United States Department of the Interior
Bureau of Land Management

Environmental Assessment
DOI-BLM-UT-Y010-2011-0048-EA

June, 2012

ENVIRONMENTAL ASSESSMENT TO APPROVE PLAN OF OPERATIONS AMENDMENT AT LA SAL MINES COMPLEX, SAN JUAN COUNTY, UTAH

Location: The La Sal Mines Complex is located in portions of:

T. 35 S., R. 11 E., SLM (La Sal County, Utah)
Sec. 3, NW¼, N½SW¼, W½NE¼;
Sec. 4, All (except for portions of the S½SE¼ and W¼);
Sec. 5, All (except for portions of the W½SE¼).
Comprising a total of 44 acres

Applicant: Denison Mines (USA) Corp.
Address: 1050 17th Street, Suite 950
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Moab, Utah 84532
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ENVIRONMENTAL ASSESSMENT
TO APPROVE PLAN OF OPERATIONS AMENDMENTAT LA SAL MINES COMPLEX, SAN JUAN COUNTY, UTAH

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1.0 PURPOSE AND NEED

1.1 Introduction

This Environmental Assessment (EA) has been prepared to analyze and disclose the environmental consequences of approval of an amendment to the Plan of Operations for the La Sal Mines Complex as proposed by Denison Mines (USA) Corp. (Denison). The EA is a site-specific analysis of potential impacts that could result with the implementation of the proposed action or alternatives to the proposed action. The EA assists the U.S. Bureau of Land Management (BLM) and U.S. Forest Service (USFS) in project planning and ensuring compliance with the National Environmental Policy Act (NEPA), and in determining whether any "significant" impacts could result from the analyzed actions.

"Significance" is defined by NEPA and is presented in Title 40 of the Code of Federal Regulations (CFR), Part 1508.27. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of "Finding of No Significant Impact" (FONSI). If the decision-maker determines that this project has "significant" impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record (BLM) and/or a Decision Notice (USFS) may be signed for the EA approving the selected alternative, whether the proposed action or another alternative. A decision record or decision notice, including a FONSI statement, documents the reasons why implementation of the selected alternative would not result in significant environmental effects beyond those already addressed in the *Moab Field Office Approved Resource Management Plan and Final Environmental Impact Statement* (2008a) and the *Environmental Impact Statement for the Manti-La Sal Land and Resource Management Plan* (1986).

Background

The La Sal Mines Complex is a group of four existing underground uranium mines operated by Denison. The mines are located north of the town of La Sal, in San Juan County, Utah. Denison excavates uranium-bearing rock from a network of underground tunnels and rooms, and transports this rock to the surface. The ore is then transported off-site for mineral processing to the White Mesa Mill located near Blanding, Utah. The La Sal Mines Complex has been operating since the 1970's with intervening periods of decreased or increased uranium production, which occurred in relation to changing economic conditions.

Although mining is conducted 800 to 1000 feet below the surface, some surface disturbance is incident to uranium ore production. This surface disturbance includes:

- Ventilation shafts, which are vertical bore holes that allow air to enter or exhaust from the underground tunnels

- Portals that provide for transportation into and out of the mine via mine shafts (vertical tunnels) and mine adits (sub-horizontal tunnels)
- Buildings and other ancillary infrastructure necessary to support the underground mines
- Development rock storage areas, which contain rock that must be excavated to reach ore within the underground mine

The location of existing surface disturbance associated with the La Sal Mines Complex is shown on Figure 1-1. The La Sal Mines Complex is located on federal lands managed by BLM or USFS, state lands managed by the Utah State Institutional Trust Lands Administration (SITLA), and private lands. BLM and USFS are responsible for management of surface resources on federal lands under their jurisdiction, and uranium mining activities occurring on those lands must be permitted in accordance with BLM regulations at 36 CFR 3809 or USFS regulations at 28 CFR 228 Subpart A. Previously approved plans of operations are in place, which address existing mine-related disturbance. Additional information regarding the location of the La Sal Mines Complex is presented in the proposed Plan of Operations Amendment (POA).

1.2 Proposed Action

The Proposed Action is to approve the POA as submitted by the proponent. The POA was submitted to BLM and USFS in December 2010 in accordance with the proponent's rights under the General Mining Law of 1872 and BLM and USFS mining regulations. Alternative actions would also be considered.

The proposed action would authorize the following activities on public lands managed by BLM and USFS at the La Sal Mines Complex:

- Modification of surface facilities at the Pandora Mine
- Construction of temporary drilling sites and access roads to support exploration drilling
- Installation of ventilation holes to provide for inflow and exhaust of air to support underground mining
- Compilation and modification of activities previously approved by two existing BLM Plan of Operations (PO) and one USFS PO and associated amendments, including any existing disturbed areas associated with the La Sal mines complex resulting from historic operations that may not have been fully delineated in those documents or in correspondence with previous operators into one POA that will address the entire La Sal Mines Complex

The POA includes expansion of an existing development rock pile at the Pandora Mine. The proposed expansion would affect approximately 6 acres of additional land at the Pandora Mine. Following the completion of mine operations, the rock pile is proposed to be reclaimed in place by regrading the rock, providing for permanent surface water drainage control, placing topsoil as available, and revegetating.

The POA also includes construction of temporary drilling sites and access roads to support ongoing exploration drilling activities. Exploration drilling is necessary to define

the extent of uranium ore at the La Sal Mines Complex, and is expected to be on-going from 2011 through 2030. The drilling process requires access for a truck-mounted drill rig and ancillary support vehicles, and construction of temporary drill sites. This is only required for the time that is required to drill and then plug the exploration drill hole. Therefore, reclamation of disturbance caused by drilling activities is proposed to be conducted seasonally after drilling operations cease in an area. This would limit the disturbance to BLM and USFS surface resources that would be present at any given time.

Additional ventilation shafts are proposed to be installed between 2011 through 2030 as required by the ongoing mining operations. These holes are vertical shafts of approximately 6 feet diameter, and extend from the surface into the underground workings. The surface openings into the ventilation shafts would be secured with metal protective structures during mining operations. Ventilation shafts would be reclaimed after mining ceases at the La Sal Mines Complex, by backfilling the shafts and sealing the surface opening.

Compilation of the previously approved Plans of Operations and all existing disturbed areas associated with the La Sal mines complex into one plan of operations is proposed to simplify regulation of the mine disturbance by BLM and USFS, and to facilitate efficient environmental compliance by the proponent. This is largely an administrative task that does not require re-approval of previously approved components of the operation. The POA also proposes modifications to reclamation and interim management plans for existing mine facilities.

Additional details regarding the proposed action are presented in Section 2.

1.3 Need for the Proposed Action

The need for this action is to allow Denison to exercise their rights under U.S. mining laws while protecting the environment in accordance with BLM and USFS regulations for locatable minerals. Denison has a right to mine on federal lands at the La Sal Mines Complex set forth by the General Mining Law of 1872 as amended. These laws provide a statutory right to conduct prospecting, exploration, development and production activities, provided they are reasonably incident to mining and comply with other federal laws (1955 Multiple Use Mining Act and case law). The proponent must comply with BLM and USFS regulations for locatable mineral operations.

1.4 Purpose of the Proposed Action

The purpose of the action is similar for BLM and USFS, but the agencies have different regulations that govern locatable minerals development. Both BLM and USFS have the responsibility to protect surface resources of public lands that they manage. BLMs purpose for the action is to prevent unnecessary or undue degradation of BLM lands in accordance with the Federal Land Policy and Management Act (FLPMA) of 1976 and BLM mining regulations. Similarly, the USFS purpose for the action is to protect USFS surface resources in accordance with USFS mining regulations at 36 CFR 228 Subpart A.

1.5 Conformance to Land Use Plans

The lands in this proposal are located on federal lands managed by either the BLM Moab Field Office or the Monticello District of Manti-La Sal National Forest. BLM is

responsible for making decisions regarding activities that would occur on federal lands managed by BLM. Similarly, the USFS is responsible for making decisions regarding activities that would occur on federal lands managed by the USFS.

1.5.1 Conformance with BLM Land Use Plan

BLM lands potentially affected by the proposed action are managed according to the Moab Field Office (MFO) Record of Decision (ROD) and Resource Management Plan (RMP) completed and signed in October 2008. The proposed action is in conformance with the goals, objectives, and decisions of the MFO RMP. Specifically, the mineral RMP goals state:

> *Provide opportunities for environmentally responsible exploration and development of mineral and energy resources subject to appropriate BLM policies, laws and regulations…(and) establish conditions of use through land-use planning to protect other resource values.* (Moab RMP, pg. 73).

The Proposed Action is in conformance with Minerals Decision 6 (MIN-6) of the RMP:

> *Existing operations will continue to be subject to the stipulations developed for the notice or the plan of operations. The BLM will evaluate all operations authorized by the mining laws in the context of its requirement to prevent unnecessary and undue degradation of Federal lands and resources.*

1.5.2 Conformance with Manti-La Sal National Forest Plan

USFS lands potentially affected by the proposed action are managed according to the Record of Decision and Manti-La Sal National Forest Plan, which was completed and signed in 1986. The proposed action is in conformance with the goals, objectives, and decisions of the forest plan, and is consistent with USFS policies and regulations.

1.6 Relationships to Statutes, Regulations, or Other Plans

1.6.1 Bureau of Land Management 3809 Regulations

FLPMA directs the Secretary of Interior to take any action necessary by regulation or otherwise to prevent unnecessary or undue degradation of federal lands. The BLM 3809 regulations (43 CFR 3809) were promulgated to implement this part of the federal Land Policy and Management Act of 1976 (Maley 1990). These regulations apply to surface disturbance associated with mining operations conducted on BLM lands in accordance with the General Mining Law of 1872.

The BLM decision space regarding the proposed Plan of Operations is set forth in the 3809 regulations. BLM may approve the Plan of Operations as submitted, approve the Plan of Operations subject to changes or conditions to meet the performance standards of 43 CFR 3809.420, or disapprove the Plan of Operations. BLM may disapprove the Plan of Operations if it does not meet applicable content requirements, proposes operations on lands withdrawn from operation of mining laws, or proposes operations that would result in unnecessary or undue degradation of public lands. The authorized officer for this decision is the BLM Moab Office Field Manager.

BLM provides definition of unnecessary or undue degradation as follows (43 CFR § 3809.5):

> *Unnecessary or undue degradation means conditions, activities, or practices that:*
>
> *(1) Fail to comply with one or more of the following: the performance standards in § 3809.420, the terms and conditions of an approved plan of operations, operations described in a complete notice, and other federal and state laws related to environmental protection and protection of cultural resources; or*
>
> *(2) Are not ''reasonably incident'' to prospecting, mining, or processing operations as defined in §3715. 0–5 of this chapter*

BLM also sets forth the requirements to prevent unnecessary or undue degradation (43 CFR §3809.415):

> *…You prevent unnecessary or undue degradation while conducting operations on public lands by— (a) Complying with § 3809.420, as applicable; the terms and conditions of your notice or approved plan of operations; and other federal and state laws related to environmental protection and protection of cultural resources …*

1.6.2 Forest Service Regulations at 36 CFR 228 Subpart A

The Organic Administration Act of 1897 provides authority for the Secretary of Agriculture to regulate occupancy and use of National Forest System land. As an agency within the Department of Agriculture, USFS derives its legal authority to regulate National Forest System land through this act. The Organic Administration Act of 1897 provides for the continuing right of the public to conduct mining activities under the General Mining Law as long as the rules and regulations covering National Forests are complied with. The act recognizes that miners and prospectors have the legal right of access into National Forests to prospect, locate, and develop mineral resources. The Multiple Use Mining Act of 1955 provides additional authority for USFS to restrict mining operations on National Forest System lands to only those uses that are reasonably incident to mining and in a manner that minimizes environmental impacts (Forest Service Manual 2800).

The USFS decision space regarding the POA is set forth at 36 CFR §228.5. The authorized USFS officer for this action is the Forest Supervisor of the Manti-La Sal National Forest. The authorized officer has the authority to:

> *(1) Notify the operator that he has approved the plan of operations; or*
>
> *(2) Notify the operator that the proposed operations are such as not to require an operating plan; or*
>
> *(3) Notify the operator of any changes in, or additions to, the plan of operations deemed necessary to meet the purpose of the regulations in this part; or*

(4) Notify the operator that the plan is being reviewed, but that more time, not to exceed an additional sixty (60) days, is necessary to complete such review, setting forth the reasons why additional time is needed: Provided, however, that days during which the area of operations is inaccessible for inspection shall not be included when computing the sixty (60) day period; or

(5) Notify the operator that the plan cannot be approved until a final environmental statement has been prepared and filed with the Council on Environmental Quality as provided in §228.4(f).

1.6.3 Other Federal Laws

More than three dozen federal environmental laws and regulations apply to various aspects of mining. In addition, each state has laws and regulations that mining companies must follow. The following are some of the other laws governing mining.

- **Surface Resources Act at 43 CFR subpart 3715** – regulates residency or seasonal occupancy of mining claims by mining claimants and requires occupancy to be authorized by the proper BLM field office through a notice or plan of operations.
- **Clean Air Act** – sets air quality standards.
- **Federal Water Pollution Control Act (Clean Water Act)** – directs standards to be set for surface water quality and for controlling discharges to surface water.
- **Solid Waste Disposal Act** – regulates the generation, storage and disposal of hazardous waste and management of solid, non-hazardous waste.
- **Endangered Species Act** – mandates protection for plants and animals listed that are threatened or endangered.
- **Migratory Bird Treaty Act** – protects migratory birds.
- **Federal Mine Safety and Health Act –**provides for mandatory safety and health standards for underground metal or nonmetal mines, including related surface operations. The purpose of these standards is the protection of life, the promotion of health and safety, and the prevention of accidents.
- **National Historic Preservation Act (NHPA) –** requires review of historical properties in consultation with the State Historic Preservation Office and tribes in accordance with Section 106. Requires that an EA include appropriate scoping, identification of historic properties, assessment of effects upon them, and consultation leading to resolution of adverse effects.
- **Bald and Golden Eagle Protection Act –**prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

1.6.4 Decisions to be made by Other Agencies regarding this Proposal

Table 1-1 lists relevant permits or approvals associated with the proposed action, and the decision-making agencies. All required permits and approvals have either been obtained

or are in progress. Additional information on these permits or approvals is included in the POA.

Table 1-1. Relevant permits or approvals required for the proposed action, and the respective decision-making agencies.

Permit/Number	Agency
Air Order/ National Emission Standards for Hazardous Air Pollutants (DAQE-AN014150002-09)	Utah Department of Environmental Quality (UDEQ)
Large Mine Permit/PO/Reclamation Plan – Pandora (M/037/012)	Utah Division of Oil, Gas, and Minerals (UDOGM)
Large Mine Permit/PO/Reclamation Plan – La Sal, Snowball, and Beaver Shaft (M/037/026)	UDOGM
Stormwater Permit for Mining	Utah Department of Environmental Quality (DEQ)
Cultural Clearance	Utah State Historic Preservation Office
Concurrence on Wildlife Protection	Utah Division of Wildlife
Mine Safety and Health Administration	U.S. Department of Labor
PO for ventilation shafts	USFS
Road Use Permit (#0410-04-42)	USFS
US Army Corps of Engineers 404 Permit for channel construction	US Army Corps of Engineers
Groundwater Discharge Permit by Rule	UDEQ – Division of Water Quality

1.7 Identification of Issues

Council on Environmental Quality (CEQ) regulations require that there be an early and open process for determining the scope of issues to be addressed and for determining the key issues related to a proposed action, and identify and eliminate from detailed study issues which are not key or which have been covered by prior environmental review. This process is termed scoping (40 CFR 1501.7). The scoping process for this EA was conducted in accordance with BLM and FS regulations and guidance. This scoping process included involvement and participation by interested persons, other government agencies, and BLM and USFS resource specialists. Based on the results of this scoping process, key issues were identified that require assessment in this EA.

