimize the need for treating groundwater. Wells would be used as back-up.

EPA Response. A gravity drain and leaky bulkhead could be evaluated during remedial design as potential measures for controlling water levels in Pit 3 and Pit 4. The additional cost of these measures has not been evaluated in the FS under Alternative 5c.

Under General Comment 18, the Tribe identified a number of concerns with passive drains used to drain the backfilled pits. At a minimum, concerns 1 through 4 would apply to passive drains installed to drain Pits 3 and 4 to the same degree they would apply to passive drains for the existing backfilled pits.

81e. “• In general, bedrock exposed by excavation activities would not be revegetated.”

This statements needs to be qualified. The site would be revegetated if a cheap local source of cover is identified such as weather monzonite near the BPits.

***EPA Response.** The FS will be revised to include a statement to this effect. However, since such a source has not been identified at this time, the FS analyses will be based on the assumption that excavated areas would not be revegetated.*

81f. “• The WTP effluent would be conveyed to the Spokane Arm of Lake Roosevelt for discharge.”

This statement also should be qualified. Discharge to the Lake would only occur until background has been achieved or until construction is complete and a new WTP is functioning.

An overview summary of the elements of Alternative 5c is presented in Table 5-3. A summary of institutional controls included under Alternative 5c is presented in Table 5-4.

***EPA Response.** Costs for construction of a new WTP were included under Alternative 5c; however, the costs are not based on a WTP that would remove sulfate to the TWQS. In this case, either continued discharge of treated effluent into Lake Roosevelt would be needed or water would be discharged to the surface water system with sulfate at concentrations that exceed the TWQS.*

The last paragraph of the Tribe’s comments appears to be text that follows the bulleted text included above. As it appears to be unintentionally included, it does not require a response.

82. Page 5-114; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 3:

“The materials designated for consolidation in Pit 3 and Pit 4 include all material excavated during mining (including the backfilled pits; approximately 38 million tons (SMI 1996)), less the ore hauled to the mill (2.9 million tons (SMI 1996)), a total of approximately 35 million tons. In addition, an allowance of one million tons is included for overexcavation of intermixed waste rock and native soil. The total weight of this material (approximately 36 million tons) exceeds the weight of material removed from Pit 3 and Pit 4 combined (approximately 33 million tons). In addition, it would not be feasible to place the material back into the pits at a density as great as that of the undisturbed, pre-mining rock. Thus, the combined capacity of Pit 3 and Pit 4 is potentially a limiting factor under Alternative 5c.” [Emphasis added.]

The capacity of Pits 3 and 4 are not a major concern. The south and southeastern walls of Pit 3 can be expanded while mining the drain blanket material. The final footprint of Pit 4 can be enlarged to accommodate any additional waste. Finally, if necessary, the BPits could be excavated and designed similarly to Pits 3 and 4 to be used much like as a secondary cell.

EPA Response. *The evaluation of pit capacity in the FS (Appendix E) assumes fill footprints that extend beyond the current edges of the pits. Hence, additional excavation of the south and southeastern walls of Pit 3 to the extent shown in FS Figure 5-16 would increase the capacity compared to that presented in the FS only to the extent that the excavated material would not need to be placed in the pits (i.e., it would not be a source of COCs and would not be used for drainage blanket construction – see response to Comment 81a). The cost for blasting, excavating, hauling, and placing such material at another location on the site has not been included in the FS. The final footprint of Pit 4 also could not be expanded beyond that assumed in the FS without extensive blasting and significant additional cost.*

The cost for using the backfilled pits area for waste placement, including drainage systems, basal FML, and surface cover, was not included in the FS. Using the backfilled pits area for waste placement would also increase the area of access and use restrictions under Alternative 5c from about 80 acres to about 97 acres (the same as Alternative 5a).

83. Page 5-115; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 3:

“An evaluation of the capacity of Pit 3 and Pit 4 is presented in Appendix E. This evaluation suggests that the waste material would need to be compacted to a density of approximately 100 percent of the average standard Proctor density, assuming the pit drainage blankets can be constructed using onsite waste rock. The evaluation further suggests that the waste material would need to be compacted to an average standard Proctor density of greater than 100 percent to contain all waste material if the pit drainage blankets cannot be constructed using onsite waste rock.” [Emphasis added]

A compaction step will not be necessary. Our experience with type of material indicates that equipment traffic will provide all of the necessary compaction. Again, volume is not really a constraint.

EPA Response. *EPA would be pleased to evaluate any density data the Tribe can provide. Equipment that would be operated in the fill placement areas, including haul trucks and dozers, is not designed to achieve a high degree of compaction. In particular, dozers are tracked vehicles that are designed to have low contact pressures.*

84. Page 5-115; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 4:

“Drainage wells would be constructed to maintain the groundwater levels in Pit 3 and Pit 4 below the waste material and limit the interaction of groundwater and reactive materials. Drainage wells would be placed both above and below the basal FML. To protect the integrity of the basal FML the drainage wells would be constructed as backfilling operations proceeded. Two wells above the liner and two wells below the liner would be installed to provide redundancy in case a well were to become unproductive.”

Drain blanket and FML liner system is designed to segregate ARD water from Bedrock-BG water, thereby reducing treatment requirements and making it easier and cheaper to meet SO4 standard. Lower blanket, beneath the FML is designed to convey background influent water. The water above the FML may require treatment (if biostabilization is ineffective during construction, or if surficial FML is breached over time), but the volume will be negligible once the cover FML is in place. A sufficient number of wells should be installed for redundancy. Note that new wells can always be drilled later; however, it is recommended that the wells be installed as the pits are filled.

EPA Response. The FS assumes that water collected in the drainage system below the basal FML would contain COCs at concentrations greater than background, because some of this water would interact with reactive rock in the pit highwall that has been exposed to oxygen and water by mining activities (i.e., non-background conditions). The FS assumes this water, as well as the water collected above the basal FML, would be treated.

85a. Page 5-116; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 3:

“Water treatment would continue, as needed. The extent of treatment that would be needed is uncertain at this time. Reactive rock is present within the pit walls, including the existing backfilled pits.”

The volume would be very is small. The potential for ARD generation also is very small because the surface area to volume ratio is small and the current preferential pathways within the bedrock flow system are probably already armored by ferri-oxyhydroxides. Grouting would be used to re-saturate the bedrock flow system to also minimize production of ARD.

EPA Response. The FS includes treatment of an estimated annual volume of 5 million gallons from the backfilled pits area and 5 million gallons from Pits 3 and 4 combined under Alternative 5c. EPA acknowledges that the future water quality that would result from implementation of Alternative 5c is uncertain; however, EPA believes it would be overly optimistic to assume that COC concentrations would not exceed background concentrations. The FS recognizes that water collected from the existing backfilled pits area following waste rock removal likely would be less contaminated than water treated under current conditions, and assumes the resulting sludge production per unit volume of water treated would be one-half of current conditions. The effectiveness and additional cost of grouting have not been evaluated in the FS. The cost and benefits of grouting could be evaluated during remedial design.

85b. “Surface water and groundwater may interact with this reactive rock and become contaminated.”

This assumption is not supported and is highly unlikely. The surface area to bulk volume of the rock that has the potential to generate ARD is small. This is the reason that there is no problem today along the extensive mineralized contact elsewhere on the reservation, even directly upgradient [See Figure 29]. In summary, transport of COCs via generation of ARD or resuspension of particulates is only a problem once the rock has been crushed—intact rock that has been chemically armored over the years does not pose a threat, unless it has been disturbed and the armoring has been removed.