1.7.1 Public Scoping

A scoping letter describing Alternative A and soliciting comments was sent by BLM in cooperation with USFS to 418 interested parties on December 21, 2010. These parties included local, state, and federal agencies; non-governmental organizations (NGOs); and the general public. On January 6, 2011, a press release was published in the Moab Times-Independent newspaper that announced a public meeting for the project. In addition, the POA was made available for public review on December 29, 2010 at public libraries in Moab, and Monitcello, Utah, and at the La Sal Store in La Sal, Utah. BLM

and USFS subsequently held two public meetings, one in La Sal, Utah on January 13, 2011, and one in Moab, Utah, on January 20, 2011. A total of 32 people attended the public meeting in La Sal, and 14 people attended the public meeting in Moab. The public comment period for scoping closed on January 31, 2011.

The BLM also maintained digital copies of the POA on the Moab Field Office webpage and listed the EA scoping information on the BLM Environmental Notification Bulletin Board. The USFS maintained digital copies of the POA on the Manti-La Sal National Forest webpage and listed the EA scoping information on the USFS Schedule of Proposed Action (SOPA) information.

A separate mailer was sent out by the USFS as part of their Notice of Proposed Action (NOPA) to 53 interested parties on February 17, 2011. In addition, a legal notice of proposed action was published in the Sun Advocate newspaper on February 22, 2011. The public comment period for the NOPA closed on March 23, 2011, 30 days after publication of the NOPA in the Sun Advocate newspaper. The legal notice of the NOPA is the document that sets the comment period, which identifies those individuals/organizations that have appeal rights for USFS decisions.

1.7.2 Internal scoping

Internal scoping with BLM and USFS resource specialists was also conducted. This process was also used to identify issues for analysis in the EA, and is summarized in a BLM Interdisciplinary Team (IDT) Checklist (attached as Appendix A).

1.7.3 Public Comments

BLM and USFS considered each document received in response to the request for public comment as a “comment document,” including e-mails, faxes, and completed written comment forms. Each comment document therefore could include more than one comment. The La Sal meeting resulted in three comment documents submitted on comment forms provided by BLM. The Moab meeting resulted in one comment document submitted on a comment form.

In addition to the comment documents gathered during the public meetings, 16 comment documents were sent to BLM and USFS via mail or email during the BLM and USFS comment period ending on January 31, 2011. Comment documents were received from 12 individuals, 1 Native American tribe, 7 non-government organizations (NGOs), and 1 local government agency.

As part of the NOPA, the USFS received six comment documents. Comment documents were received from 3 individuals, 1 Native American tribe, 7 NGOs, and 1 local government agency.

1.7.4 Issues

An issue is a point of debate, dispute, or disagreement regarding the anticipated effects of a proposed action. CEQ regulations at 40 CFR §§1500.4 and 1500.7 require that the environmental assessment focus on issues that are key to the proposed action. Key issues are directly or indirectly caused by the proposed action and may lead to the development of alternative actions or other mitigation. Non-key issues are defined as being: 1) outside the scope of the proposed action; 2) already decided by law, regulation, forest plan, BLM

area management plan, or other higher-level decision; 3) irrelevant to the decision; or 4) conjectural and not supported by scientific or factual evidence.

Issues were identified based on the scoping process described above, and on internal scoping completed by BLM and USFS resource specialists. These issues were categorized as either key or non-key issues based on the CEQ regulations.

Air Quality

- How would ore loading and ore transportation affect air quality?
- Is dust generated at development rock piles a hazard with respect to potential carcinogens, silica, or other hazardous materials?
- What are the potential hazards related to air emissions from the mine including dust and other emissions from the operation?
- What are the risks to workers and the general public associated with exposure to silica in the ore and development rock?
- What is the potential for the mine to cause adverse air quality effects to the Class I Air Quality status of Arches and Canyonlands National Parks?
- What potential long-term effects to air quality could be caused by air emissions from the mine?
- What potential regional effects to air quality could be caused by air emissions from the mine?
- What effects are associated with the White Mesa Mineral Processing Mill?

Cultural Resources

- Would the project affect cultural resources?

Development Rock

- Have existing development rock piles caused adverse effects to soil, sediments, or groundwater in vicinity of mine?
- Would placement of additional development rock cause adverse effects to soil, sediments, or groundwater in vicinity of mine?
- Is arsenic in development rock or soils a hazard to workers or the general public during mine operations?
- Is the capacity of the proposed Pandora mine development rock area (DRA) sufficient to support planned mineral production?

Geology

- Would the project affect future oil and gas development?
- How would the project affect uranium production and reserves?

Groundwater

- What are the effects on water quality from water collecting in the underground mine workings?

- What are the potential effects of mining on the drinking water of La Sal?
- What are the potential effects of ore stockpiles on drinking water of La Sal?
- What are the potential effects of ventilation shafts on Groundwater Quantity and Quality?
- What are the potential effects of exploration drilling on Groundwater Quantity and Quality?
- What are the potential effects to groundwater during the post-reclamation period?

Hazardous Waste

- Would the mine generate toxic waste?

Noise

- What are the potential effects of noise on wildlife, hunters, recreationists, and the town of La Sal?

Radiological Issues (including Radon)

- Would adverse effects be caused by air emission of radioactive particulates from the mine vents and mine surface facilities?
- What are the potential hazards related to emissions of radon gas from the mine?
- What potential long-term effects to air quality could be caused by radioactive air emissions from the La Sal Mines Complex?
- Would adverse effects be caused by external gamma radiation from mine surface facilities?
- Would the proposed action or alternatives increase cancer risk for La Sal residents?
- Would uranium, radon, radium, or other radionuclides bio-accumulate in vegetation?
- Would radon emissions from vent holes affect vegetation, wildlife, soil and water?
- What are the risks associated with exposure to uranium, radium, radon, and radon daughter products after mine reclamation?
- What are the risks associated with emission of radon from exploration drill cutting disposal areas?
- What is the appropriate reclamation performance criterion for emission of radiation from reclaimed areas?

Reclamation

- How long would it take to reclaim affected areas?
- What is the risk of human and animal intrusion into development rock piles after reclamation is complete?

- Would adequate growth media be available to support reclamation?
- Would reclaimed DRAs support a vegetative cover?
- Would reclamation be stable after it is completed?

Slope Stability

- Is the current Pandora development rock pile stable?
- Would the proposed final configuration of the Pandora development rock pile be stable?

Socioeconomics

- What are the socioeconomic effects of the proposed action and alternatives?
- Would ore truck travel cause adverse effects to area income from tourism?

Surface Water

- Would flooding and storm events cause adverse environmental effects as a result of sediment transport and erosion of mine waste piles?
- Is there potential for stormwater to transport contaminants away from the mine site?

Transportation

- What are the effects of ore trucking on public safety?

Vegetation

- Are sensitive or otherwise protected plant species present in the project area?
- What are the baseline vegetation conditions?
- What are the effects of historic, current, and proposed disturbance to vegetation?

Visual Resources

- Would truck traffic cause an adverse effect on visual resources and tourism?

Wildlife

- What are the effects to wildlife from uranium mining in La Sal area?
- What are the effects of ore transportation on wildlife mortality?
- Would bioaccumulation of radioactivity affect wildlife or livestock?
- Would fugitive dust or silica cause adverse effects to wildlife?
- Would release of radioactive and non-radioactive particulates from ventilation shafts cause adverse effects to wildlife?
- Would the noise of ventilation fans cause adverse effects to wildlife?
- Would the project affect migratory birds?
- Would the project result in habitat loss to general wildlife and winter range for deer and elk?

Worker Health and Safety

- Would the POA cause workers at the La Sal Mines Complex to work in an environment that will have adverse health effects?
- Would workers at the La Sal Mines Complex spread radioactive contamination into the La Sal community?

1.8 Issues Considered but Eliminated from Further Analysis

Other issues were considered, but were eliminated from detailed analysis.

1.9 Summary

This chapter has presented the purpose and need of the proposed project, and the key issues (i.e.; those elements of the human environment that could be affected by the implementation of the proposed project). In order to meet the purpose and need of the proposed project in a way that resolves the issues, BLM and USFS have considered a range of action alternatives. These alternatives are presented in Chapter 2. The potential environmental impacts or consequences resulting from the implementation of each alternative considered in detail are analyzed in Chapter 4 for each of the identified key issues.

2.0 DESCRIPTION OF ALTERNATIVES, INCLUDING PROPOSED ACTION

2.1 Introduction

Alternative actions are developed to meet the purpose and need for the action, while addressing key issues identified during scoping. As set forth by 40 CFR 1502.14, this portion of the analysis compares environmental impacts of the alternatives to sharply define the differences and provide a clear basis for choice by the decision maker and the public. In the following sections, the alternatives are described in detail and the environmental effects are summarized with respect to the issues described previously in Chapter 1. Additional analyses of the environmental effects of the alternatives are presented in Chapters 3 and 4.

2.2 Alternative A – Proposed Action

Alternative A would approve the POA as submitted by Denison. The following sections describe the proposed action. Additional information is included in the proposed POA, which is attached as Appendix B. This alternative would authorize the following activities on public lands managed by BLM and USFS at the La Sal Mines Complex:

- Modification of surface facilities at the Pandora Mine
- Temporary construction of drilling sites and access roads for exploration drilling
- Installation of ventilation holes to provide for inflow and exhaust of air to support underground mining
- Compilation and modification of activities previously approved by two existing BLM Plan of Operations (PO) and one USFS PO and associated amendments, including any existing disturbed areas associated with the La Sal mines complex resulting from historic operations that may not have been fully delineated in those documents or in correspondence with previous operators into one POA that will address the entire La Sal Mines Complex

These components of Alternative A are described in the following sections, and additional details are presented in the POA and associated attachments.

2.2.1 Modification of Surface Facilities at the Pandora Mine

Proposed modifications to existing surface facilities at the Pandora Mine include the following:

- Expansion of the existing DRA
- Creation of a topsoil stockpile area
- Installation of drainage control structures

The modifications would result in additional surface disturbance of approximately 6 acres. Total disturbance at the Pandora Mine would increase from approximately 9 acres to 15 acres. Surface facilities at the Pandora Mine are located on public lands administered by BLM. Additional information regarding the proposed modifications is provided in the following sections.

2.2.1.1 Expansion of the Existing Development Rock Area

The existing DRA at the Pandora Mine would be expanded to the south and west to accommodate continued mineral production. This work would occur in the northeast quarter (NE ¼) of the southeast quarter (SE ¼), Section (Sec.) 1, Township (T) 29 South (S), Range (R) 24 East (E), Salt Lake Base Meridian (SLBM). A location map showing this facility is included as Figure 2-1.The expansion would ultimately encompass approximately 2 of the additional 6 acres proposed for site expansion. The facility would be constructed by placing development rock on the existing DRA at an angle of repose slope ranging from approximately 30 to 35 degrees. This approach would facilitate efficient production during mining, and provide for placement of approximately 200,000 cubic yards (cy) of additional development rock material. This process would gradually extend the footprint of the facility south and west toward the boundary of the expansion.

During reclamation, the angle of repose slopes would be reduced to a final reclamation slope of 3 horizontal (H):1 vertical (V) (18.4 degrees). The full extent of the proposed footprint would be utilized upon completion of reclamation activities when the slopes are reduced to the finished grade.

2.2.1.2 Creation of a Topsoil Stockpile Area

Approximately 36 inches of soil from approximately 3 acres of disturbed area would be salvaged and stockpiled at the Pandora Mine. Topsoil would be salvaged mainly from the proposed DRA expansion and portions of the proposed drainage channel realignment. Approximately 8,000 cy of soil would be stockpiled from the upper soil horizons, and approximately 4,500 cy of suitable fill material would be salvaged and used as inert fill where needed along the realigned channel during construction.

Most soil excavation would be performed using a tracked dozer, although a front-end loader, motor grader or other equipment may also be used. Haulage equipment would not be allowed to cross the stockpiles so that compaction of stockpiled soil would be minimized. The topsoil storage location is designed to be outside of drainage areas to minimize erosion. The topsoil stockpile would be contoured, ripped, and broadcast seeded in the late fall with seed mix(es) approved by BLM and UDOGM. Seeding efforts would continue until vegetation is established.

Detailed maps and cross-sections of the proposed DRA at the Pandora Mine are presented in Section 5.2.5 of the POA, which focuses on reclamation of all DRAs at the La Sal Mines Complex.

2.2.1.3 Installation of Drainage Control Structures for Channel Realignment

Alternative A would improve drainage control structures at the Pandora Mine during expansion of the DRA. The proposed design for the drainage control structures is provided in the Final Drainage Report for the Pandora Mine included as Attachment D of the POA. All drainage control structures were designed for a 100-year, 24-hour storm event. Drainage control structures that would be improved include realignment of an ephemeral drainage west of the Pandora DRA and installation of culverts in several locations.

The ephemeral drainage channel west of the Pandora DRA would be realigned to accommodate DRA expansion. The realigned drainage channel would consist of two reaches: an upstream grass-lined reach and a downstream riprap-lined reach.

Culverts would be installed as follows:

- A long culvert would be used to convey surface water runoff from watersheds north and east of the Pandora Mine surface facilities into the realigned drainage channel. This culvert would convey stormwater beneath the surface facilities, and mitigate potential effects to stormwater quality from the surface facilities.
- Culverts would also be used to convey water within the realigned drainage channel under the existing access road to the surface facilities.

2.2.2 Mine Ventilation Holes and Exploration Drilling

Alternative A would approve installation of additional mine ventilation holes (ventilation shafts), completion of exploration drilling, and construction of ancillary access roads. Worker health and safety at the La Sal Mines Complex depends on the installation of ventilation shafts, which are vertical shafts that provide for either inflow or exhaust of air. Development of the mine also requires exploration drilling, which is used to identify uranium ore bodies in the subsurface and guide mine development activities.

Alternative A would provide for installation of additional ventilation shafts and exploration drilling during three phases. Alternative A would provide for BLM and USFS approval of mine ventilation holes and exploration drilling within the general areas shown on Figure 2-2. Because the specific locations for these activities cannot be pre-determined, Alternative A would require that the specific locations for these facilities and the location of associated access roads be subject to BLM and USFS review prior to construction. This requirement would be included in the POA as a condition of approval. Additional information regarding the proposed disturbance associated with these phased activities is presented in the following sections.

2.2.2.1 Phase 1 (continuing for approximately two to three years after approval of the proposed POA)

Exploration drilling and installation of ventilation shafts during Phase 1 would be conducted in an area of current mining, located northeast of the Pandora Mine surface facilities (approximately in a portion of the NE ¼ Sec. 6 and portion of the N ½ Sec. 5, T 29S, R25E, SLBM), and in an area west of the Beaver Shaft Mine (approximately in a portion of the NW ¼ of Sec. 3 and portions of the NE ¼ and NW ¼ Sec. 4, T29S, R24E, and portions of the SW ¼ and SE ¼ Sec. 33, portions of NE ¼ SW ¼, and the SE ¼ Sec. 34, T28S, R24E, SLBM). Mining would occur in these areas for approximately 2- to 3-years after approval of the proposed POA.

Anticipated disturbances within the area includes 24 ventilation shafts, including seven in the area northeast of the Pandora Mine surface facilities and 17 in the area west of the Beaver Shaft Mine. Four of the ventilation shafts would be on BLM land, six would be on USFS land, and the remaining 14 (west of Beaver Shaft Mine) would be on private land. Exploration drilling in the Phase 1 area would include up to 200 exploration holes per year for a period of 3 years: 40 exploration drill holes on BLM land, 50 exploration holes on forest system land, and 110 exploration holes on private land.

Estimated future disturbed areas associated with these proposed activities are provided in Table 2-1.

Table 2-1. Alternative A- Phase 1 Disturbed Area Estimates

BLM land ventilation shafts (4)*	4 Acres
USFS land ventilation shafts (6)*	6 Acres
Private land ventilation shafts (14)*	14 Acres
BLM exploration drilling (20% of total drill holes per year)**	10 Acres
USFS exploration drilling (25% of total drill holes per year)**	13 Acres
Private land exploration drilling (55% of total drill holes per year)**	28 Acres
Total disturbance	**75 Acres**
Total BLM disturbance (including Pandora Mine expansion)	**21 Acres**
Total USFS disturbance	**19 Acres**

**Typical disturbance from ventilation shafts include 0.25 acres per ventilation shaft, and approximately 0.75 acres per ventilation shaft for new roads.*

*** Disturbance for exploration drilling is accounted on a biennial basis with the assumption that reclamation would be complete in that timeframe. An estimated surface disturbance area for each drill hole is 30 feet (ft) by 40 ft (less than 0.1 acres). Temporary exploration roads are estimated to be approximately 0.1 acres per drill hole based on historical operations.*

2.2.2.2 Phase 2 (approximately five years of operations after completion of Phase 1)

Phase 2 would be located north of the Pandora Mine surface facilities (S ½ Sec. 36, T28S, R24E and portions of the NE ¼ and SE ¼ Sec. 31, T28S, R25E, SLBM) and in an area west of the Beaver Shaft Mine (N ½ Sec. 5, T29S, R24E; and S ½ Sec. 32, T28N, R24E, SLBM). Activities are anticipated to occur in these areas starting after completion f Phase 1 and extending for approximately 5 years.

Anticipated disturbance in this phase includes 23 ventilation shafts; 13 in the area north of the Pandora Mine surface facilities and 10 in the area west of the Beaver Shaft Mine. Six ventilation shafts would be on USFS land, four would be on SITLA-managed land, and the remaining 13 would be on private land. Exploration drilling during Phase 2 would include up to 200 exploration holes per year for 5 years. This would consist of no

exploration drilling on BLM land, 50 exploration holes on forest system land, and 150 exploration holes on lands not managed by BLM or USFS.

Estimated future disturbed areas associated with these proposed activities are provided in Table 2-2.

Table 2-2. Alternative A- Phase 2 Disturbed Area Estimates

USFS land ventilation shafts (6)*	6 Acres
SITLA land ventilation shafts (4)*	4 Acres
Private land ventilation shafts (13)*	13 Acres
USFS exploration drilling (25% of total drill holes per year)**	12.8 Acres
SITLA exploration drilling (20% of total drill holes per year)**	10.2 Acres
Private land exploration drilling (55% of total drill holes per year)**	28 Acres
Total disturbance	**74 Acres**
Total BLM disturbance	**0 Acres**
Total USFS disturbance	**18.8 Acres**

**Typical disturbance from ventilation shafts includes 0.25 acres per ventilation shaft, and approximately 0.75 acres per ventilation shaft for new roads.*

*** Disturbance for exploration drilling is accounted on a biennial basis with the assumption that reclamation would be complete in that timeframe. An estimated surface disturbance area for each drill hole is 30 ft by 40 ft (less than 0.1 acres). Temporary exploration roads are estimated to be approximately 0.1 acres per drill hole based on historical operations.*

2.2.2.3 Phase 3 (extending for 12 or more years after completion of Phase 2)

Phase 3 would be located south and east of Pandora Mine surface facilities (approximately in a portion of the S ¼ Sec. 1 T29S, R24E and portions of Sec. 5 and Sec. 6, T29S, R25E, Salt Lake Base Meridian, San Juan County, Utah). Phase 3 also includes an area to the far west of the Beaver Shaft Mine, where a new shaft on private land called the Redd Block IV shaft would be constructed private land in accordance with an existing state permit (approximately in the SE ¼ and a portion of NE ¼ Sec. 31, T28S, R24E, Salt Lake Base Meridian, San Juan County, Utah). The Red Block IV shaft is currently permitted, and development of the shaft is not dependant on the proposed action. Properties owned or operated by others could conceivably be mined in areas west of the Planned Phase 3 area.

Anticipated Phase 3 disturbances include 12 ventilation shafts; eight in the vicinity of the Pandora Mine surface facilities and four in the area west of the Beaver Shaft Mine. Six of these ventilation shafts would be on BLM land, two would be on USFS managed land, and the remaining four would be on private land. Exploration drilling in the Phase 3 area would include up to 200 exploration holes per year for 11 years. These would include 100 exploration holes on BLM land, 30 exploration holes on forest system land, and 70 exploration holes on lands not managed by BLM or USFS.

Estimated future disturbed areas associated with these proposed activities are provided in Table 2-3.

Table 2-3. Alternative A- Phase 3 Disturbed Area Estimates

BLM land ventilation shafts (6)*	6 Acres
USFS land ventilation shafts (2)*	2 Acres
Private land ventilation shafts (4)*	4 Acres
BLM exploration drilling (50% of total drill holes per year)**	25.5 Acres
USFS exploration drilling (15% of total drill holes per year)**	7.7 Acres
Private land exploration drilling (35% of total drill holes per year)**	17.9 Acres
Total disturbance	**63.1 Acres**
Total BLM disturbance	**31.5 Acres**
Total USFS disturbance	**9.7 Acres**

**Typical disturbance from ventilation shafts include 0.25 acres per ventilation shaft, and approximately 0.75 acres per ventilation shaft for new roads.*

*** Disturbance for exploration drilling is accounted on a biennial basis with the assumption that reclamation would be complete in that timeframe. An estimated surface disturbance area for each drill hole is 30 ft by 40 ft (less than 0.1 acres). Temporary exploration roads are estimated to be approximately 0.1 acres per drill hole based on historical operations.*

2.2.3 Compilation and Modification of Previously Approved and Existing Activities into one Plan of Operations

The La Sal Mines Complex has been in operation since the 1970's. Federal and state mine permitting regulations were instituted and modified during this period in accordance with changes in various statutes and regulations. Existing activities and mining-related disturbances at the La Sal Mines Complex include both pre-law and post-law disturbances and a variety of Plans of Operations, EAs, and approvals that reflect the evolving process of mine regulation by BLM and USFS over the last 30 years. Alternative A would compile previously approved and existing activities associated with

the La Sal Mines Complex into one Plan of Operations that addresses all federal lands affected by the mine complex and complies with current BLM and USFS regulations.

Compilation of previously approved and existing activities under Alternative A includes the following:

- Definition of existing mining-related disturbances on federal land associated with the La Sal Mines Complex
- Revision of the site reclamation plan for existing disturbance areas
- Stipulation of a monitoring plan that sets forth environmental monitoring requirements for the operation
- Stipulation of an interim management plan that establishes requirements for short-term shutdown of the mine if economic conditions change

These actions are described in detail in the POA. The following sections summarize these actions, with a focus on aspects that could affect the environment and require assessment in this EA.

2.2.3.1 Definition of Existing Mining-related Disturbances on Federal Land

The La Sal Mines Complex consists of four mine sites: Pandora Mine, La Sal Mine, Snowball Mine, and Beaver Shaft Mine. At each of these sites, there are existing surface facilities that support mining operations.

Existing surface facilitates include the following:

- DRAs
- Ore stockpile areas
- Fuel and oil storage areas
- Mine offices and dry
- Maintenance shops and warehouses
- Designated parking areas and storage yards
- Mine access roads
- Electrical generators
- Air compressor stations
- Water systems
- Septic systems (including leach field)
- Ventilation shafts and access roads

Detailed descriptions and information regarding the specific regulatory jurisdiction of these facilities are presented in the POA.

2.2.3.2 Revision of the Site Reclamation Plan for Existing Disturbance Areas

Alternative A would modify the reclamation plan for existing mine facilities on BLM and USFS lands associated with the La Sal Mines Complex. These facilities are detailed in the POA. The purpose of these modifications is to update the existing reclamation plans

to meet current requirements of 43 CFR Part 3809.420 and 36 CFR 228A §228.8 (f) and (g) and §228.10, and applicable state regulations.

Alternative A would address the following reclamation issues:

- Drill hole plugging requirements
- Land regrading and reshaping
- Road reclamation
- Slope stability
- Mine portals
- Surface water drainages
- DRAs
- Shaft reclamation
- Ore stockpiles
- Wildlife habitat
- Topsoil handling
- Revegetation
- Isolation and control of potential acid-forming, toxic, or deleterious materials
- Removal or stabilization of buildings, structures and support facilities
- Post-closure management and reclamation performance criteria

Additional information relevant to proposed modification to reclamation plans is presented in the POA.

2.2.3.3 Stipulation of a Monitoring Plan that sets forth Environmental Monitoring Requirements for the Operation

The POA would also revise approaches for environmental monitoring to conform with 43 CFR Part 3809.401, Section (b)(4) and 36 CFR 228A §228.7 and §228.9. Additional information regarding the proposed monitoring plan is presented in the POA.

The monitoring plan would address the following:

- Stormwater management structure monitoring
- Fuel storage area monitoring
- Noxious weed monitoring
- Air quality monitoring
- Radiation monitoring

2.2.3.4 Stipulation of an Interim Management Plan that Establishes Requirements for Short-term Shutdown of the Mine if Economic Conditions Change

Alternative A would establish a plan for management of the La Sal Mines Complex during periods of interim shutdown. These are periods when the mine must shut down

temporarily as the result of fluctuations in metal prices or other factors. The interim management plan addresses requirements of 43 CFR Part 3809.401, Section (b) (5) and 36 CFR 228A §228.10.

The interim monitoring plan would address:

- Measures to stabilize excavations and workings
- Measures to isolate or control potential toxic or deleterious materials
- Control of noxious weeds
- Provisions for storage or removal of equipment, supplies, and structures
- Measures to maintain project area in a safe and clean condition
- Monitoring plans

2.3 Alternative B – No Action Alternative

The No Action Alternative assumes that the La Sal Mines Complex would not be expanded. Mining operations would continue under existing permits until mining ceased because of either a lack of required ventilation shafts or a lack of exploration drilling. Reclamation would then be conducted in accordance with requirements of the existing plans of operations.

2.4 Alternative C – Require Modifications to the Proposed Action before Approval

Alternative C was developed to meet the Purpose and Need for the Action, and to address the key issues identified by the BLM, USFS, and the public during the scoping process. Alternative C would be identical to Alternative A with the exception of the specific modifications described below. These modifications would be incorporated into the POA after completion of the EA, but before approval of the POA by authorized officers of BLM and USFS.

2.4.1 Vent and Production Shaft Reclamation

As described in the POA, Alternative A would require reclamation of ventilation and production shafts on federal, state and private lands by backfilling the shafts with development rock. Shafts that penetrate aquifers would be lined and sealed during construction to mitigate potential leakage of groundwater into the underground mine. During reclamation, the lining would mitigate potential interaction of groundwater with development rock placed into the shafts during reclamation. However, over time, there is potential that the shaft linings may deteriorate, and allow some interaction of the backfilled development rock with the D aquifer, the drinking water source for the community of La Sal. Alternative C would require engineering mitigations to be implemented to reduce the potential for interaction of development rock with the D aquifer. This may include installation of low-permeability seals within backfilled ventilation shafts above and below the D-aquifer, use of inert rock fill for shaft backfill within the portion of the shaft that could potentially interact with the D-aquifer, or other appropriate engineering methods. Denison would provide engineering designs and specifications for reclamation of shafts that penetrate the D-aquifer to BLM or USFS, prior to shaft reclamation. This requirement would address key issues related to

protection of groundwater quality and drinking water sources for the community of La Sal.

2.4.2 Pre-construction Radon Assessment for New Ventilation Shafts

As discussed in public scoping comments, Denison had past compliance issues associated with air quality regulations for radon, a gas that is released from ventilation shafts at underground uranium mines. Denison has addressed these past compliance issues with the U.S. Environmental Protection Agency (EPA) and the state of Utah, the appropriate agencies for regulation of radon gas released from uranium mine ventilation shafts. Radon gas can be hazardous in high concentrations, and removal of radon gas from the La Sal Mines Complex is required to protect worker health and safety. Generally, radon released into the atmosphere quickly dissipates. However, radon discharge from ventilation shafts is closely monitored to mitigate risks to potential surface receptors.

Alternative C would address the potential for similar issues with new ventilation shafts by requiring pre-construction radon modeling for new shafts. The pre-construction modeling would assess expected radon discharge rates, location of potential receptors to the proposed ventilation shaft, and compliance with applicable regulations. For ventilation shafts that would be placed on lands under the jurisdiction of BLM or USFS, the pre-construction radon assessment would be provided to BLM and/or USFS prior to construction to demonstrate that emissions from the ventilation shaft would be in compliance with the requirements of 40 CFR 61, Subpart B. Mines subject to this regulation may not emit radon-222 to the ambient air in excess of those amounts that would cause any member of the public to receive in any year an incremental effective dose equivalent to 10 millirem per year (mrem/yr) above background. If preconstruction radon modeling does not demonstrate that the vent hole would be expected to comply with the regulation, design modifications would be implemented to comply with the regulation, or the ventilation shaft would not be constructed. After construction, monitoring of radon emissions would be conducted in accordance with 40 CFR 61, Subpart B or other EPA or UDEQ approved methods for the life of the ventilation shaft.

2.4.3 Pre-construction Cultural Resource Surveys

Denison provided a proposed action (alternative A) that is forward-looking, with three phases of exploration and ventilation shaft construction. This approach was requested by BLM to provide adequate assessment of future mining activities at the La Sal Mines Complex. However, as described in the POA, Denison cannot identify the specific location of ventilation shaft, exploration drill holes and associated access roads at this time. Exploration drilling and ventilation shaft construction is an iterative process. For example, the locations of ventilation shafts depend on the results of exploration drilling. Similarly, the location of exploration drilling in any given year is dependent on the results of exploration drilling in the previous year. Alternative A would approve a specific number of exploration drill holes, ventilation shafts and associated access roads within defined perimeters in each of three phases. Before initiation of these activities in Phases 1, 2 and 3, Denison would provide BLM or USFS (as appropriate based on jurisdiction) the specific locations for exploration drilling or ventilation shaft construction within the perimeters approved by this action.