***EPA Response.** EPA does not agree that upgradient mineralized areas can be used to predict conditions within the Midnite Mine. EPA used data from upgradient mineralized areas that have not been mined to characterize background conditions for the Midnite Mine. Where groundwater and surface water interact with the mineralized contact that has been disturbed and exposed to air at the Midnite Mine, the potential exists for generation of ARD. As described in the response to comment 85b, the FS recognizes that this water likely would be less contaminated than water that is currently treated.*

85c. “Groundwater that seeps into the pits from bedrock also may be contaminated as a result of its interaction with unmined ore or other reactive rock that has been exposed to oxygen.”

This is the reason that grouting has been added: to re-saturate the bedrock flow system.

***EPA Response.** See response to Comment 85a.*

85d. “Therefore, it is assumed for FS analysis that water that collects in the Pit 3 and Pit 4 drainage systems and runoff and seepage within the existing backfilled pits would contain elevated levels of COCs and would need treatment.”

In light of the previous discussion this assumption is overly conservative and results in a false depiction of treatment costs in the overall analysis. Only water needing any treatment beyond approximately 1-5 yrs after construction has been completed would be water above the basal FML...all others will be at BG.

***EPA Response.** See response to Comment 85a.*

85e. “The potential also would exist for runoff water to contain COCs at levels greater than background in other areas of the drainages where ore, protore, and waste rock are excavated to bedrock. The potential would be greatest in areas where bedrock consists of schists of the Togo formation (primarily the eastern half of the site).”

See Previous comment above. Again, this should not be a major hurdle and should not require additional treatment as assumed in the FS.

Relatively little of the drainage area of the Western Drainage consists of the Togo formation.

EPA Response. Monitoring would be needed to assess whether background concentrations of COCs would be exceeded in water from other areas of the drainages where ore, protore, and waste rock would be excavated to bedrock under Alternatives 5a and 5c. EPA views it as unlikely that background concentrations would be exceeded in these areas, and the FS assumes treatment of water from these areas would not be necessary.

86. Page 5-117; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 2:

“A potential staging of construction activities under Alternative 5c includes a site preparation phase and a construction phase (MUMNRTC 2004).” Note this has changed somewhat as described above.

EPA Response. Highwall grouting and in-situ biological treatment could be evaluated during remedial design as potential measures for reducing generation of ARD. The staging of these measures has not been evaluated in the FS under Alternative 5c.

87. Page 5-117; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 3:

“Cleanup actions for MAA sediments would be implemented after completion of cap construction. It is estimated that implementation of Alternative 5c would require approximately 6 to 8 years.”

These “cleaner materials” would be placed in Pit 4.

EPA Response. The FS will be revised to note that excavated sediments would be placed in Pit 4.

88. Page 5-117; Section 5.3.9 Alternative 5c (Complete Pit Backfill including Excavation of Backfilled Pits and Water Treatment); Paragraph 3:

“Alternative 5c presents logistical problems for remedy staging because contaminated water would continue to be produced after Pit 3 becomes unavailable for temporary water storage, as described under Alternative 5a. Because material in the backfilled pits would be excavated, the construction time for Alternative 5c would be longer than for Alternative 5a, which would increase the amount of contaminated water that would need to be contained and treated during construction. The approach to containing and treating contaminated water during construction under Alternative 5c would be similar to the approach described under Alternative 5a.”

This is not necessarily correct and depends on staging. All of these construction operations could occur under current conditions and NPDES requirements. This could take a year longer, but treatment requirements would be the same.

EPA Response. We do not agree all construction operations could occur under current conditions. Pit 3 would not be available for storage of untreated water, which would present logistical problems for containing contaminated water. The excavation operations would expose very large surface areas of reactive materials to air and water, which could result in generation of water containing relatively high concentrations of ARD constituents. While volumes of water needing treatment would be approximately the same as under current conditions, the concentrations of COCs and ARD constituents would likely be significantly higher than under current conditions.

89. Page 5-118; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 3:

“Based on the results of the HHRA, the concentrations of the one or more COCs in surface water, groundwater, sediment, and surface materials must be reduced to approximately background, or the pathway eliminated, to reduce the incremental risk due to the release to acceptable levels under an unlimited use scenario. Similarly, based on the results of the ERA, the concentrations of one or more risk drivers in surface water, sediment, and surface material must be reduced to approximately background to protect ecological receptors.”

Please describe the difference between this alt and 5a. Note ground water will not require ICs. Also there is no HH concerns associated with failure of the WTP/BPits because these elements are not necessary. Therefore, this alt is more protective of future HH/ECO concerns and also drastically minimizes the potential of recontaminating downstream areas that may have undergone restoration by PRPs/MUMNRTC.

EPA Response. Alternatives 5a and 5c are compared under the Overall Protection of Human Health and the Environment criterion in the comparative analysis (Section 5.4.1 of the FS). Groundwater in all affected areas would require use restrictions until the cleanup levels are achieved. The duration of the period that use restrictions would be needed is estimated to be on the order of one to several decades under either of these alternatives. Groundwater use restrictions are anticipated within the WMA for the foreseeable future under either of these alternatives. See also response to General Comment 3. With respect to recontamination potential, Alternative 5c involves more earthmoving and associated potential for contaminated sediment release than any other alternative.

90. Page 5-118; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Last Paragraph:

“Surface Water and Sediment in Open Pits. Under Alternative 5c, the surface water and sediment exposure pathways in the open pits would be eliminated. However, if contaminated water flows exceed the capacity of the treatment system, it would be necessary to provide a contaminated water storage pond. This could occur if runoff from the existing backfilled pits area needs to be treated. Such a pond would be a potential source of exposure to contaminated surface water and sediment, similar to the existing pit lakes.”

Again, this is not likely. All alternatives share this concern.

EPA Response. It is not anticipated that the WTP could be operated under Alternative 5c without some water storage capacity. Water storage would be needed to eliminate fluctuations in flow rates entering the WTP. We agree that water storage would be required under each alternative.

91. Page 5-119; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 2:

“Groundwater Within the MA. Under Alternative 5c, use restrictions are included to reduce potential future human exposures to contaminated groundwater within the MA. After a period of recovery, which may be on the order of one to several decades, it may be possible to discontinue the use restrictions in areas of the MA from which waste materials have been removed. The use restrictions would be needed for the foreseeable future within the areas where waste materials are consolidated (approximately 80 acres).”

Site-wide use of groundwater could become unrestricted, once again.

EPA Response. We do not anticipate unrestricted use of groundwater within the WMA. See response to Comments 3 and 89.

92. Page 5-119; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 3:

“Assuming the drainage systems in Pit 3 and Pit 4 function as designed, these measures would result in containment and treatment of all water that comes in contact with mine waste, which could limit transport of contaminants from MA groundwater to surface water to very low levels. Some potential would exist for the drainage systems to fail. Should this occur, poor quality groundwater could accumulate in the pits.”

[Emphasis added.]

Perhaps, however, this not likely. All alternative share have this concern with respect to failure. The big difference between 5c and all others, is that it can be easily rectified via installing of surface extraction wells and other means.