Alternative C would also approve a specific number of exploration drill holes, ventilation shafts, and associated access roads within the perimeters and phases proposed for

Alternative A. In addition, Alternative C would require avoidance of cultural resources eligible for listing on the National Register of Historic Places (NRHP), which would be identified with preconstruction cultural resource surveys of the specific locations for exploration drill holes, ventilation shafts, and associated access roads. The cultural resource surveys and plans for avoidance would be provided to BLM or USFS (as appropriate based on jurisdiction) prior to construction. Avoidance of cultural resources eligible for listing on the NRHP would ensure that future exploration drilling or ventilation shaft construction is protective of cultural resources.

2.4.4 Pre-construction Wildlife and Vegetation Surveys

Similarly, Alternative C would also include pre-construction wildlife and vegetation surveys prior to exploration drilling, ventilation shaft construction or access road construction. As described above, the specific location for exploration drill holes and ventilation shafts would be provided to BLM or USFS prior to Phase 1, 2 or 3 exploration drilling, ventilation shaft construction or access road construction. Alternative C would require that these areas be surveyed for the presence of sensitive wildlife or vegetation prior to construction, and that potential affects to these species be managed as set forth in terms and conditions of approval for the POA, which is attached as Appendix C.

These surveys would focus on special status species including:

- Bald eagle (Haliaeetus leucocephalus)
- Ferruginous hawk (Buteo regalis)
- Flammulated owl (Otus flammeolus)
- Gunnison’s Prairie dog (Cynomys gunnisoni)
- Lewis’ woodpecker (Melanerpes lewis)
- Northern goshawk (Accipiter gentilis)
- Peregrine falcon (Falco peregrinus anatum)
- Golden eagle (Aquila chrysaetos)
- Beaman’s Townsendia (Townsendia beamanii), a BLM sensitive plant species

This component of Alternative C would address key issues associated with protection of wildlife in the area of the La Sal Mine Complex.

2.4.5 Modification of Reclamation Approach

Several key issues were identified that relate to reclamation of affected areas. They include issues such as how long would it take to reclaim affected areas, would adequate growth media be available, and would DRAs support a vegetative cover? Alternative C would address these issues by modifying the reclamation approach as follows:

- Revegetation test plots would be installed and monitored at the La Sal Mines complex prior to reclamation
- Slope breaks would be installed during final grading of Pandora DRA to reduce soil erosion and promote development of vegetative cover

Revegetation test plots would evaluate performance of growth media, seed mixtures, and soil amendments in meeting the reclamation performance criteria. Denison would prepare

a reclamation test plot plan, install the test plots, and monitor performance for a period of years sufficient for the test plots to meet the reclamation performance criteria. The plots would be initiated within 12 months of approval of the POA. The reclamation approaches developed based on performance of the reclamation test plots would then be utilized during reclamation of the La Sal Mines Complex, including providing additional growth media to use during reclamation, if necessary.

The proposed Pandora DRA would have reclaimed slope lengths of approximately 250 to 300 ft. Long slope lengths can promote soil erosion on reclaimed slopes (UDOGM 2000). Alternative C would include installation of slope breaks such as terraces or benches on the Pandora Mine DRA to reduce maximum slope lengths to less than approximately 100 ft. This approach would reduce soil erosion, and thereby, improve long-term revegetation performance.

2.4.6 Management of Noise

A key issue relates to the effects of noise of various receptors. Mine ventilation would require a series of ventilation shafts, which provide inflow or exhaust of air from the underground mine. The air flow is provided by ventilation fans, which are large electric fans that force air either into or out of the underground workings. When located on the surface, existing ventilation fans cause noise that is perceptible by some residents of the La Sal community. This noise also has the potential to affect wildlife in the area of the fan.

Alternative C would require installation of ventilation fans underground in all new ventilation shafts, unless installation underground is not feasible because of health and safety concerns. This would place the ventilation fans approximately 800 to 1000 ft. below the surface to mitigate noise concerns with surface ventilation fans. In addition, where existing fans present a localized noise concern, Denison would utilize available engineered methods to reduce noise including: installation of sound barriers to direct noise away from receptors, extended risers on fans to dissipate noise, and baffles in cases where such modifications to existing fans are available.

2.4.7 Routine Monitoring of Development Rock Environmental Characteristics

The term “environmental characteristics” of development rock describes the potential for the rock to cause water quality risks, or direct contact risks related to incidental ingestion or inhalation. Environmental characteristics of development rock produced to date are well known, and generally, future development rock is expected to be similar. However, there is potential that environmental characteristics of development rock could change in the future as new areas are mined. A key issue regarding whether placement of additional development rock would cause adverse effects to soil, sediments, or groundwater was identified based on public scoping. Alternative C would address this issue by requiring annual sampling of development rock during active mining and analysis of environmental characteristics of the rock. This information would be provided to BLM and USFS. If future monitoring of development rock environmental characteristics indicates the rock is likely to cause environmental effects not addressed by this EA, Alternative C would require Denison to modify the POA to meet applicable state and federal environmental regulations.

2.4.8 Modifications to Pandora DRA

The key issue relates to the available capacity of the Pandora development rock pile in relation to the planned mine production rates. As shown in Figure 2-3, Alternative C would expand the DRA into the valley area to the south of the proposed DRA. This conceptual design provides an increase in capacity of approximately 625,000 cy, resulting in a total capacity (including Alternative A capacity) of approximately 865,000 cy. As stated in the Plan of Operations Amendment, the estimated minimum and maximum annual volume of development rock are 31,000 and 103,000 cy, respectively. Based on these estimates, the additional capacity would satisfy the lifetime of the mine at the minimum rate and up to 8 years at the maximum rate.

The Alternative C DRA expansion would also result in an expansion to the affected boundary at the Pandora mine. The proposed affected boundary from the Plan of Operations Amendment was 15.39 acres. The Alternative C expansion of the DRA would require an affected boundary of 20.32 acres, approximately 5 additional acres.

2.4.9 Additional Terms and Conditions of Approval

Alternative C includes additional design features beyond those included in the applicants POA that would reduce or eliminate impacts to resources of concern. A list of these design features can be found in Appendix C.

2.5 Alternatives Considered, but Eliminated from Further Analysis

A consortium of environmental organizations submitted joint comments during public scoping. These organizations included Uranium Watch, Living Rivers, Canyonlands Watershed Council, Grand Canyon Trust, Center for Biological Diversity, and the Sierra Club (Uranium Watch et al.). These organizations proposed an alternative they named the “Environmental Protection Alternative”.

The proposed components of the Uranium Watch et al. alternative were evaluated with respect to the scope of the EA, BLM and USFS regulations, other state and federal laws, and the regulatory jurisdiction of BLM and USFS. Portions of the Uranium Watch et al. Environmental Protection Alternative have been incorporated into Alternative C.

The components of the proposed Uranium Watch et al. Environmental Protection Alternative are described in the following sections:

Develop and maintain a locally available La Sal Mines website to make mine information more readily available to the public

This is not necessary because BLM and USFS websites are currently in place, which describe the POA and the associated NEPA analyses. In addition, regulatory information associated with the mine is publically available upon request.

Interim site cleanup of specific areas at the La Sal Mines Complex

Management of solid wastes on lands subject to the jurisdiction of BLM and USFS is addressed in Alternatives A and C.

Installation of a local meteorological monitoring station

A local meteorological station is currently in place and operating in the La Sal area.

Installation of additional air quality monitoring devices, beyond those currently required by EPA and the state of Utah

USFS environmental protection requirements for locatable mining operations at 36 CFR 228.8 require compliance with all other laws for environmental protection. This section also states "certification or other approval issued by state agencies or other federal agencies of compliance with laws and regulations relating to mining operations will be accepted as compliance with similar or parallel requirements of these regulations". Accordingly, USFS has no requirement to implement further monitoring requirements for air quality beyond those set forth by the EPA and the state of Utah.

Similarly, BLM regulations at 43 CFR 3809.415 require compliance with "other Federal and state laws related to environmental protection" to meet requirements to prevent unnecessary or undue degradation. BLM is not required to reassess the adequacy of air quality monitoring stipulated by EPA or the state of Utah, who have regulatory jurisdiction with respect to air quality laws.

Restriction on the scope of the POA to exclude the La Sal Mine, installation of ventilation shafts, or exploration drilling

The POA addresses inherent and interconnected parts of the proposed mining process at the La Sal Mines Complex. Therefore, it is appropriate to analyze these proposed activities together in this EA.

Use of non-chemical methods for weed control

Department of Interior and BLM policy is to implement an integrated pest management plan. The Moab RMP affirms the use of integrated pest management. Use of chemicals has been analyzed at the programmatic level. This EA tiers to the 2007 Vegetation Treatment using Herbicides on BLM Lands in 17 Western States Programmatic EIS.

Development of a plan to reduce risks associated with arsenic

Proposed measures to isolate or control potential toxic or deleterious materials including arsenic are addressed in the POA and Alternatives A and C. In addition, further sampling and evaluation of the arsenic concentrations in DRAs were completed to support this EA. This information is described in Section 3.3.3.2. The proposed measures to isolate or control potential toxic or deleterious materials including arsenic are adequate to address this issue.

Survey of pre-mining vegetation conditions

Vegetation conditions at the La Sal Mines complex have are described in *Southwest Regional Gap Analysis Program* (USGS 2004), and site specific analysis of the potential for threatened or endangered, or sensitive plant species is addressed in the Biological Assessment and Evaluation (Appendix C). Pre-construction surveys for threatened or endangered, or sensitive species would be a design feature of Alternative C.

Spring and fall assessments of reclamation progress

BLM and USFS would monitor Denison's compliance with the amended Plan of Operations for the La Sal Mines Complex in accordance with BLM and USFS regulations. BLM monitoring requirements are set forth at 43 CFR §3809.600, and USFS inspection requirements are set forth in 36 CFR §228.7.

Develop a generic mine closure performance standard by BLM and require compliance with that standard at the La Sal Mines Complex with separate NEPA review, public comment and decision-making process for that standard

No federal or state radiological standards currently exist for reclamation of uranium mine sites. A site specific reclamation performance criterion for emission of radiation is proposed in the POA, and this criterion is assessed in Section 4.9.1. Potential development of a generic mine closure standard for all uranium mines is beyond the scope of this EA.

Conduct health assessments of all citizens who are living in the La Sal area and long-term tracking of heath of citizens even if they move from the La Sal area.

Neither BLM nor USFS have authority to conduct health assessments of La Sal citizens. The agencies also do not have authority to require other state or federal agencies to conduct health assessments. Denison is required to comply with state and federal laws that are intended to protect human health and safety including National Emission Standards for Hazardous Air Pollutants and regulations of the Mine Safety and Health Administration.

Sample soils, vegetation and water to determine potential uptake of radionuclides or presence of leachates in vicinity of mine

Sampling of development rock, ore and background soils was conducted to support evaluation of key issues related to radiological effects and environmental characteristics of the materials. Sampling of water was not necessary to support evaluation of key issues, because the mine is unsaturated, and not in connection with groundwater.

Completion of radiation surveys of mine facilities

These surveys were completed to support analysis of effects in the EA, and results are discussed in Sections 3.3.8 and 4.9.

Development of a plan for fires and other emergencies including shutdown of mine ventilation system and exclusion of pregnant emergency responders

Emergency response plans are currently in place at the mine, which define procedures to be taken in the event of a mine fire. Emergency response plans for structural fires in the La Sal area or for wildland fires in the general vicinity of the La Sal Mines complex are the responsibility of the local fire department and/or other state or federal agencies. Specifying emergency response requirements for these agencies is not within the scope of the proposed action. Potential hazards to emergency personnel associated with responding to fires or other emergencies near the mine ventilation system are assessed in Section 4.

Development of plan for continual long-term monitoring

A proposed monitoring plan for the La Sal Mines Complex is included in both Alternative A and Alternative C. This monitoring would continue for the life of the mine, and until mine reclamation meets reclamation performance requirements. Continual long-term monitoring of the site during the post-reclamation period is not necessary to address the key issues.

Require concurrent reclamation of any DRAs that will no longer receive development rock from mining operations prior to final cessation of mining

Under Alternatives A and C, all existing DRAs would be maintained in operable condition for the life of the mine, and would be reclaimed when mining ceases.

Placement of temporary cover on inactive DRAs

Potential environmental and radiological effects of DRAs are analyzed Section 4. Based on that analysis, installation of a temporary cover on inactive DRAs is not a reasonable and practical requirement for environmental protection.

Assessment of existing access routes associated with mine operations, and reclamation of any access routes that are not being used

Access routes that are associated with and required for mining are described in the POA, and these roads would be reclaimed under the proposed action. Reclamation of other historical or existing roads in the area that are not associated with the La Sal Mines Complex is not within the scope of the proposed action.

Require Denison to provide BLM and USFS copies of correspondence with Utah Division of Air Quality and EPA regarding radon monitoring, and copies of any citations or orders issued by the Mine Safety and Health Administration (MSHA) within 30 days of receipt or submittal of those documents

BLM and USFS would monitor Denison's compliance with the POA for the La Sal Mines Complex. However, BLM and USFS would defer to the Utah Division of Air Quality and EPA regarding radon monitoring, and to MSHA regarding mine safety. BLM and USFS would not require these documents to assess compliance with the POA. Information regarding air quality and radon is available from the Utah Division of Air Quality and EPA, and safety information is available from MSHA.

Install diffusers at all existing ventilation shafts

Potential effects of the proposed action and the alternatives with respect to air quality, radiological issues, and noise are analyzed in Section 4. Installation of diffusers on all existing ventilation shafts is not necessary to address the key issues.

Development of a reclamation cost estimate that includes long-term monitoring of the area

Costs for monitoring would be included in the reclamation cost estimate. The reclamation cost estimate would calculated after the decision in accordance with regulations at 43 CFR §3809 and 36 CFR 228 Subpart A.

Require trucks transporting ore to be covered with "hard covers" rather than the existing practice of utilizing flexible covers over the ore

Under Alternatives A and B, ore would be transported in accordance with U.S. Department of Transportation (DOT) regulations (CFR Title 49, Transportation), and Denison's "Transportation Policy for Shipments of Colorado Plateau Uranium Ores to the White Mesa Uranium Mill" (Denison 2007). These regulations and policy require the ore to be covered during transportation to prevent potential dispersion of dust from the ore; however, the regulations and policy do not require a "hard cover".

2.6 Summary Comparison of Alternatives

Comparison of the key issues described in Section 1.7.3 with selected measurement indicators provides a means to compare the alternatives. Table 2-1 is a summary presented to define the differences between the alternatives with respect to the key issues and measurement indicators. Detailed evaluation of the alternatives is presented in Section 4, Environmental Consequences.