EPA Response. *A concern with Alternative 5c is that, should water accumulate in the pits, it could develop poor quality, similar to the existing backfilled pits. There would be O&M required in perpetuity to collect and treat this water. The estimated cost of Alternative 5c does not include any cost for collection and treatment under such a scenario.*

93. Page 5-119; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 4:

• Ore, protore, and waste rock would be completely removed to pre-mining topography from the Western and Central Drainages, thereby restoring unimpeded flow to these drainages (with the possible exception of the existing backfilled pits area) within the MA and eliminating the existing seeps at the toe of the South Spoils and near the PCP. An estimated average of 55,000,000 gallons per year of runoff water within the MA from areas currently covered by mine waste would be conveyed to the drainages as clean water. [Emphasis added.]

Seems that this is a residual from Alternative 5a. If not, please explain. Does this mean the flow would be impeded in the BP area or does it imply this area will produce contaminated drainage?

EPA Response. *The possible exception noted would be for the case where the backfilled pits area produces contaminated drainage. If runoff from the existing backfilled pits contains COCs at concentrations greater than background, it would be collected for treatment. This could occur due to contact with reactive rock exposed in the highwalls of the backfilled pits or due to mixing with contaminated seep water.*

94. Page 5-119; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 4:

“• Surface water quality in the drainages would be improved because discharge of groundwater to the drainages would be reduced from an estimated average of 17,000,000 gallons per year to an estimated average of 12,000,000 gallons per year, and the quality of this groundwater probably would be improved.”

• An estimated average of 10,000,000 gallons per year of water would be collected in the existing open pits and backfilled pits areas. This water would be treated using the existing active treatment process.”

Please cite this analysis. In light of the earlier discussion, 20 gpm (1M gpy) is higher than WTP requirement estimates and higher than anticipated.

EPA Response. *The procedure used to estimate the average annual volume of water that would be treated under Alternative 5c (10 million gallons) is described in Appendix C of the FS.*

95. Page 5-119; Section 5.3.9.2 Overall Protection of Human Health and the Environment; Paragraph 4:

“As a result of these source control and water treatment actions, the estimated average uranium load in the Eastern Drainage under Alternative 5c would be reduced to approximately 29 pounds per year, compared to an estimated 100 pounds per year under current conditions and more than two orders of magnitude less than the estimated uranium load of 10,000 pounds per year under Alternative 1 (Appendix F). This limited analysis suggests that the average uranium concentration in Blue Creek may be reduced to the background concentration over time.”

Again, this incorrectly assumes current water quality. The short-term quality of water entering the pits from the bedrock flow system will be more similar to the current concentrations measure in Pit 4 which is much different than a site-wide mixture. (See General Comment No. 6).

EPA Response. The uranium load in the Eastern Drainage was estimated based on measured uranium concentrations in the WTP effluent and background surface water and groundwater concentrations. Please refer to Appendix F of the FS for details of the analysis. The estimated uranium load in the Eastern Drainage under Alternative 5c is larger than under some other alternatives because the estimated flow in the Eastern Drainage is larger.

96. Page 5-119; Section 5.3.9.4 Long-Term Effectiveness and Permanence; Paragraph 5:

“Sediment. The evaluation of residual risks due to sediment is the same as under Alternative 5a.” This statement is incorrect. The ground water to surface water pathway is still active in 5a. Partitioning between surface and sediment will continue to occur allowing for reconcentrating COCs in downstream sediments.

EPA Response. The FS assumes that a recovery period that is on the order of one to several decades would be required to achieve RAOs for groundwater under both Alternative 5a and Alternative 5c. During this recovery period, there would be some potential for recontamination of sediment as a result of precipitation of COCs in the water column. The potential for recontamination would be considered in planning sediment response actions during the remedial design and remedial action phases.

97. Page 5-120; Section 5.3.9.4 Long-Term Effectiveness and Permanence; Paragraph 6:

“FML cover. Covers that include FMLs would further limit water percolation and radon flux compared to soil covers that do not include FMLs. The FML would mitigate the effects of potential damage resulting from erosion or other factors (see discussion of protective covers under Alternative 3c). However, over the long term, the FML

would be subject to deterioration, and reducing percolation and radon flux would primarily be accomplished by the soil cover.”

This cover could be replaced as will be necessary as is done on all RCRA disposal facilities that use FMLs.

EPA Response. The FS does not anticipate replacement of the FML, in part because of the adverse effects that would result from removing the vegetative cover above the FML. The vegetative cover would provide for erosional stability and would reduce the potential for percolation of water into the waste material. The FS does not include O&M costs for replacement of the FML, including associated increases in water treatment requirements while the cover is being replaced. These costs would increase the estimated cost of Alternative 5c.

Note that the assertion that all RCRA facilities that use FMLs replace the FMLs as necessary is overly broad. While periodic FML replacement may be a requirement at individual facilities, such an action is costly, as it would require removal and reconstruction of the overlying soil cover and destruction of vegetation established on it. If an FML liner underlying a vegetated soil cover becomes ineffective, appropriate modifications should be evaluated, such as local repairs, rather than automatically requiring the disruption of replacing the FML.

98. Page 5-120; Section 5.3.9.4 Long-Term Effectiveness and Permanence; Paragraph 7:

“Lake Roosevelt discharge pipeline. The pipeline would be susceptible to damage from erosion and slope movement. It would run through uncontrolled areas, and could be damaged by excavation activities. Periodic inspections and maintenance would be needed to identify and repair any damage.”

The pipeline will only be needed during construction phase. The new WTP can be used to meet TSWQS and discharge to the MA. The pipeline should remain in the event of catastrophic failure of WTP.

EPA Response. The FS will include a table of costs for modifications to the WTP to remove sulfate to the TWQS. It is anticipated that sulfate concentrations in site water collected for treatment would exceed the TWQS following construction.

99. Page 5-124; Section 5.3.9.4 Long-Term Effectiveness and Permanence; Last Paragraph:

“Under Alternative 5c, residual risks to tribal members and tribal resources would be reduced from current conditions. However, residual risks would continue to exist in surface materials, surface water, groundwater. Risks from these media would be managed through use of institutional controls. This includes restrictions on the WTP (3 acres), water storage pond (5 acres) cover area (80 acres) and sludge disposal site, if

any (1 acre). Reliance on institutional controls and information programs lacks certainty at this Site due to unique regulatory structure (e.g., limited Tribal mechanisms, allottee rights and federal jurisdiction).” [Emphasis added.]

Residual risks would be incurred only prior to and during construction until after construction. Then such risks will be minimal. Water storage pond is not necessary and appears to be a residual from another Alternative.

EPA Response. *The reference to residual risks from exposure to surface materials will be deleted from future revisions of the FS. The potential for residual risks from exposure to groundwater and surface water would continue until background concentrations are achieved in these media. It is estimated that a period of recovery that would be on the order of one to several decades would be needed until background concentrations are achieved in these media under Alternative 5c. It is anticipated that a water storage pond would be needed under Alternative 5c to eliminate fluctuations in flow rates entering the WTP.*

100. [Not submitted by the Tribe]

EPA Response. *No response needed.*

101. Page 5-125; Section 5.3.9.5 Reduction of Toxicity, Mobility, or Volume Through Treatment: Paragraph 1:

“Alternative 5c includes treatment of contaminated water collected in the pit drainage systems using an active ex-situ treatment process, which is described in 5.3.1.4. Under Alternative 5c, the toxicity of an estimated average of 10,000,000 gallons per year of contaminated water would be reduced using active treatment. The water treatment sludge would be dewatered and solidified to reduce the potential for leaching of COCs. The process would produce an estimated 60 tons of dewatered and solidified sludge per year. The active treatment process is considered irreversible; i.e., no significant remobilization of COCs would be expected assuming the sludge is disposed of such that it is not subject to leaching.”

Grouting and Biotech should get credit here as well.

EPA Response.

Highwall grouting and in-situ biological treatment could be evaluated during remedial design as potential measures for reducing generation of ARD. The additional cost, effectiveness, and implementability of these measures have not been evaluated in the FS under Alternative 5c.

101. Page 5-127; Section 5.3.9.5 Reduction of Toxicity, Mobility, or Volume Through Treatment: Paragraph 7:

“Availability of Services and Materials. Considerations related to the availability of suitable cover materials are described under Alternative 3c. Considerations related to

the availability of offsite sludge disposal capacity are described under Alternative 2b. These considerations would be reduced under Alternative 5c because the required cover material volumes and estimated sludge volumes would be lower. The estimated volume of soil required for cover construction is 700,000 cubic yards. Cover materials would not be needed until complete backfilling of the pits was completed. As a result, identification and development of cover materials sources may not impact construction scheduling. There are adequate sources of labor, equipment, and reagents to conduct active water treatment and dewater and solidify the sludge.”

The local labor force has specialized KSA’s associated with reclaiming uranium mines using dirt moving activities.

EPA Response. *Comment noted. The availability of services for earthwork activities was not anticipated to be a limitation in the evaluation of implementability in the FS.*

102. Page 5-128; Section 5.4 COMPARATIVE ANALYSIS: Paragraph 7:

This section should be revised taking into account all previous comments/concerns. Also Alternative 5c appears to be missing from the analysis.

EPA Response. *The comparative analysis will be revised and updated as appropriate. Alternative 5c is included in the comparative analysis in the draft FS provided for the Tribe’s review, but the heading begins with Alternative 5a and Alternative 5c is later in the heading.*

Tables and Figures

1. Table 5-7 incorrectly describes RAOs for Surface water. Note the TSWQS does not list U total separately, but the sum of all U species cannot exceed 0.3 pCi/L. Therefore, the ARAR for U total is 0.3 pCi/L (approximately 0.3 ug/L). The SDWA is incorrectly used to set the RAO for surface water as well. If EPA plans on using GW as a surrogate, then the HSCA is the ARAR (background).

EPA Response. *See response to Comment 11*

2. The values in Table 5-8 should be calculated to reflect hardness for the receiving waterbody, Blue Creek. The lowest hardness (4 consecutive days out of the year) for Blue Creek is more on the order of less than 25 mg/L. Because the equations used to calculate the numeric standards are not applicable for hardnesses less than 25 mg/L, the standards should be calculated using a hardness of 25 mg/L.

EPA Response. *See response to Comment 11. A footnote will be added to clarify that the ARAR is the mathematical formula, and that the hardness of the receiving water will be used to determine compliance with ARARs.*

3. [Not submitted by Tribe]

[EPA Response. No response needed]

4. Table 5-9. Again HSCA GW is not used as an ARAR

EPA Response. *The numerical groundwater standards in HSCA are listed in Table 5-9. These numerical standards are less than background concentrations, hence, the background concentrations are used as the potential ARARs.*

5. Table 5-10. Not sure how HSCA values are being calculated. They should be at background, not lower.

EPA Response. *Table 5-10 shows numerical standards listed in HSCA. Since these are less than background, the background concentrations are used as the potential ARAR.*

6. Table 5-11. Not sure how HSCA values are being calculated. They should be at background, not lower.

EPA Response. *See response to Comment 5.*

7. Concerned that construction costs are still overstated Table 5-20 and 5-21 (5a & 5c)

EPA Response. *It is not clear what element(s) of the cost estimate this comment refers to. We note that the estimated unit cost for the largest element of cost under Alternatives 5a and 5c, consolidation of mine waste in the pits, is \$1.98/cy, which is very similar to the unit cost estimated by the Tribe (\$1.85/cy).*

8. Table 5-23 Sludge production assumes chemistry is consistent, yet the says best scenario is that it would achieve Pit 4 WQ.

EPA Response. *We believe the best-case water quality in Pit 3 would be similar to the current water quality in Pit 4. This best-case water quality probably could only occur if storage of seep water in Pit 3 was discontinued, or if in-pit treatment of Pit 3 water was conducted. For the purpose of estimating costs in the FS, the best-case water quality scenario for Pit 3 was not used. Rather, it was typically assumed (Alternatives 2b, 3c, 4e, and 5a) that water quality and unit sludge production (the volume of sludge produced per 1,000 gallons of water treated) would be similar to current conditions. Under Alternatives 3d, 4d, and 5c, it was assumed that unit sludge production would be one-half of current conditions because these alternatives either include in-situ treatment that would likely reduce COC concentrations in the WTP influent (Alternatives 3d and 4d) or would likely treat less-contaminated water (Alternative 5c).*

RESPONSIVENESS SUMMARY – ATTACHMENT C

**EPA Response (dated August 2, 2005) to WDOH
Comments on the Human Health Risk Assessment**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

MN MCF 2.5.2.2
MMEAR

FOIA OK
AR yes
8/02/05

August 2, 2005

Reply to
Attn Of: ECL-115

Gary Robertson, Director
Division of Radiation Protection
Washington State Department of Health
PO Box 74827
Olympia, WA 98504-7827

Re: Midnite Mine Draft Human Health Risk Assessment

Dear Mr. Robertson:

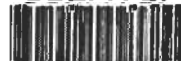
The U.S. Environmental Protection Agency (EPA) received your letter dated June 20, 2005 providing Washington Department of Health (DOH) comments on the EPA's January 2004 Midnite Mine Draft Human Health Risk Assessment (Risk Assessment). The Risk Assessment has already been initially revised to address inconsistencies and errors identified by reviewers. Based on DOH comments, EPA may make additional revisions prior to finalizing the Risk Assessment later this year.

We intend to publish the Risk Assessment as part of the Remedial Investigation (RI) and Feasibility Study (FS). We believe that the descriptive information in the RI about sampling objectives, locations, and methods, as well as the results of our data evaluation and development of cleanup objectives will help clear up misunderstandings on the part of the reviewers with regard to background characterization, radon measurements, soils and other important matters. The text in the Draft Risk Assessment quoted in DOH Comment #13 regarding a sampling bias will also be clarified.

Several of the DOH comments focus on assumptions related to Tribal subsistence uses of the affected area (e.g. soil ingestion, use of surface water for drinking). EPA's project team worked closely with the Spokane Tribe of Indians (Tribe) in developing the risk assessment scenarios and assumptions for the Midnite Mine site. Where scientific data or relevant studies did not conflict with the Tribe's input regarding exposures from traditional practices, EPA accepted the Tribe's assumptions and acknowledged the uncertainties associated with these and other assumptions in the risk assessment.

The DOH comments state that "The human health risks reported in the RA may be so overestimated as to be orders of magnitude higher than they would be in actuality." We feel that DOH greatly overstates the significance of uncertainties in the risk estimates, and we support our views in the enclosed response to comments. Rather than

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seek to specify the combined effect of the uncertainties; however, we wish to underscore that the primary purpose of the risk assessment is to determine whether risks and hazards are sufficient to trigger the need for remedial action. Even omitting scenarios and pathways with potentially significant uncertainties, site-related risks (risks above risk from background) are well above the threshold for remedial action. As shown in Table 5-13, excess risks from the radiation exposure and radon inhalation associated with mere presence in the mined area (using worker hours or residential hours) is sufficient to warrant remedial action. This fact remains whether EPA relies on soil concentrations of radionuclides or direct radiation measurements to estimate external radiation exposure.