Table 2-4. Summary of alternatives with respect to key issues and measurement indicators

Measurement Indicator	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C**
Noise			
Expected number of new ventilation fans installed on the surface	Up to 59	0	0
Expected decibel level of noise near new ventilation shafts	Up to 90	Not applicable	Approximately 80
Radiological Issues			
Expected number of new ventilation shafts	Up to 59	0	Up to 59
Pre-construction radon modeling required prior to ventilation shaft construction	No	Not applicable	Yes
Pre-construction and post-reclamation radiological surveys	No	No	Yes
Reclamation			
Revegetation test plots completed	No	No	Yes
Available stockpiled soil	10,630 cubic yards (cy)	2,630 cy	34,500 cy
Additional growth media provided to supplement existing soil stockpiles	No	No	Yes, if necessary based on results of revegetation test plots
Rock Characterization			
Frequency of routine environmental characterization of	None	None	Annual

Measurement Indicator	Alternative A (Proposed Action)	Alternative B (No Action)	Alternative C
development rock during mining			
Slope Stability			
Maximum DRA slope after reclamation	3:1	No limit	3:1
Socioeconomics			
Expected duration of mining operation and associated employment and tax revenue	2023	Approximately 2012	2023
Transportation			
Percent increase in haul truck traffic on state and federal highways	0 to 5 percent	0	0 to 5 percent
Water			
Volume of development rock used as backfill within D-aquifer for reclamation of production and ventilation shafts	Approximately 6,000 cy	Approximately 2,600 cy	None
Installation of aquifer seals during reclamation of ventilation shafts	No	No	Yes
Wildlife			
Number of new surface ventilation fans installed	Up to 59	None	None

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the potentially affected existing environment (i.e., the physical, biological, social, and economic values and resources) of the impact area as identified in the IDT Checklist (Appendix A) and presented in Chapter 1 of this EA. This chapter provides the baseline for comparison of effects described in Chapter 4. Resources that could be impacted to a level requiring further analysis are described in this section. This section focuses on the key issues developed through project scoping and described in Chapter 1.

3.2 General Setting

The La Sal Mines Complex is located in the Canyonlands Section of the Colorado Plateau, on the south side of the La Sal Mountains. The mine lies at an elevation of approximately 7,000 ft above mean sea level (amsl). Topography consists of a series of generally south trending valleys on the south flank of the La Sal Mountains.

The La Sal Mountains consist of three major peaks ranging 11,000 to 13,000 ft elevation surrounded by mesas and canyons typical of the Canyonlands section of the Colorado Plateau (Hunt 1958). The La Sal Mountains receive much higher precipitation than the arid areas surrounding the mountains, and exhibit markedly different vegetation including alpine tundra at the highest elevations; aspen, spruce and fir in moderate elevations; and piñon-juniper at the base of the mountains.

The LA Sal Mines Complex is located in a semi-arid environment, with sparse vegetation such as juniper, piñon pine, cacti, and sagebrush. The Pandora and Snowball mines are located near the lower elevation extent of piñon-juniper forest at approximately 7,000 ft elevation. Vegetation in the areas of the La Sal and Beaver Shaft mines is characterized by sagebrush and cactus. The contrast in vegetation between the La Sal Mountains to the north and the La Sal Mines Complex area to the south exhibits the marked orographic effects on climate in the area, with more precipitation occurring in the La Sal Mountains than in the area of the La Sal Mines Complex.

The La Sal Mines Complex is located near the watershed boundary between the Dolores River to the east and the Colorado River to the west. The La Sal, Pandora and Snowball mines lie within the Dolores River watershed, and the Beaver Shaft mine straddles the watershed boundary between the Dolores River and Colorado River watersheds. Perennial surface water is not present in the area of the La Sal Mines Complex, and surface water is generally only present during short-term, intense precipitation or snow melt events.

The La Sal Mines Complex is located near the town of La Sal, which is a small community of approximately 339 people. Industry in the La Sal area includes agriculture and mining.

3.3 Resources/Issues Brought Forward for Analysis

3.3.1 Air Quality

Air quality can be affected by both anthropogenic air emission sources as well as naturally occurring air emissions. Southeastern Utah air emissions occur from natural sources such as windblown dust and forest fires. Anthropogenic air emissions occur from industrial facilities,

vehicle exhaust, and residential activities such as wood-burning fireplaces. Air pollution in excess amounts can cause health concerns for humans as well as adverse effects on vegetation, wildlife, water bodies, and visibility.

3.3.1.1 Regulatory Requirements

Air quality and associated permitting for industrial air emission sources are regulated under the federal Clean Air Act. Industrial air emission sources may include stationary (or point) sources, mobile sources, and fugitive sources. EPA has developed several air quality standards by which industrial facilities must comply in order to operate.

National Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) were developed by EPA and adopted by the State of Utah, and are intended to protect public health and welfare. Primary standards represent air quality levels, with an adequate safety margin, required to protect public health. Secondary standards represent air quality levels necessary to protect public welfare. These standards must be met outside a facility's property boundary.

NAAQS have been established for nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), small particulate matter less than 10 microns in size (PM10), very small particulate matter less than 2.5 microns in size (PM2.5), lead, and ozone. The NAAQS that the La Sal Mines Complex must comply with are listed in Table 3-1. Units for the air quality standards presented in Table 3-1 are micrograms per cubic meter of air ($\mu g/m^3$) unless otherwise specified.

Table 3-1. National Ambient Air Quality Standards

Pollutant	Averaging Period	Primary Standard	Secondary Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean 1-Hour	100 $\mu g/m^3$ [(a)] 0.053 ppm [(b), (c)]	100 $\mu g/m^3$ [(a)] None
Sulfur Dioxide (SO_2)	1-Hour 3-Hour 24-Hour Annual Arithmetic Mean	0.075 ppm [(b), (d)] None 0.14 ppm [(b), (e)] 0.03 ppm [(b)]	None 0.5 ppm [(b), (e)] None None
Particulate matter less than 10 microns in diameter (PM_{10})	24-Hour	150 $\mu g/m^3$ [(a), (f)]	150 $\mu g/m^3$ [(a), (f)]
Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)	24-Hour	35 $\mu g/m^3$ [(a), (g)]	35 $\mu g/m^3$ [(a), (g)]
	Annual	15 $\mu g/m^3$ [(a), (h)]	15 $\mu g/m^3$ [(a), (h)]
Carbon Monoxide (CO)	1-Hour	40,000 $\mu g/m^3$ [(a), (e)]	N/A
	8-Hour	10,000 $\mu g/m^3$ [(a), (e)]	N/A
Lead	3-Month Rolling Average	0.15 $\mu g/m^3$ [(a)]	0.15 $\mu g/m^3$ [(a)]
Ozone	8-Hour	0.075 ppm [(b), (i)]	0.075 ppm [(b), (i)]

Notes:
Data from EPA (2011a)
N/A - Not applicable
[a] Micrograms per cubic meter
[b] Parts per million
[c] The standard is based on the 3-year average of the 98th percentile of the daily maximum 1-hour average
[d] The standard is based on the 3-year average of the 99th percentile of the daily maximum 1-hour average
[e] Not to be exceeded more than once per calendar year
[f] Not to be exceeded more than once per calendar year on average over 3 years
[g] The standard is based on the 3-year average of the 98th percentile of the 24-hour average
[h] The standard is based on the 3-year average of the weighted annual mean
[i] The standard is based on the 3-year average of the fourth-highest daily maximum 8-hour average

Prevention of Significant Deterioration Increments

In addition to the NAAQS, the Clean Air Act has established the Prevention of Significant Deterioration (PSD) program to afford additional protection to preserve air quality in designated areas of the U.S. EPA has defined three area classifications with different air quality protection goals. Class I areas are afforded the highest level of protection and include areas with special national value such as national parks and wilderness areas. Human activity within the boundary of these Class I areas is closely monitored and virtually no industrial activity is allowed. Very limited industrial growth is allowed outside the boundary but near any Class I area. Class II areas allow moderate industrial growth by limiting the amount of air quality degradation. Class III areas allow the largest amount of incremental degradation; however there are no designated Class III areas at this time.

For each PSD classification, EPA has developed PSD increment standards that limit the incremental increase in air pollutant concentrations above the concentrations as of a specific date, called a baseline date. Baseline dates are established when a PSD major source permit application is deemed complete by the permitting authority. Any change in ambient air concentrations from that baseline date either consumes PSD increment (if there is an increase) or expands PSD increment (if there is a decrease). The sum of changes from the baseline date may not exceed the PSD increment. The Utah Department of Environmental Quality (UDEQ) evaluates and manages PSD increment consumption in Utah and ensures that degradation of air quality is less than the PSD increment limits. PSD increments have been established for PM10, SO2, and NO2. The standards for incremental change in air quality for each area classification are shown in Table 3-2.

The La Sal Mines Complex is located in an area designated by EPA as PSD Class II. This designation means that EPA allows moderate industrial growth in the area, by restricting air quality concentrations to the more stringent Class II increment limit, rather than the NAAQS. The baseline dates applicable to the La Sal Mines Complex are 1977 for PM10 and SO2, and 1988 for NO2. Thus, the incremental increases of PM10, SO2, and NO2 must be below the limits set by EPA, as shown in Table 3.3.1-2. The nearest PSD Class 1 area is Canyonlands National Park, which is located approximately 50 miles west of the La Sal Mines Complex.

Table 3-2. Prevention of Significant Deterioration Increments

Pollutant	Averaging Period	Class I Area	Class II Area	Class III Area
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	2.5	25	50
Sulfur Dioxide (SO_2)	3-Hour	25 [(a)]	512 [(a)]	700 [(a)]
	24-Hour	5 [(a)]	91 [(a)]	182 [(a)]
	Annual Arithmetic Mean	2	20	40
Particulate matter less than 10 microns in diameter (PM_{10})	24-Hour	8 [(a)]	30 [(a)]	60 [(a)]
	Annual Arithmetic Mean	4	17	34
Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)	24-Hour	2 [(a)]	9 [(a)]	18 [(a)]
	Annual Arithmetic Mean	1	4	8

Notes:
Data from CFR (2011)
All concentrations given in units of micrograms per cubic meter
N/A - Not applicable
[(a)] Not to be exceeded more than once per calendar year

National Emission Standards for Hazardous Air Pollutants

Under Section 112 of the Clean Air Act, underground uranium mines that exceed specified production thresholds are required to monitor the amount of radon gas being emitted from mine vents. This regulation is codified in the Code of Federal Regulations (CFR) 40 CFR 61, Subpart B, National Emission Standards for Hazardous Air Pollutants (NESHAPs). 40 CFR 61, Subpart B applies to the owner or operator of an active underground uranium mine which has mined, will mine, or is designed to mine over 100,000 tons of ore during the life of the mine; or has had or will have an ore production rate greater than 10,000 tons per year, unless it can be demonstrated that the mine will not exceed total ore production of 100,000 tons during the life of the mine.

Mines subject to this regulation may not emit radon-222 (Rn-222) to the ambient air in excess of those amounts that would cause any member of the public to receive in any year an incremental effective dose equivalent to 10 millirem per year (mrem/yr) above background. The La Sal Mines Complex will produce more than 100,000 tons of ore during the life of the mine and therefore is subject to the NESHAPs for underground uranium mines.

Greenhouse Gases

EPA has issued a rule under the Clean Air Act addressing permitting programs for greenhouse gas (GHG) emissions from industrial facilities. The EPA's Tailoring Rule establishes permitting requirements for large industrial facilities that emit more than 75,000 tons of GHGs per year (EPA 2011b). The permitting rules apply to the largest air pollution emitters such as power plants and oil refineries, and do not apply to most small emission sources under the CAA permitting programs. The GHG permitting rules were implemented on January 2, 2011.

EPA has delegated authority to UDEQ to administer the air permit program for industrial emission sources in Utah. The La Sal Mines Complex is subject to the requirements set forth in Utah Administrative Code (UAC) Title R307, "Environmental Quality, Air Quality."

Air Quality Permitting

Emissions from regulated sources in Utah are managed through air quality permits that are issued by UDEQ. These air quality permits are referred to as "Approval Orders" under the UDEQ regulations. To obtain an Approval Order (AO) in Utah, an industrial source must identify all potential air emissions of regulated pollutants associated with its operations and demonstrate compliance with ambient air quality standards.

The La Sal Mines Complex currently consist of four active underground uranium mines, including the Pandora Mine, Beaver Shaft, La Sal Mine, and Snowball Mine. Denison is currently permitted to produce a maximum of 192,000 tons of ore per year from the mines based on an air quality permit issued by UDEQ, AO DAQE-AN0141510002-09. Activities associated with existing mining operations that produce air emissions include underground mining operations, ore and rock handling and storage, diesel generator and air compressor operations, and ore transport. Denison submitted a Notice of Intent (NOI) application to UDEQ for approval to modify the permit to increase ore production from 192,000 tons per year to 312,000 tons per year, and to add several small diesel generators for backup power if primary power is interrupted. This application was approved in March 2012.

The La Sal Mines Complex is located in a rural environment, near the small town of La Sal, Utah. The air quality in the vicinity of the mine is in compliance with ambient air quality standards based on modeled pollutant concentrations resulting from La Sal Mines Complex operations. The project site and surrounding area are designated as "attainment" or "unclassifiable" for all criteria pollutants. These designations signify that the region meets the ambient air quality standard for each pollutant (attainment) or there are insufficient data to make a determination (unclassifiable). An area that does not meet the ambient air quality standard for a given pollutant is designated "non-attainment" by the federal administrator. No designated non-attainment areas are present in the La Sal area.

3.3.1.2 Background Concentrations

Because the project location is remote, there are few nearby stationary air pollution sources and existing background pollutant concentrations are generally expected to be low. No air pollutant monitoring datasets are available from the La Sal Mines Complex or in the immediate vicinity. However, background pollutant concentration data for PM10 were provided by Utah Division of Air Quality (UDAQ) for recent mine permitting in southeastern Utah (Tetra Tech 2008a). The PM10 data were collected in 2003 from the nearest monitoring station in Moab, Utah.

The annual background NO2 concentration was taken from a monitoring station located in Santa Clara, Utah. This station is located in a relatively rural residential area and is more representative of the La Sal area than most other monitoring stations which are located in large urban areas. The NO2 data were obtained from the UDEQ air monitoring data website (UDEQ 2011c). The annual average NO2 concentration at this site is 3.5 ppb (6.5 µg/m3), based on the 2008 monitoring year. Monitoring data were not available for this site in other years beside 2008. The background pollutant concentrations are presented in Table 3-3.

Table 3-3. Background Air Pollutant Concentrations.

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)[a]
Nitrogen Dioxide (NO_2)	Annual	6.5
Particulate Matter less than 10 microns diameter (PM_{10})	24-Hour Annual	67 22

Note:
[a] Micrograms per cubic meter

3.3.1.3 Visibility

Atmospheric visibility is measured by visual range, which is the average distance at which contrasting objects can be discriminated. Some air pollution can cause visibility impairment, often in the form of a regional haze. The Colorado Plateau experiences some of the best visual range in the United States, having the least amount of visibility impairment along with the Nevada Basin and Alaska (USFS, NPS, and USFWS 2010). The visual range in southeastern Utah is considered an important resource in the area with several Class I areas located in the region including Arches National Park (NP) and Canyonlands NP. The La Sal Mines Complex is located approximately 27 miles southeast of Arches NP, and 27 miles east of Canyonlands NP.

3.3.2 Cultural Resources

The term 'cultural resources' refers to archaeological, traditional, and built environment resources, including, but not necessarily limited to, buildings, structures, objects, districts, and sites. Not every object or feature that might be considered a cultural resource necessarily requires study. Certain properties can be so minor or fragmentary or ubiquitous that they lack the potential for significance as defined within Section 106 of the National Historic Preservation Act (NHPA) and the implementing regulations found at 36 Code of Federal Regulations (CFR) 800. At the same time, not all potentially important cultural resources are visible or apparent prior to conducting technical studies or consultations specific to a particular project. Archaeological resources may be buried, without surface features, or inconspicuous to the untrained eye. Sites of important events, traditional cultural properties, or places associated with an important person may lack obvious physical characteristics. Importantly, it is not always a simple matter to identify and evaluate cultural resources that could possess historical value and that therefore require consideration under federal and state laws and regulations.