A second purpose of risk assessment is to support the development of risk based concentrations (RBCs), concentrations of contaminants in environmental media below which site risk levels are acceptable. RBCs are considered in the development of site cleanup levels, particularly where regulatory values are unavailable. EPA used tribal assumptions from the risk assessment to develop RBCs for water (based on ingestion and on combined ingestion and vapor inhalation) and for soil (based on ingestion). While assumed soil and water ingestion rates are higher than default rates, the differences in the rates are not large. Since these RBCs were lower than background levels for key risk drivers, soil and water RBCs that would factor in meat and plant ingestion were not necessary. Instead, background concentrations will serve as the basis for remedial action objectives and cleanup levels for risk drivers. Uncertainty in the Midnite Mine exposure assumptions does not alter this conclusion.

Finally, risk assessments are sometimes used as a risk communication tool for affected communities. In this area, EPA agrees with DOH that the Risk Assessment is not a reflection of current conditions. We hope to work with the Tribe and DOH to develop clear and helpful public information about the risk assessment, its function, and how the local community can take steps to minimize their exposure to Midnite Mine impacted media.

EPA responses to the comments you provided in your letter are enclosed, with EPA responses in *italic* following each DOH comment. If you have any questions about this letter or the enclosure, please contact me at (206) 553-1215.

Sincerely,



Ellen Hale
Remedial Project Manager

Enclosure

cc: Randy Connolly, Superfund Coordinator, Spokane Natural Resource Department
Robert Nelson, Dawn Mining Company

EPA Response to DOH Comments on Midnite Mine Draft Risk Assessment

Note: EPA responses are in italic text following the DOH comments (dtd June 20, 2005).

DOH General Comments

Future potential risk versus current risk

The RA acknowledges that many exposure assumptions overestimate risk, and that traditional tribal lifestyles result in potential exposures that are much greater than typical default exposures. It is understood that these exposure assumptions are designed to predict theoretical future exposures in the event that people practice a traditional lifestyle within the boundaries of the Mined Area (MA) and/or Mining Affected Area (MAA). Since the RA is geared to look at potential future use, the RA does not estimate what current risks are, nor is there any attempt to quantify current human use of the site. Therefore, readers should not interpret the results of the RA as indicative of current exposure.

EPA generally agrees with this comment. EPA also agrees that careful risk communication is appropriate to make these points clear to the community.

Background Risks

The RA estimated cancer risks in some cases that approach 100%, and hazard quotients that exceed 100,000. Risks and hazards predicted using the future tribal exposure scenarios are such that it is necessary to frame them in reference to background exposures. Tables 5-13 through 5-18 show risks associated with residential and non-residential traditional lifestyle exposures on the MA and MAA in relation to risks occurring in the background area. In general, background risks are less than MAA risks and less than MA risks.

That said, the text mentions that radionuclides in the background area are generally twice the national average (page 3-2, first sentence), but it is not clear from the text where background reference areas are located and if those areas are representative of the conditions at the MA and MAA prior to impacts from mining activities. It is important to note that this is a natural, heavily mineralized zone, and so pre-mining conditions at the site would naturally have large concentrations of radionuclides and metals. The text cites a 2003 URS document, *Draft Technical Memorandum for Suitability of Background Sampling Used to Establish Site Impacts on the Midnite Mine Superfund Site*, but there is no other mention of the background area suitability. We question if there are surface water or ground water data at the site located above mining activities that may best reflect what the natural background conditions are for radionuclides and metals.

In the absence of quantitative data regarding pre-mining conditions at this site, background areas and sample locations for Midnite Mine were selected consistent with EPA risk assessment guidance and background policy, which state that background constituents or locations should not be influenced by activities on or releases from the site but should have the same basic

characteristics as the site. Upstream surface water and upgradient ground water data are available and are included in the background data set; however, EPA does not believe that these areas alone reflect natural background conditions.

DOH has previously commented on the background estimates for this site. EPA has published several Quality Assurance Project Plans, a Technical Memorandum on the Statistical Approach for Discrimination of Background and Impacted Areas for Midnite Mine RI/FS (Oct 5, 2001), and a Technical Memorandum Evaluation of NURE Data (October 15, 2001). These reports are posted on the Midnite Mine website and were shared with DOH. Because the risk assessment is not a stand-alone document, EPA may add text that references these documents and the Remedial Investigation.

Early childhood exposures and cancer risk

What considerations, if any, were used to adjust the cancer risk associated with early life exposure to mutagens as outlined in EPA's draft supplemental guidance for assessing cancer susceptibility from early life exposure to carcinogens?

Radionuclides are the primary cancer risk contributor at the site. Radionuclide cancer risks are calculated for lifetime exposure, taking into account differences in sensitivity to radiation as a function of age. The increased sensitivity to early life exposure to radionuclides is therefore incorporated in the lifetime risk estimates and no additional corrections were made.

DOH Specific Comments

1. Background subtraction. The standard method for risk assessments corrects for background prior to reporting the results. Background corrections may result in minor corrections for some pathways but would make a profound difference in the reported impacts from others. Reporting only the net cancer risk is the only unbiased method of presenting the results.

Describing background contributions in the risk assessment is consistent with the EPA policy of fully, openly, and clearly characterizing risk. In accordance with the National Contingencies Plan (NCP), CERCLA decisions about the need for remedial action are based on the excess risk, or "net risk." Total risk estimates can be used to approximate excess risk where the background risk contribution is negligible. Because background adds significantly to the total risk at the Midnite Mine site, however, the risk assessment for Midnite Mine includes tables showing background, incremental, and total risk estimates for transparency.

2. Radon estimates (Section 3.2.2). A predicted 1 pCi/g soil gives 1.25 pCi/l in indoor air. Using an assumed soil concentration for the MA and MAA of ~108 pCi/g Ra-226 yields about 136 pCi/L for indoor air (according to the RA). The quoted relationship is based upon existing homes and would not be indicative of the indoor radon concentration in newer homes. Assuming basic construction techniques such as a ventilated crawl space

or a poured concrete slab, DOH estimates these values to be high by at least a factor of 2, with a more likely correction to be a factor of 5 or 6. The resulting indoor radon concentrations for an assumed soil concentration of 108 pCi/g would be in the range of 9 to 45 pCi/L. Correcting these results for a background radon mean of 5 pCi/L yields a net concentration of 4 to 40 pCi/L. The resulting risk (net of background) would be in the range of 2.7×10^{-3} to 4.5×10^{-2} . This is compared with 0.2 in Table 5-1 (likely a calculated error factor of 4 to about 70). This neglects consideration that all homes within Washington State require a vapor barrier or that homes within Stevens and Spokane County require the installation of a passive stack to reduce indoor radon concentrations. Although these codes do not apply to the Spokane Tribe, the incorporation of standard building practices should be assumed.

Baseline risk assessments are intended to evaluate site risks in the absence of remedial actions. To EPA's knowledge, the Spokane Tribe does not have building codes requiring radon resistant construction methods and HUD is not required to meet State of Washington or Stevens County code in their construction. As in other rural areas, mobile homes are commonly used in place of more permanent home construction. It is not appropriate to assume radon resistant construction techniques or building codes in the baseline risk assessment where none exist currently. The assumption that future construction would be similar to existing homes was reasonable, conservative, and consistent with the objectives of a baseline risk assessment.