3.3.2.1 Native American Consultation

On March 10, 2011, BLM mailed a letter to 15 representatives of 8 tribes and pueblos, initiating consultation with appropriate, legally recognized Native American groups who used the region historically. BLM received responses from two tribes—the Southern Ute Indian Tribe and the Hopi Tribe. BLM representatives held a consultation meeting with the Southern Ute Tribal Council on April 8, 2011, who expressed concerns about air quality. The Hopi Tribe responded with a letter dated March 28, 2011, stating that they support the identification and avoidance of prehistoric archaeological sites and consider them to be traditional cultural properties. Additional information regarding consultations is presented in Chapter 5.

3.3.2.2 Cultural History Overview

To better understand the historical relevance or significance of the associated cultural resources, it is important to be aware of the historic and prehistoric activities that occurred in the area. The Pre-contact era encompasses everything from the Paleoindian period (ca. 10,000–6,000 B.C.) to the Protohistoric period (1300–1776 A.D.). The Paleoindian period is characterized by sparse settlement and the hunting of large Pleistocene mammals. Around 6,000 B.C. the Archaic period, which loosely defines the period of time between the end of the Pleistocene and the widespread adoption of agriculture, began. The Archaic period is defined by a diversification of occupation locales and an increasing reliance on plant food sources. The end of the Archaic period and the beginning of the Formative period came around 100 A.D. The Formative period, broadly characterized by a village agricultural economy, extended to approximately 1300 A.D. In southeastern Utah, the Formative period is marked by one distinct culture occupying the region: the Ancestral Puebloan (or Hisatsinom, following the Hopi nomenclature). The project area is located in the extreme northern Ancestral Puebloan range, at the interface between the Great Basin and Colorado Plateau culture areas. The archaeological record in and around the project inventory area reflects Formative period patterns of subsistence that are more similar to those of the Archaic. Hunting and gathering remained central to Ancestral Puebloan lifeways, supplemented with agriculture. Within the inventoried area the Formative period is divided into six different phases. Table 3-4 represents the chronology of the region during the Formative period.

Table 3-4. Chronology of San Juan County's Formative Period

Phase	Date Range
Basketmaker II	A.D. 100–500
Basketmaker III	A.D. 450–700
Pueblo I	A.D. 750–900
Pueblo II	A.D. 900–1100
Pueblo III	A.D. 1100–1300
Pueblo IV	A.D. 1300–1700

The end of the Pre-contact era is defined as the Protohistoric period, which is loosely defined as 1300–1776 A.D. The Protohistoric period refers to the time period when European goods and ideas were beginning to infiltrate native cultures but most natives had not yet come into contact with European peoples.

The Post-contact era is arbitrarily designated as beginning at the time when written documents of the region were first recorded. As few of the earliest records survive today, the Post-contact era may be more appropriately regarded as the period when cultural dominance within the region gradually shifted from aboriginal to Euro-American control. Lisbon Valley and the surrounding vicinity were sparsely populated and marginally developed over the duration of the Historic period. The primary themes that dominated the Lisbon Valley area through the Historic period are homesteading, copper and (later) uranium prospecting, mining, land survey, and ranching. Based on known evidence in and around Lisbon Valley, these activities appear to have commenced after passage of the Homestead Act of 1862. Little is understood about any earlier historic occupations in and around the inventory area. The time from 1776 to 1826 is referred to as the Spanish Exploration period, and 1826 to 1847 as the Early Euro-American Exploration

period. Colonization of the area occurred in earnest between 1847 and 1896, when homesteaders from Colorado began moving into the area.

In 1896 Utah became the 45th state. The residents of Utah were involved in a variety of enterprises ranging from agriculture to service industries. Like much of the West, by the beginning if the twentieth century the economy of the Four Corners region was firmly established on resource exploitation and extractive industries. Sheep and beef ranching were major industries in the region until the end of World War II. The Four Corners region was one of the few areas in and around Utah to enjoy an economic boom during the post-war period, fueled by the U.S. Government's drive to establish a domestic stockpile of refined yellowcake uranium oxide. Uranium ore had first been discovered in San Juan County in 1898 by Richard Weatherill (Shumway 1970). San Juan County is located at the center of the southwestern United States' uranium districts. Between 1952 and 1957, 40 percent of San Juan County became staked with uranium mining claims (McPherson 1995:256), thanks in part to the discoveries of Charles Steen in the Lisbon Valley. The uranium boom resulted in the improvement and development of the regional transportation system because of the need for roads and bridges able to carry ore trucks and heavy equipment year-round. At present, tourism is the most vibrant industry in the Four Corners region.

3.3.2.3 Class I File Search

A Class I literature review was conducted to identify the extent of previous cultural resource surveys and any known cultural resource sites present in the project area. Record searches for this project were performed by archaeologists accessing the records of the Utah Division of State History (UDSH) in Salt Lake City, the BLM Moab Field Office, and the USFS Monticello Field Office. The record searches resulted in the identification of numerous previously conducted cultural resources studies and known cultural resource sites within the project area and a 0.5-mile radius.

Previous Inventories

Thirty-two cultural resource inventories, or surveys, have been completed within 0.5 mile of the project area. Seven (22%) of these were purely block surveys, 17 (53%) were purely linear, and three (9%) had both block and linear sections; the remaining five (16%) surveys are of unknown type. Several of the cultural resource surveys conducted within the project area were completed for proposed exploration drilling, mine vent construction, road construction, and other activities associated with La Sal Mines Complex operations.

One of the cultural resource inventories was conducted for the proposed development rock pile expansion at the Pandora Mine, included in the Proposed Action. This intensive Class III pedestrian survey of 8.8 acres resulted in the identification and documentation of one prehistoric isolated occurrence (SWCA 2009).

Known Resources

At this time only a small portion of the project area has been subject to surface inventory for cultural resources. These studies have identified cultural resources but it is likely that other unidentified cultural resources are present in uninventoried portions of the project area. Buried archaeological deposits may also be present in certain depositional environments.

As of July 2011, 28 archaeological sites have been recorded within 0.5 mile of the project area; however, records are available for only 25 (89%) of these sites. Of the 25 sites with available

records, none (0%) have historic components and all (100%) are prehistoric in age. The site types included 16 flaked stone, or lithic, scatters; one lithic quarry; and eight open camps.

Only two of the known sites (7%) are considered 'historic properties', or eligible for nomination to the National Register of Historic Places (NRHP). Of the remaining sites, 14 (50%) have been determined to be not eligible for the NRHP and 12 (43%) sites are unevaluated for NRHP eligibility. Data on isolated occurrences within the search radius are not available. Isolates, by definition, are not considered eligible for inclusion on the NRHP.

3.3.3 Development Rock Environmental Characteristics

Several issues were identified that relate to the environmental characteristics of development rock. Development rock is rock that must be excavated during mining to reach ore, but that does not contain enough uranium to support profitable mineral processing. Ore is rock that contains a high enough concentration of uranium to support profitable mineral processing. Ore excavated from the La Sal Mines Complex would generally be present in ore stockpiles for 7 days or less (CDM 2010a). Conversely, development rock that cannot be placed within previously mined voids underground would be permanently stored in DRAs located on the surface that would be reclaimed at the end of mining. Therefore, the following discussion focuses on environmental characteristics of development rock.

Evaluation of key issues related to development rock considers several factors:

- How is the rock managed?
- What are the environmental characteristics of the rock?

Existing conditions relevant to the key issues are discussed in the following sections.

3.3.3.1 Management of Development Rock

Production of development rock is integral to the underground mining process, because the rock must be excavated to provide access to the ore. Currently, development rock is managed in two ways:

- Placement on the surface in DRAs
- Placement underground within previously mined voids

To the extent practicable, development rock is placed underground within voids that were mined during previous periods of operation. This is the preferred method for management of development rock, because it does not require haulage to the surface and does not entail any disturbance of surface resources. However, it is not feasible to store all development rock underground for several reasons. Firstly, when rock is broken during mining, the volume of the rock expands by a factor equal to the increased void space between the broken fragments of rock. This volume increase requires some haulage of development rock to the surface. Secondly, the mining process requires maintenance of open haulage-ways underground to provide access to current and future mining areas. Accordingly, development rock from those areas also requires haulage to the surface.

Development rock that must be hauled to the surface is managed by placing the rock into DRAs located near the mine portals. DRAs are located at each of the four mines of the La Sal Mines Complex. The size and configuration of the existing DRAs is described in the following section.

3.3.3.2 Environmental Characteristics of Development Rock

Rock excavated from uranium mines, and other metal mines, may have the potential to affect the environment. Therefore, development rock was assessed using various approaches to understand the environmental characteristics of the rock. Development rock was initially characterized in *Evaluation of Development Rock Piles at the La Sal Mines Complex* (CDM 2009a) to address identification of potentially deleterious materials as defined in state mine permitting regulations, and prevention of unnecessary or undue environmental degradation in accordance with BLM mining regulations. Further sampling and evaluations related to the arsenic concentration of the development rock were also conducted to address a key issue identified during public scoping.

Environmental characteristics that were evaluated consist of:

- Will the rock generate acid mine drainage?
- Will the rock generate other deleterious leachate that could affect water quality?
- Does the rock have potential to cause human health risks through incidental ingestion or inhalation?

These issues are discussed further in the following sections. Details of these evaluations are included in *Evaluation of Development Rock Piles at the La Sal Mines Complex* (CDM 2009a). Radiological characteristics of development rock are evaluated separately in Section 3.3.8.

Potential for Development Rock to Generate Acid Mine Drainage

Acid mine drainage is a common problem at metal mines. It can cause severe effects to surface water or groundwater quality. Acid mine drainage is caused by exposure of specific minerals called sulfide minerals to oxidation as a result of mining. The potential for the Pandora rock to generate acid rock drainage was evaluated through completion of a field paste pH survey and field examination of rock mineralogy using a hand lens. The field paste pH method is well-suited to identify acid generating rock that has been present on the surface for a period of years to decades. It is, therefore, ideal to evaluate the potential for acid rock drainage at the La Sal Mines Complex. The field paste pH data indicate that the rock is not acid generating. The development rock was also examined using a hand-lens to identify the mineralogy of the rock, and to specifically examine the rock for the potential presence of sulfide minerals. No sulfide minerals were identified in the development rock. The mineralogical data support the paste pH data, and also indicate that the development rock is not acid generating.

Potential for Development Rock to Generate Deleterious Leachate

It is possible for development rock that is not acid generating to affect water quality through other processes. This is caused by interaction of the rock with infiltrating rainwater or snow melt, and subsequent discharge of leachate from the piles into surface water or groundwater. Generation of deleterious leachate requires two mechanisms:

- The rock must contain deleterious constituents that are soluble in water
- Sufficient percolation through the pile must occur to produce problematic leachate

Evaluation of the rock for deleterious constituents that are soluble in water was completed using a method called the meteoric water mobility procedure (MWMP). The MWMP is a column test

where a sample of the rock is placed into a column and water is slowly percolated through the rock. The resulting leachate from the column tests is analyzed for dissolved constituents to identify constituents that have dissolved from the rock sample. Additional analyses were conducted to evaluate whether problematic leachate production is likely from the piles. Development of leachate from rock piles is dependent on factors such as precipitation, evaporation and water storage capacity within the DRA. The potential for water to percolate though the pile was evaluated using unsaturated flow modeling using UNSAT-H. The UNSAT-H model simulates processes of precipitation, infiltration, evaporation and percolation. This modeling is described in detail in Evaluation of Development Rock Piles at the La Sal Mines Complex (CDM 2009a) and *Estimation of Percolation through Mine Rock Stockpiles Using UNSAT-H* (CDM 2010). This work shows that it is unlikely that the DRAs produce deleterious leachate.

Potential for the Rock to Cause Risks Related to Direct Contact

The development rock contains naturally enriched concentrations of uranium and other constituents such as arsenic, molybdenum, selenium and vanadium. These constituents could potentially cause risks to humans as a result of incidental ingestion and inhalation of dust during various activities. Three development rock samples from discrete locations on the Pandora DRA were analyzed in *Evaluation of Development Rock Piles at the La Sal Mines Complex* (CDM 2009a) to evaluate this issue.

Additional samples were collected during completion of this EA to further characterize the DRAs at the La Sal Mines Complex. Sampling was completed at all existing DRAs at the La Sal Mines complex. Each sample contained 90 increments of equal mass that were spatially representative of DRAs at the Pandora, Snowball, La Sal, and Beaver mines. These samples were analyzed for 32 trace metals in an EPA certified contract analytical laboratory. These data characterize the average concentrations of arsenic, molybdenum, selenium, uranium, vanadium and other metals in the DRAs, and are used to characterize potential human health risk related to incidental ingestion and inhalation.

An initial screening-level evaluation of this data was conducted using toxicity screening values. This evaluation is based on comparison of the total metals concentrations detected in the composite samples with appropriate toxicity screening criteria developed by BLM and EPA. The guidance document titled, *Risk Management Criteria for Metals at BLM Mining Sites* (BLM 2004) provides risk management criteria (RMC) for human exposure to soils for various land uses on BLM property such as campers, all-terrain vehicle (ATV) drivers, BLM workers, and surveyors. The BLM RMC values are used to support land management of former mine sites and as benchmark concentrations to which environmental concentrations may be compared. In particular, BLM RMC values were developed such that "people will not experience adverse health effects from metal contamination on BLM lands during their lifetimes if exposure is limited to soil… with concentrations at or less than the RMC" (BLM 2004, p. 3).

However, BLM RMCs have not been identified for several site-specific metals of interest at the La Sal Mines Complex including uranium. In order to assess the potential toxicity of these metals, EPA Regional Screening Levels (RSLs) (EPA 2008) for a commercial/industrial exposure scenario were utilized as toxicity screening criteria. Although the commercial/industrial exposure scenario is not the same as the expected post-mining land uses of the property (for example, non-motorized recreation), the exposure concentrations provided in this scenario are

conservative; that is, the scenario assumes additional human health exposure to metals on the site (e.g., more hours of exposure per year for a worker) than what is anticipated given the anticipated post-mining land use. Similar to RMCs, EPA RSLs have been developed using conservative exposure assumptions, and represent levels that are protective of human health for most site conditions (EPA 1996). The use of screening criteria for an industrial land use is very conservative for the La Sal Mines Complex DRAs, because it assumes exposure for 250 days per year over 25 years.

The 90-point composite sample data show that average metals concentrations for molybdenum, selenium, uranium, vanadium and other metals do not exceed any human health screening criterion for the following land uses: camper, ATV driver, or surveyor. The arsenic concentrations of the DRAs range from 10.6 milligrams per kilogram (mg/kg) to 15.2 mg/kg. Two of the DRAs slightly exceed the arsenic screening criterion for a BLM worker of 12 mg/kg. When a value exceeds the initial screening criteria, further human health risk assessment is required to evaluate risks. Therefore, a more detailed assessment was conducted by a qualified human health risk assessor, and a site-specific RMC for arsenic of 37 mg/kg was calculated (CDM 2009a). Using this site-specific value, the average arsenic concentrations of the DRAs of 10.6 milligrams mg/kg to 15.2 mg/kg are well below the site specific RMC, and arsenic in DRAs is not expected to cause adverse human health effects.

3.3.4 Geology

3.3.4.1 Stratigraphy

The La Sal Mines Complex is located in an area of gently dipping sedimentary rocks, which include interbedded clastic and chemical sedimentary rocks. Clastic sedimentary rocks include shale, siltstone, sandstone and conglomerate. Chemical sedimentary rocks include limestone and evaporites such as halite and sylvite. Accumulations of unconsolidated quaternary sediments are present in the valley bottoms near the La Sal Mines Complex and in a large area south and west of the mines. Figure 3-1 shows the surface geology in the area of the La Sal Mines Complex based on geologic data provided by the Utah Geological Survey (Doelling 2004).

The mine is located on the south limb of the Pine Ridge anticline, and the rock units strike generally west-northwest and dip gently towards the south-southwest at approximately 3 to 5 degrees. Additional information regarding the structural geology of the area is provided below in Section 3.3.4.

This section describes the rock units extending from Pennsylvanian Hermosa Formation, which is located deep under the La Sal Mines Complex, to the Cretaceous Dakota Sandstone, which crops out on ridge tops near the mine complex area. The Paradox Member of the Hermosa Formation contains rock salt, which forms an impermeable barrier to groundwater flow and divides a deep Paleozoic aquifer from the overlying Mesozoic and Cenozoic aquifers (Weir et al. 1983). The rock salt is composed of 70 to 80 percent halite (NaCl) , potash salts such as sylvite (KCl), and gypsum (CaSO4 + 2 H2O) (Weir et al 1983, Cater 1955). Therefore, the Paradox Member of the Hermosa Formation provides a suitable base level for this investigation. The Pardox Member is also important in controlling the regional structural geology of the area. Information regarding the stratigraphy beneath the Pennsylvania Hermosa Formation is provided in Weir et al. (1983), Carter and Gualtierri (1965) and Doelling (2004).

A thick sequence of clastic sedimentary rocks containing various portions of sandstone, siltstone, shale, conglomerate and local limestone overlies the Hermosa Formation. These rock units range in age from Triassic to Cretaceous. This sequence of clastic sedimentary rocks is important both with regard to the hydrogeologic framework of the area and the occurrence of uranium-vanadium mineralization. This sequence includes the following formations:

- Permian Cutler Formation
- Upper Triassic Chinle Formation
- Jurassic Glen Canyon Group
- Mid to Upper Jurassic San Rafael Group
- Upper Jurassic Morrison Formation
- Lower Cretaceous Burro Canyon Formation
- Cretaceous Dakota Sandstone
- Unconsolidated Quaternary deposits

The Permian Cutler Formation directly overlies the Hermosa Formation, and consists predominantly of arkosic sandstone and conglomerate. Small quantities of sandy shale are present within the formation. The thickness of this formation within the La Sal Quadrangle ranges from 390 to 2,687 ft.

The Moenkopi Formation is overlain by the Upper Triassic *Chinle Formation*. This unit consists primarily of siltstone interbedded with fine grained sandstone, shale and conglomerate. The individual lithological units within the formation are lenticular and discontinuous. This unit is up to 600 ft. thick, but the thickness varies within the La Sal Quadrangle (Carter and Gualtaieri 1965).

The Chinle Formation is overlain by the Jurassic *Glen Canyon Group*, which consists of three formations: the Wingate Sandstone, the Kayenta Formation, and the Navajo Sandstone. The *Wingate Sandstone* overlies the Chinle Formation. This formation consists of massive, fine grained sandstone composed of clean well-sorted quartz sand grains. The thickness of the Wingate Sandstone varies from 150 to 280 ft in the La Sal Quadrangle.

The *Kayenta Formation* overlies the Wingate Sandstone and consists of interbedded sandstone, siltstone and shale. The sandstone is thin bedded, flaggy to massive, and occurs in discontinuous beds that interfinger with siltstone and shale. The thickness of the Kayenta Formation is approximately 160 ft.

The *Navajo Sandstone* is massive fine-grained clean quartz sandstone, which overlies the Kayenta Formation. This unit is eolian in origin as evidenced by very large tangential cross-bedding. The formation ranges in thickness from 0 to 240 ft in the La Sal Quadrangle.

The Glenn Canyon Group is overlain by the Jurassic *San Rafael Group*, which includes the Entrada Sandstone and the Summerville Formation. The *Entrada Sandstone* consists of a combination of horizontally bedded and eolian, cross bedded sandstones with a bimodal grain size distribution including

very fine grained sandstone (<0.0001 inches (in.) grain size) and medium grained sandstone (0.02 to 0.03 in. grain size). The Entrada Sandstone is subdivided to include the Dewey Bridge Member, the Slick Rock Member and the Moab Sandstone Member. The S*ummerville Formation* overlies the Entrada Sandstone, and consists primarily of sandy and silty shale. This unit also includes local sandstone and limestone layers. The unit is approximately 60 to 140 ft thick.

The Upper Jurassic *Morrison Formation* overlies the Summerville Formation. This formation is important because it hosts the uranium-vanadium mineralization and the underground mine workings of the Las Sal Mine Complex. The Morrison Formation includes two Members: the Salt Wash Member and the Brushy Basin Member. The lowermost Member is the Salt Wash Member, which consist of sandstone with interbedded red shale and a few local beds of limestone. This unit ranges in thickness from 0 to 105 ft thick in the La Sal Quadrangle. The Top Rim Sandstone Unit is a sub-unit within the Salt Wash Member, which contains the uranium-vanadium mineralization and the underground workings at the La Sal Complex.

The Salt Wash Member is overlain by shale of the Brushy Basin Member. The thickness of the Brushy Basin Member ranges from 200 to 400 ft, and is composed of variegated siltstone, shale and conglomerate. The Brushy Basin Member crops out in the area of the Pandora Mine portal and surface facilities. The Lower Cretaceous *Burro Canyon Formation* overlies the Morrison Formation. This formation is heterogeneous and includes conglomerate, sandstone, shale and thin lenses of limestone. The base of the Burro Canyon Member is composed of a massive coarse grained sandstone up to 110 ft. thick. Total thickness of the formation is estimated to be 260 ft. The Burro Canyon Formation crops out in the valley walls surrounding the surface facilities of the Pandora Mine.

The Cretaceous *Dakota Sandstone* is a flaggy sandstone unit, which overlies the Burro Canyon Formation. This formation also includes less abundant conglomerate, carbonaceous shale, and local impure coal. The sandstone ranges from fine grained and thin-bedded to coarse grained and cross-bedded. The Dakota Sandstone is approximately 200 ft. thick (Carter and Gualtaieri 1965; Cater 1955).

Unconsolidated Quaternary deposits are also present including alluvial deposits, eolian deposits, and landslide deposits. These units commonly form a thin veneer of unconsolidated sediments in areas where they are present. Alluvial sediments are present in the valley extending southward from the Pandora Mine surface facilities, and a large area of Quaternary sediments are present in an area extending south and west of the mine.

3.3.4.2 Structural Geology

Figure 3-2 shows the generalized structural geology of the area based on information provided by Hunt (1958). The La Sal Mines Complex lies in an area of northwesterly trending anticlines and synclines, which have been intruded by the igneous laccoliths that form the La Sal Mountains. The anticlines are cored by intrusive evaporites of the Paradox Member of the Hermosa Formation, and are the western extant of the series of evaporate-cored anticlines present in Paradox Valley, Gypsum Valley and Disappointment Valley in Colorado. This structural fabric has been modified extensively by intrusion of igneous laccoliths in the La Sal Mountains, which caused doming of the sedimentary rocks around the margins of the mountains.

The La Sal Mines Complex lies on the southern limb of the Pine Ridge anticline, and rock units in the area dip gently towards the southwest. Broad undulations in the orientation of the sedimentary rock units in the mine area are present.

3.3.5 Groundwater

Numerous key issues related to groundwater were developed based on public scoping. The following sections summarize the existing condition of groundwater in the La Sal Mines Complex area. Additional information is available including *Hydrogeologic Evaluation of the Denison Mines (USA) Corp., La Sal Mines Complex* (CDM 2009b), which is included in the POA..

3.3.5.1 Hydrogeologic Units

The regional hydrogeology of the area encompassed by the La Sal Mines Complex is described by the US Geological Survey (USGS) in *Regional Hydrology of the Dolores River Basin* (Weir et al 1983) and by Lowe (1996) in *Ground-Water Resources of San Juan County.* Weir et al. (1983) identifies two major hydrogeologic units: an upper unit and a lower unit. The lower unit is hosted by Precambrian and Paleozoic crystalline and metamorphic rocks. This unit is separated from the upper unit by the rock salt of the Paradox Member of the Hermosa Formation, which is essentially impervious to fluid flow. Groundwater within the lower unit is saline, and oil and gas deposits are locally present. The upper unit includes all rock stratigraphically above the Paradox Member, including the clastic sedimentary rocks present in the La Sal Mines Complex area.

This investigation considers only the upper hydrogeologic unit, because it is pertinent to potential groundwater uses in the area and to potential effects of mining on groundwater. The upper unit includes a series of predominantly sandstone aquifers, which are separated by confining units composed dominantly of shale. Weir et. al (1983) identified the following aquifers within the upper unit:

- Mesozoic sandstone aquifer
- Tertiary to Upper Cretaceous aquifer
- Alluvial aquifers

Lowe (1996) developed similar hydrogeologic units based on previous work in the area by Avery (1986) and Howells (1990). However, the Lowe (1996) hydrogeologic units use a different naming convention. Lowe (1996) subdivides the *Mesozoic sandstone aquifer* into the *N* and *M aquifers*, and refers to the *Tertiary to Upper Cretaceous aquifer* as the *D aquifer*.

The Mesozoic sandstone aquifer includes the saturated portions of the Chinle Formation, Wingate Sandstone, the Navajo Sandstone, and the Salt Wash Member of the Morrison Formation. Each of these units is composed dominantly of sandstone. The aquifer is underlain by rock salt of the Paradox Member and is overlain by bentonitic shale of the Morrison Formation, which are both confining layers.

Several confining units and leaky confining units are present within the Mesozoic sandstone aquifer, which restrict vertical movement of water between individual sandstone aquifers. The Summerville shale is a confining unit within the aquifer that restricts movement of water between the Salt Wash aquifer and an underlying aquifer including the Chinle Formation, Wingate Sandstone and the Navajo Sandstone. In addition, the Carmel Formation and the

Kayenta Formation contain interbedded shales which are likely leaky confining layers, which are less permeable than the adjacent sandstone layers but more permeable than confining layers such as rock salt and shale. So the Mesozoic aquifer is a layered aquifer with individual sandstone aquifers separated by confining and/or leaky confining units (Weir et al. 1983).

Lowe (1996) has subdivided the Mesozoic aquifer into the N aquifer and the M aquifer. The N aquifer includes the Wingate Sandstone, Kayenta Formation, Navajo Sandstone, Carmel Formation, and Entrada Sandstone. This is the portion of the Mesozoic aquifer that lies underneath the confining layer formed by the Summerville Shale. The N aquifer is reported to be 750 to 1,250 ft thick when fully saturated.

The M aquifer occurs in saturated portions of the lower units of the Morrison Formation, which include the Bluff Sandstone, Salt Wash, Recapture, and Westwater Canyon Members. The M aquifer is a primary source for domestic water within San Juan County in areas where it is the shallowest available aquifer (Lowe 1996). The Bluff Sandstone, Recapture and Westwater Canyon Members of the Morrison Formation are present in other areas of San Juan County, but these units are not present in the area of the La Sal Mines Complex. The underground mine workings of the La Sal Mines Complex are located in an unsaturated portion of the Saltwash Member of the Morrison Formation. Where saturated, this rock unit is a part of the M aquifer, and is approximately 150 ft thick in the vicinity of the La Sal Mines Complex. The Brushy Basin Member of the Morrison Formation is a bentonitic shale that forms a confining layer above the M aquifer. This confining layer restricts recharge to the M aquifer where it is present, and it may lead to confined conditions within the M aquifer in areas south and west of the La Sal Mines Complex.

The Tertiary to Upper Cretaceous aquifer is similar to the Mesozoic aquifer, but it occurs in sandstones that are higher in the stratigraphic sequence. This aquifer is bounded at the lower contact by bentonitic shale of the Brushy Basin Member of the Morrison Formation. The Tertiary to Upper Cretaceous aquifer contains a lower, dominantly sandstone aquifer hosted by the Burro Canyon Formation and the Dakota Sandstone, and an upper sandstone aquifer hosted by the Mesaverde Formation. The Mancos shale is a confining unit that separated the upper and lower sandstone aquifers. Lowe (1996) defines this aquifer as the D aquifer. It ranges from 150 to 400 ft thick in areas where it is fully saturated. However, in the direct vicinity of the La Sal Mines Complex, the areal distribution of the D aquifer is fragmented, and therefore recharge and discharge from these isolated islands of the D aquifer are local in extent. The D aquifer is a common target for water well drillers in San Juan County in areas where it is present, because it contains relatively good quality water and is shallow. The D aquifer is utilized for drinking water in areas south and west of the La Sal Mines Complex.

Alluvial aquifers are locally present in valley bottoms and other areas that contain accumulations of unconsolidated alluvial deposits. Based on a review of well drillers reports acquired from the Utah Division of Water Rights, unconsolidated aquifers within the eolian and alluvial deposits south and west of the La Sal Mines complex are also used for water wells in the area.

3.3.5.2 Recharge Areas

The primary recharge areas for aquifers that are present near the La Sal Mines Complex are the high altitude areas of the La Sal Mountains, which are located north of the mine. The laccolithic intrusions of the La Sal Mountains caused doming of the older sedimentary formations, and the hydrogeologic units described above crop out around the porphyry of the La Sal Mountains. The

La Sal Mountains receive more precipitation than the town of La Sal, because of the higher elevation. The abundant precipitation and the exposed outcrop area of the hydrogeologic units are the primary controls on recharge. Lowe (1996) reports that most of the recharge within San Juan County occurs at elevations in excess of 8,000 ft.

In the direct vicinity of the La Sal Mines Complex, recharge to the hydrogeologic units beneath the Brushy Basin Member of the Morrison Formation is restricted by the bentonitic shale confining layer of the Brushy Basin Member. Hydrogeologic units below the Brushy Basin member include the M and N aquifers of Lowe (1996) (i.e.; the Mesozoic Sandstone aquifer defined by Weir et al. 1983). The underground mine workings of the La Sal Mines Complex are located in an unsaturated portion of the Saltwash Member of the Morrison Formation. Where saturated, this rock unit is a part of the M aquifer. Therefore, potential recharge into underlying aquifers that would flow through the underground workings is restricted by the Brushy Basin of the Morrison Formation in the area of the mines.

The Burro Canyon Formation and the Dakota Sandstone crop out in the vicinity of the La Sal Mines Complex. These units form the D aquifer of Lowe (1996) (i.e. the Tertiary to Upper Cretaceous aquifer of Weir et al. 1983). These units receive recharge from precipitation within the mine area. However, annual precipitation is lower in the La Sal area as compared to higher-elevation areas in the La Sal Mountains. This causes relatively less groundwater recharge into the D aquifer to occur in the La Sal area, as compared to the La Sal Mountains.