3. Outdoor radon. DOH staff could not locate detailed information on the outdoor radon measurements. Were measured results obtained at 2 meters in height? Were flux measurements obtained and then converted to an airborne concentration? What were the conditions at the time of measurement? The RA provides insufficient detail on the measurements and calculations to verify the results. Due to air diffusion patterns, an airborne concentration of 9 pCi/L would be extremely difficult to obtain in an outdoor environment at 2 meters in height. More information to support the outdoor radon measurements must be included.

Outdoor radon samples were collected in both the Mined Area and in background areas. Radon measurements were made using alpha track detectors over periods of 6 to 8 months to obtain long term averages. Samples were obtained at approximately 2 meters above surface level at surface sampling locations. Background locations included those influenced by natural mineralization. The collection of radon samples is described in the Phase 2A/1B RI/FS QAPP. EPA will consider adding this information to the risk assessment or referencing the QAPP and Remedial Investigation report.

4. Soil ingestion. Given crop growing periods, annual snow cover of several months, and more limited soil contact during winter activities, it is highly unlikely that the 300 mg/d intake rate could possibly represent a lifetime ingestion rate. This subject has been discussed numerous times over the past four years. The supporting arguments contained in the RA might be compelling for a short-term exposure period but are lacking for a 70-

year, 365-days/year exposure. A significant correction is required to align this ingestion rate with an RME for the Spokane Tribe.

Region 10 does not assume reduced soil ingestion rates based on anticipated snow cover. While snow cover is likely to reduce direct soil ingestion, indirect soil ingestion exposure pathways would persist (i.e., studies have demonstrated that soil derived house dust is a significant source of exposure, especially for children) (Succop, Bornschein et al., 1998; von Lindern, Spalinger et al., 2003). There are other uncertainties that could affect soil ingestion: winter mud, wind, and sparse vegetation could increase the amount of soil present in house dust; outdoor activities vary over the year; consumption of roots with residual soil may occur year round; paving and lawns may be less prevalent in rural areas than in many urban and suburban settings. The Risk Assessment discussed uncertainties associated with the soil ingestion rate used on Midnite Mine. In the absence of tribal-specific soil ingestion studies, however, it is reasonable and protective to assume that tribal soil ingestion rates may be greater than CERCLA default rates (Simon, 1998).

5. Animal calculations. The operating assumption is "Assuming all meat needs are met by animals foraging within the boundaries of the site." However, the exposure pathways sections clearly state that wild game is the assumed ingestion endpoint. Small animals, such as field mice, would be the only meat source that forage exclusively within the boundaries of the site; therefore, correction factors are required since the operating assumption (wild game foraging within the boundaries of the site) is inherently flawed. Appendix E provides details on how the calculations were performed. Cattle were modeled as a surrogate for wild game. Assuming the size of the land as $1.4 \text{ E}+06 \text{ m}^2$, the estimated forage correction factor for the site would reduce the pathway risk by roughly 1,300 times less than that currently estimated. The range of mule deer is approximately 40 to 50 square miles. Not including this correction factor results in a serious overestimate of the predicted pathway risk.

A simple and direct approach was used to assess risks from animal consumption given the absence of tissue samples from wild game. If representative wild game samples had been analyzed, they would have been useful to assess risks associated with subsistence consumption, but the relative contribution from the site versus other sources of naturally occurring COCs would remain uncertain. Therefore, exposure from on-site sources of animal protein was modeled using uptake factors for cattle (Oak Ridge National Laboratory, 2002). The Risk Assessment states that this approach is likely to overestimate risk, based on a variety of factors. However, beef was used as a surrogate for a traditional subsistence diet which could include diverse protein sources composed of animals with varying home range areas (e.g., fish, reptiles, amphibians, birds, and small mammals) (Harper, Flett et al., 2002).

If meat exposure consisted primarily of game with large ranges, then risks would be overestimated to a larger degree, but likely less than 1,300 times. For example, a crude correction factor would divide the site area by the relevant home range (e.g., for mule

deer this would approximate 0.5 square miles divided by 50 square miles for a correction factor of 100). Interestingly, a 1987 study of Blue Creek fish tissue samples shows comparable contaminants concentrations in fish tissue and in the Risk Assessment model results for beef tissue.

6. Water calculations. The use of surface water as a source for long-term drinking water consumption is not realistic. Water-borne biotic issues alone would prevent this from occurring for anything other than a short-term exposure. A correction factor should be applied to account for reductions in activity during the water treatment process if surface waters and runoff ingestion are included in the analysis.

We acknowledge that uncertainties related to water consumption are likely to overestimate site risks. However, ingestion of surface water is a reasonable exposure pathway for a traditional subsistence use scenario. Treatment to address pathogens (e.g., iodine, filtering, or boiling) would not address concentrations of contaminants of concern.

7. Plant calculations. The operating assumption is that 100% of plants are grown or obtained from the site. This assumption seems unlikely for a number of reasons:
 - First, this is in direct conflict with the statements made at the beginning of the RA. Namely, “the mined area is defined by visible disturbances at the ground surface (e.g., an absence or paucity of native vegetation and topsoil, bare rock, obvious grading, and stockpiled ore, waste rock, and topsoil).” Realistically, a farming community (of any size) could not be developed without significant redevelopment and the introduction of topsoil that would allow for adequate crop production to meet the needs of the population of interest. Are the areas where the biased sample collections were performed the same locations that plant production is likely to occur?

The plant exposure pathway is based on plants gathered from the site. Agricultural activities were not assumed to occur on site. The Hanford exposure scenario, which includes agricultural uses, was discussed to describe uncertainties related to plant production and sustainability requirements. The Spokane Tribe did not provide EPA with specific information regarding likely plant harvest species or locations.

- Second, no discussion is provided about grain consumption. Even in a subsistence setting, the production of grain is usually included and did not appear to be considered in this RA.

Grain was not included in the exposure scenario developed by the Tribe (Harper, Flett et al., 2002). Consequently, suitability for grain production was not addressed.

- Third, the RA does not contain any data or discussion about the soil contamination depth and how this relates to the farming community onsite. This

information is critically important in determining whether the contamination exists in the effective root zone for a given type of food crop. Effective root zones can vary anywhere from 6" to 3' depending upon the food product.

In developing the risk assessment work plan, EPA initially attempted to correlate soil contaminant levels with plant tissue levels, but given uncertainties in the uptake factors, EPA used plant tissue data collected by Dawn Mining Company, as described in the Human Health work plan. (URS Corporation, 2001). Root contaminant concentrations used in the risk assessment are a good indication of what contaminants are in the effective root zone. EPA selected plant COPCs based on whether the soil contaminants were elevated relative to background, and modeled plant tissue concentrations only for contaminants not analyzed in plant tissue.

- Fourth, no correlation was made between the plants collected and analyzed onsite to the plants likely required to satisfy 100% of the daily volumetric (and caloric) requirements. Without a detailed analysis of the likely plants that could be grown in the area, the effective root depth of those plants, and how they would relate to the plant data obtained, any plant pathway calculations would simply be a guess.

The risk assessment acknowledges uncertainty in how closely the plants sampled approximate the tribal diet. However, a detailed analysis of the likely plants that could be grown in the area is not necessary, as the wild plants in the tribal subsistence diet grow in the area naturally.

- Fifth, many references for human consumption patterns exist to establish the fact that no location can likely produce all dietary needs. Previously published analyses assumed that 62% of fruit and vegetables are grown locally for Native American exposure scenarios. The section on plant ingestion acknowledges the limitation for sustainability but provides no correction in the predicted events based upon this limitation. Even 62% would likely be a high bias for the mine site.

Uncertainties related to the assumption that 100% of plants in the subsistence diet originate from the site are discussed in the Risk Assessment, Section 5.7.3. It is unclear whether DOH considers 62% a high bias for a combination of plant sources in the mined area, mine affected drainages, and Blue Creek. Productivity in these areas may differ.

- Finally, no correction is provided for the limited plant growing season in the area and the yield that would be required for an assumed seven-month growing season (frost-free days with a mean temperature of at least 10°C). All of these factors would have to be considered in order to arrive at a reasonable estimate of onsite food consumption and production.

Subsistence plant gathering would rely on native plant species endemic to the area. Growing season is already accounted for. To determine specific yield in this context

would require detailed information about which plants are significant elements of the subsistence diet and where and when they could be gathered.

8. Exposure point concentrations (EPC) (Section 5.7.2). EPCs were based entirely on plant roots. This is acknowledged as biasing high the contaminant concentrations. This approach works for small volumes of medicinal plants but is not supported when one uses EPCs for plants and the uptake volumes required.

As discussed in the Risk Assessment, roots were selected to represent exposure to plants because information regarding the plant utilization preferences of the Spokane Tribe were unavailable to EPA. Available data from the site (Shepherd Miller Inc., 1999b; 1999a) indicated that the use of root data would be more health-protective, as the concentrations were generally higher. Many subsistence diets rely heavily on plant roots. Concentrations for lead-210 and radium-226 were estimated from soil uptake factors, because plant samples were not analyzed for these parameters. The uptake factors used, from the Oak Ridge National Laboratory's Risk Information web site (http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=nrad), are based on whole plants, not just roots. These two contaminants contributed most to the cancer risk estimates for this pathway.

9. Blue Creek. 100% of soil ingested is from sediment at Blue Creek. In a situation such as this, one should correctly apply a correction factor for the amount of time spent near the creek beds and fraction of time spent obtaining food products contaminated from creek bed sediments. Not all soil ingested would be contaminated. DOH Radiation Protection staff have conducted a separate review of Blue Creek water and sediment data. The results of this review will be forwarded to you in a separate letter. One of the major conclusions of this review is that there are other plausible sources for radionuclides and metals found in the water quality and sediments in Blue Creek below the confluence with Oyachen Creek and associated with the Blue Creek delta. Water quality and sediments in lower Blue Creek and its delta may reflect natural conditions associated with a series of uranium mines that are in close proximity to the delta and lower Blue Creek, as opposed to an indication of impacts from the Midnite Mine located miles from the delta.

Lacking a sound basis for a time-weighted soil ingestion rate, EPA presented site risks by area, assuming 100% of soil ingestion in each. This facilitates comparisons between areas, provides an upper bound on soil ingestion risks from any single area, and provides information to the community for risk reduction measures.

EPA notes that while there are other natural sources of metals and radionuclides in the area that provides sediment and surface water to Oyachen Creek, mineralized areas were also sampled to determine background levels for the Remedial Investigation. Background levels were used to select COPCs for quantitative risk assessment by area, and the reduced list of COPCs used for Blue Creek sediment and water exposure point concentrations reflects the fact that conditions change with distance from the Mined Area. Note that to reflect potential subsistence uses in affected areas of Blue Creek, the

exposure point concentrations for Blue Creek water and sediments include data from all samples below the mine confluence.

10. Missing from the RA is a discussion of the viability of the wells drilled at the MA and MAA. Historical data from the U.S. Bureau of Mines (USBM) for the Midnite Mine site indicate that water quality can be good once you drill deeper than 50' into the bedrock. However, fractures are few and the production is low. At the contact of alluvium with bedrock, production is a little higher but the water quality is poor. Well production information from two USBM reports published in the 1990's indicates that well production ranged from 0.05 gal/min to 0.3 gal/min. To put these water production rates into perspective, banks typically require a minimum of 5.0 gal/min before they provide financing, with 10+ gal/min desired for the type of operations considered in this RA. In order to support a resident lifestyle in the MAA and MA areas, obtaining sufficient water of good quality is critically important. In this instance, further analysis would be required to determine what type of production onsite is supported by a well. It is entirely possible that water production onsite might be insufficient for any activities. There is nothing wrong with recognizing this limitation in a RA and incorporating it into the analysis.

EPA and the Tribe did not make a determination regarding whether well yield and water quality would support the uses evaluated in the risk assessment. However, it is not essential that the four liters of drinking water come from a single source or that the source be limited to groundwater. Subsistence residents are assumed to use the surrounding area for water, including residential wells, springs, seeps and surface water sources. The amount of water necessary to secure a loan and the quality of the water has limited relevance.

Yields for some alluvial and bedrock wells may be low, but some areas of the unconsolidated zone potentially could supply water (instantaneous) at 5 to 10 gallons per minute (EPA pump test data were not directed at answering this question, and monitoring well locations were not selected to maximize yield). Hydraulic conductivity ranges widely in bedrock, and well yield depends on whether the screened interval of the well intercepts a productive fracture(s). Workers at the mine (when it was active) obtained water from an on-site well, and it seems reasonable that residents would be able to locate a well with sufficient yield somewhere in the affected area.

11. Section 5.5 of the RA states the following, "Risk estimates based on measured radiation fields are more certain than other measurements because they are more direct measures of exposure than other types of data and require fewer human activity assumptions to estimate risk." In spite of this clear statement of intent, the RA chose to use estimated gamma exposure rates based upon soil concentrations—although numerous direct measurements at the site had already been obtained. The risks from soil-derived external exposures were a factor of three (3) greater than the risk estimated from directly measured exposure rates onsite. The action (of using the derived external exposure rates) in this single exposure pathway highlights a number of significant issues. First, the modeled data (i.e., the derived external dose rates from soil concentrations) do not match

the actual measurements obtained with a large margin of error, and no effort was apparently made to correct the modeling error. Second, it is likely that the soil concentration used as the input activity was biased high and is therefore a contributor to the error observed. Finally, high input soil concentrations would affect a number of other pathway calculations and would lead to a bias in all other areas observed.

EPA guidance generally recommends using estimates of radiation risk derived using slope factors in a similar manner to that used for chemical contaminants. Slope factors provide an estimate of risk calculated from contaminant concentrations. In some instances it may be appropriate to also consider estimates of risk based on direct measurements of radiation exposure. In such cases exposure rate data should be used in conjunction with, rather than instead of, characterization data of radionuclide concentrations. At Midnite Mine, gamma measurement data was used in the risk assessment to provide perspective on risks calculated based on soil concentrations and to support the evaluation of uncertainties.

Although risks calculated from direct gamma measurement were approximately three times lower than those calculated from soil concentrations, the risk estimates include uncertainties that are probably greater in magnitude than the difference between the two measurement methods. The difference in risks based on the two methods does not materially alter the conclusions of the risk assessment.

In addition to EPA guidance, there were other reasons for relying on the soil concentration-based risks. Field gamma measurements do not have the same level of quality assurance as soil data from a fixed lab, and soil data were being used for other exposure pathways. As discussed above, while there may be a measurement bias, RI soil sample locations in the MA and downwind areas were selected using a stratified random sampling approach, and these measurements are not likely to result in a bias based on sampling approach. The factor of three difference between the two measurement methods does not necessarily indicate a bias in all soil data. It could affect estimates of risk from radiation exposure, from ingestion of radium and its decay products in soil, and indoor radon (which was calculated from soil concentrations). Again, these effects would not alter the risk conclusions.

12. Gamma calculations continued. Section 5.7.2 continues the discussion of the reasoning behind the use of soil concentration values, by mentioning that the “uncertainties associated with corrections to existing field data for instrument calibrations are recognized.” The uncertainties associated with corrections are minimal if performed correctly and would be a fraction of the large bias included by using a bias soil concentration for the airborne exposure rate.

The uncertainties of concern were related to methods used in previous investigations. Additional sampling and cost would have been necessary to minimize the uncertainties, and it was not clear that substantial improvement in decision making would result.

13. Section 5.7.2. "Many of the samples collected at the Midnite Mine were biased high because they represent where contaminants were most likely to be concentrated." DOH staff could not locate any discussion of the data correction to compensate for the bias in sampling. Since the sampling regime should have been for (or to aid in) a site characterization, the lack of a standardized approach to the collection methods and locations is a serious error that results in an un-quantified bias in the entire RA.

The statement from the risk assessment is worded overly broadly and clearly needs to be revised. EPA used a standardized approach for the RI, and to the extent possible we incorporated existing data. RI soil samples, as noted above, were selected using a stratified random sampling approach, and within a given drainage, sediment and surface water sample locations were also selected randomly. RI wells were located systematically, though not randomly, to provide relevant hydrogeologic data and to characterize conditions in the mined area and mine affected areas. Individual wells used in the risk assessment were selected to show a range of conditions. We do not believe that a systematic bias in developing exposure site concentrations exists.

14. Sweat lodge radon. There are two potential sources of radon in a sweat lodge. First, soil Ra-226 activity directly beneath the sweat lodge could potentially contribute to an airborne radon activity within the sweat lodge. Basic calculations can show that the positive pressure gradient associated with the sweat lodge (in use) will inhibit radon entry and result in the radon emanating through the soil to move around and out of the sweat lodge. This would result in a negligible radon concentration within the sweat lodge from this source. The second source is Ra-226 (and progeny) contained within the contaminated water used for the sweat lodge. The radon gas released from the water used in a sweat lodge would take time to reach an equilibrium with the progeny. Achieving an equilibrium similar to a home environment (i.e., an equilibrium factor ~0.4) would take at least five half-lives (~30 minute half-life) and would significantly affect the estimated risk. Recall that the dose from radon alone is about a factor of 10 less than the dose from the progeny. Even though the radon contribution to risk from the sweat lodge is small in comparison to other reported risks, a detailed analysis of this exposure pathway would likely result in a significant reduction in the calculated risk.

Residential exposures to airborne radon were assumed to occur over 24 hours, of which 12.5 hours were spent indoors. Technical information and data to determine pressure gradients and radon equilibrium fractions specific to a sweat lodge were not available, so time spent indoors was assumed to include time spent in a sweat lodge, with comparable radon concentrations. While this may overestimate actual radon concentrations in a sweat lodge, the magnitude of excess risks related to radon exposure either indoors or outdoors is sufficient to warrant remedial action (Table 5-13). Risk from inhalation of radon gas emanating from the water used for sweat lodge was not evaluated, as it was not considered a significant risk contributor relative to indoor radon in the MA and MAA residential exposure scenarios.

For non-residential subsistence scenarios, indoor radon was not evaluated, while outdoor radon was evaluated assuming 2,000 hours per year (see Table 5-13). Non-resident sweat lodge use was assumed to take place near Blue Creek, where radon was not a COPC in air, soil, or surface water.

EPA intends to add radon and external radiation exposure for the MA recreational scenario to the risk assessment for completeness. However, further detailed analysis does not appear necessary to refine the risks from radon exposure during sweat lodge use.

15. A quantitative uncertainty analysis should be performed for the Native American scenario at the Midnite Mine site to determine the distribution of risk. The analysis should be performed by a radiological group not involved with any onsite analysis to date to ensure objectivity. This uncertainty analysis would not be required if the necessary corrections were made to the deterministic risk assessment.

At some sites, quantitative uncertainty analysis, sometimes involving probabilistic analysis, can provide additional characterizations of risks and uncertainties that can be useful for decision-making. Such analysis is not necessary for every site, however, and in many cases qualitative methods provide adequate characterization of uncertainty. Considerations for quantitative uncertainty analysis include whether the risk assessment in its current state is sufficient to support risk management decisions and whether progression to a higher level of analysis would provide sufficient benefit to warrant the additional effort. In the case of Midnite Mine, EPA evaluated risk driving pathways and contaminants in the risk assessment. As is standard practice in EPA risk assessments, EPA also provided an evaluation of uncertainties. The basis for action, the relative risks and the key pathways are sufficiently clear to support risk management decisions. The benefit associated with additional quantitative analysis is not clear.

16. Conclusions 6th bullet (Page 6-5). The conclusion states that had typical RME or average exposure factors been used, risks would still have exceeded a target risk ($>10^{-4}$ risk). These assumptions and risks are not presented in the tables or elsewhere in the document.

Although there are uncertainties in some of the exposure factors, in others there is less uncertainty. Direct gamma exposure and radon gas exposure, for instance, are two examples where direct measurements (of gamma radiation fields or radon concentrations) can lead directly to estimates of human exposure because the exposure is based on time spent on site, rather than activities. The magnitudes of the excess risks associated with these two pathways (see Table 5-13 of the risk assessment) make it clear that target risk criteria would be exceeded even if other pathways were eliminated from consideration.

As stated in the Introduction of the RA, EPA has developed a Risk Assessment in order to make decisions about remediation of the Midnite Mine, and it is not intended to predict the actual or potential risk for an individual. Considering our comments outlined above, DOH is concerned

that the January 2004 Draft Risk Assessment does not represent the “reasonable maximum exposure (RME) and average estimates of risk with an adequate margin of safety,” as stated in the first paragraph of the RA. The human health risks reported in the RA may be so over-estimated as to be orders of magnitude higher than they would be in actuality.

CERCLA decisions are based on risks for the reasonable maximum exposure. Average risk estimates may support risk management decisions. Adequate margins of safety are not part of CERCLA risk assessment, and EPA intends to remove this term from the risk assessment.

While an average estimate of risk was not performed using central tendency subsistence exposure assumptions (e.g. for meat, plant, water, and soil ingestion rates), the food ingestion rates were based on caloric need to sustain an active subsistence lifestyle, so in that sense it is neither central tendency nor RME, but simply what would be needed to meet all energy requirements. EPA believes that the uncertainties are bounded by the scenario where a resident or worker is simply present at the site (not eating food from the site, drinking, using a sweat lodge, or ingesting soil). As shown in Table 5-13, excess risks from the radiation exposure and radon inhalation associated with mere presence in the mined area (using worker hours or residential hours) is sufficient to warrant remedial action.

EPA and DOH agree that for individual tribal members who are not using the site as intensively as assumed under either the subsistence/residential or subsistence/visitor scenario, careful risk communication is necessary.

References Cited in EPA's responses

Shepherd Miller Inc. (1999a). Midnite Mine Data Transmittal Report RA-1 (Upland Vegetation Soil Sample Results). Submitted by Dawn Mining Company to the Bureau of Land Management. Prepared for SMI: Fort Collins, CO. January 29, 1999a.

Shepherd Miller Inc. (1999b). Midnite Mine Data Transmittal Report RA-4 (Vegetation Sampling Results). Prepared for Dawn Mining Company for Submittal to the Bureau of Land Management. Prepared for SMI: Fort Collins, CO. April 23, 1999b.

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