3.3.5.3 Groundwater Flow

The principal direction of groundwater flow within the Mesozoic and Tertiary to Upper Cretaceous aquifers is lateral, because the confining layers restrict groundwater flow between the individual sandstone aquifers (Weir et al. 1983). In the vicinity of the La Sal Mines Complex, groundwater flows from the recharge areas in the La Sal Mountains generally towards the south.

3.3.5.4 Springs

The high resolution National Hydrography Dataset (USGS 2012) was evaluated to identify potential springs in the vicinity of the La Sal Mines Complex. No springs are identified within approximately 2 miles of the La Sal Mines Complex. Several springs are present north and west of the La Sal Mines Complex at distance ranging from approximately 2 to 5 miles. Intermittent drainages are present in the area south of the La Sal Mines Complex, and several small stock ponds are present. This suggests that seasonally, groundwater discharge to the surface may occur in those areas.

3.3.3.5 Water Quality

Groundwater quality data for the alluvial aquifer, D aquifer, and M aquifer are summarized below based on data provided by Weir et al. (1983).

- Groundwater from alluvial aquifers has moderate to high concentrations of total dissolved solids, chloride and sulfate with neutral pH
- Groundwater from the Dakota aquifer has high concentrations of total dissolved solids, chloride and sulfate with neutral pH
- Groundwater from the Salt Wash aquifer has moderate concentrations of total dissolved solids, chloride and sulfate with neutral pH

3.3.5.6 Existing and Future Uses of Groundwater

A query of the water well records maintained by the Utah Division of Water Rights (UDWR) was completed to identify local wells within two miles of the La Sal Mine Complex. The aquifers exploited by the local water wells can be generally interpreted from the well files and indicate water use from the following aquifers:

- Alluvial aquifers hosted by Quaternary alluvial sediments such as sand and gravel
- The Dakota Formation, which is a part of the D aquifer as defined by Lowe (1996)
- The Morrison Formation, which is likely a part of the M aquifer as defined by Lowe (1996)

The majority of the wells appear to be completed in the D aquifer and in alluvial aquifers located south and west of the La Sal Mines Complex near the town of La Sal. As discussed previously, the Brushy Basin Member of the Morrison Formation, a low-permeability confining unit, separates the D aquifer from the areas of underground mining.

The well intake depths range from 0 to 460 ft below the surface, and the static water levels range from 0 to 385 ft below the surface. Based on reported static water level depths of 0 ft below the surface in areas several miles south of the La Sal Mines Complex, it appears that artesian conditions are present in some areas.

San Juan County, Utah is a rural community with approximately 14,000 residents over an area of approximately 8,000 square miles (less than 2 residents per square mile) (U.S. Census Bureau [USCB] 2000). It is anticipated that local uses of groundwater near the La Sal Mines Complex will remain similar in the future.

The current water supply for the underground mine is an existing well utilizing an water right owned by UMETCO Minerals Corporation. Denison is in the process of transferring this water right to Denison in accordance with state water rights law (C. Woodward, Denison Mines (USA) Corp, personal communication, 2011).

3.3.6 Hazardous Wastes

A key issue was identified based on public scoping that relates to whether the mine produces toxic waste. This discussion of toxic waste focuses on the broader classification of hazardous waste as defined by the federal Resource Conservation and Recovery Act (RCRA):

"Hazardous waste is solid waste, or a combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either:

- cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or
- pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

Hazardous wastes include listed hazardous wastes and characteristic hazardous wastes. Characteristic hazardous wastes exhibit one of four characteristics: ignitability, corosivity, reactivity, or toxicity. Hazardous waste as defined by RCRA includes solid wastes that exhibit a characteristic of toxicity.

Small quantities of hazardous wastes are generated at the site such as used aerosol paint cans, and spent parts cleaning solvents. These wastes are disposed of in accordance with applicable regulations. Solid waste generated "from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore" is not hazardous waste as defined by RCRA section 3001(b)(3)(A)(ii) (U.S.C. 2002). Development rock and ore are therefore not hazardous wastes or toxic wastes as defined by RCRA. General environmental characteristics of development rock are discussed in Section 3.3.3 and radiological characteristics of development rock are described in Section 3.3.8.

Non-hazardous solid waste is managed in accordance with applicable regulations. Roll-off containers for disposal of trash are located at each of the active mine sites. The trash is picked up on a routine basis by a service company and disposed of at an approved landfill. Scrap metal is stored in a bin and/or on pallets near the La Sal Mine maintenance shop and warehouse until it is picked up for recycling. Used batteries and tires are stored on pallets on the concrete floor of the shop and are transported off-site and recycled by licensed vendors.

3.3.7 Noise

3.3.7.1 Introduction and Basic Noise Concepts

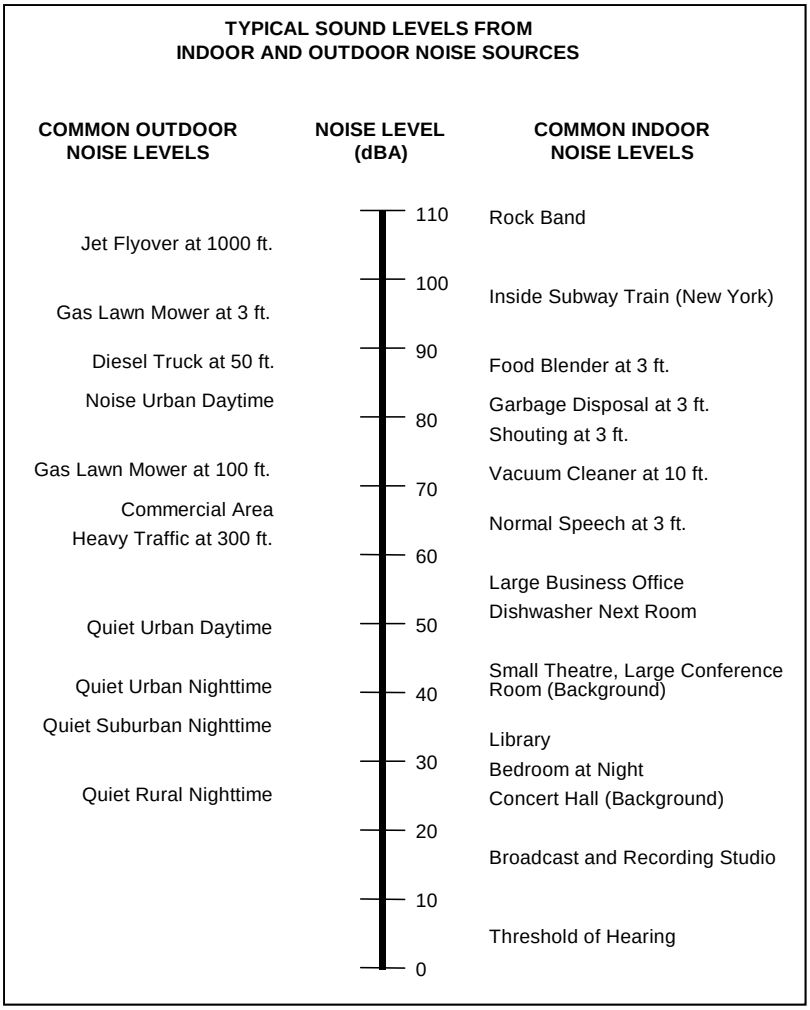
One key issue was identified that relates to the effects of noise from mining operations on various receptors. This section presents background information on current environmental noise levels in the vicinity of the mine as well as a discussion of applicable noise regulations and guidelines.

Sound is mechanical energy characterized by the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level (amplitude). The human ear experiences sound as pressure on the ear. The sound pressure level is the logarithmic ratio of that pressure to a reference pressure, and is expressed in decibels (dB). A value of 0 dB corresponds to the approximate threshold of human hearing.

Environmental sounds are measured with the A-weighted scale of a sound level meter. The A scale simulates the frequency response of the human ear by giving more weight to the middle frequency sounds and less to the low and high frequency sounds. A-weighted sound levels are designated as dBA (i.e. A-weighted sound levels expressed in decibels). Exhibit 3.3-1 shows the range of sound levels of common indoor and outdoor activities, expressed in dBA.

Because sounds in the environment usually vary with time they cannot simply be described with a single number. One method used to describe variable sounds is the equivalent noise level, which is derived from a large number of moment-to-moment A-weighted noise level measurements.

The equivalent noise level (Leq) is the constant sound level that in a given period has the same sound energy level as the actual time-varying sound pressure level. Leq provides a methodology for combining noise from individual events and steady state sources into a measure of cumulative noise exposure. It is used by local jurisdictions, the Federal Highway Administration (FHWA), and state departments of transportation (including Utah Department of Transportation (UDOT)) to evaluate noise effects. The day-night average noise level (Ldn) represents the 24-hour energy average noise level with a 10-dBA penalty (addition) applied to noise levels between 10 p.m. and 7 a.m. The Ldn is a useful metric of community noise impact because people in their homes are much more sensitive to noise at night than during the day.



Source: FHWA, 1980.

Exhibit 3.3-1: Common Indoor and Outdoor Noises

A key concept in evaluating potential noise effects is the perceived effect of incremental increases in existing noise levels. The effect of increasing noise levels is presented in Table 3-5. For example, the table shows that an increase of 3 dBA is barely perceptible, an increase of 5 dBA is noticeable, and that a 10-dBA increase would be perceived by someone to be a doubling of the noise level (loudness). In practice, the goal of a noise impact analysis is usually to show no more than a 5 dBA increase in noise level (moderate impact) from a proposed project. Increases of 5-10 dBA would tend to be noticeable to most but not substantial. An increase of 10 dBA or more would be perceived by most as a substantial impact.

3.3.7.2 Typical Average Ambient Noise Levels by Land Use

Data provided in the EPA publication "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" (1974) is often used to identify the average ambient daytime and nighttime noise levels expected with different land uses.

Daytime and nighttime Leq noise levels can be estimated based on the day-night average noise levels (Ldn) identified in the US EPA document. According to this document, typically, there is a 10-dBA change in noise levels between the daytime and nighttime.

Table 3-5. Decibel Changes, Loudness, and Energy Loss

Sound Level Change (dBA)	Relative Loudness/ Impact	Acoustical Energy Gain (%)
0	Reference	0
+3	Barely Perceptible Change/Slight	50
+5	Noticeable Change/Moderate	67
+10	Twice as Loud/Substantial	90
+20	Four Times as Loud/Very Substantial	99

Source: FHWA, 2011 (Modified).

Table 3-6 presents a summary of the ambient noise levels associated with various land uses. From the table, it can be seen that a rural residential area will typically have a daytime average noise level of 40 dBA. Suburban residential areas will typically have an average daytime noise level of 50-55 dBA while in urban residential areas one can expect average daytime noise levels of 60-70 dBA. As presented later, the estimated daytime noise levels at the receptors in La Sal closest to the vent fans range from 50 to 60 dBA, noise levels usually associated with suburban and urban residential areas rather than the rural residential area noise levels that can be found in other parts of La Sal.

Table 3-6. Average Ambient Noise Levels for Various Land Uses

Land Use Description	Day-Night Average, Ldn (dBA)	Daytime Average, Leq (dBA)	Nighttime Average, Leq (dBA)
Wilderness	35	35	25
Rural Residential	40	40	30
Quiet Suburban Residential	50	50	40
Normal Suburban Residential	55	55	45

Land Use Description	Day-Night Average, Ldn (dBA)	Daytime Average, Leq (dBA)	Nighttime Average, Leq (dBA)
Urban Residential	60	60	50
Noisy Urban Residential	65	65	55
Very Noisy Urban Residential	70	70	60

Source: US EPA, 1974.

3.3.7.3 Federal/Utah Highway Noise Regulations and Guidelines

Although there are no state of Utah noise regulations directly applicable to stationary or mobile noise sources associated with mining, guidance can be found in federal regulations that apply to highway noise effects. These include the applicable FHWA noise abatement criteria (NAC) (23 CFR Part 772), which have been interpreted and implemented for projects in Utah by UDOT. The FHWA NAC presented in Table 3-7 are based on specific land use categories.

The residential land uses in the La Sal area would fall under FHWA Activity Category B if this were a federally/state funded noise abatement project. UDOT noise abatement policies specify that noise abatement (mitigation) for existing highways be considered when noise levels approach or exceed the stated NAC (ref). UDOT defines "approach the noise abatement criteria" (23 CFR 772.5(g)) as 1 dBA below the NAC (AD 236). For example, UDOT might determine that a noise abatement project in a residential area should be considered if the measured or modeled maximum 1-hour Leq were greater than 66 dBA.

Another federal agency that has set standards for interior and exterior noise levels is the U.S. Department of Housing and Urban Development (HUD). HUD site acceptability criteria for housing indicate that acceptable sites are those where noise levels do not exceed an Ldn of 65 dBA. Although the HUD standards were developed for urban environments, they serve as a useful guideline in analyzing noise effects.

Table 3-7. Federal Highway Administration Noise Abatement Criteria

Activity Category	1-Hour Leq (dBA)	Description of Noise Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Residential
C	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers,

Activity Category	1-Hour Leq (dBA)	Description of Noise Category
		hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.

Notes: (1) Source: 23 CFR Part 772
(2) Activity category F includes developed lands that are not sensitive to highway noise. There is no noise impact criterion for the land uses in this category and no analysis of noise effects is required.
(3) Activity category G includes undeveloped lands. For these lands, the highway agency determines if the land is permitted for development. If it is, the agency assigns the land to the appropriate activity category and analyzes it in the same manner as developed lands in this category. If the land is not permitted for development, the agency determines the existing noise levels on these lands but does not have to abate highway noise effects to these lands.

3.3.7.4 Speech Interference

Speech interference is an indicator of the effect of noise on typical daytime and evening activities. A speech interference criterion, in the context of impact duration and time of day, is used to identify substantial noise levels. As shown in Table 3-8, noise peaks can result in speech interference if the noise level outside exceeds 66 dBA (3.3 ft distance between speaker and listener).

Table 3-8. Steady Sound Levels that Allow Communication Outdoors

Distance (ft)	1.6	3.3	6.6	9.8	13.1	16.4
Normal Voice (dBA)	72	66	60	56	54	52
Raised Voice (dBA)	78	72	66	62	60	58

Source: EPA, 1974.

3.3.7.5 Existing Noise Levels

The main sources of noise in the La Sal area are the mine operations including the ventilation fans, vehicle traffic, aircraft, and general community activity. Near the ventilation fans, fan noise becomes the dominant source of noise.

Several factors affect the propagation of noise from these sources. The main factors potentially applicable to the La Sal Mines Complex area are:

- Distance
- Atmospheric effects
- Ground type – pavement vs. vegetative ground cover
- Topography
- Shielding - walls and berms, buildings

Generally, noise is most audible when traveling along a direct line-of-sight; noise levels from a point source will attenuate at a rate of approximately 6 decibels for each doubling of distance over hard surfaces. Barriers, such as walls, berms, or rows of buildings that break the line-of-sight between the source and the receptor can greatly reduce noise levels from the source because the barriers block sound. Solid, uninterrupted walls and berms may reduce noise levels by 10 dBA (FHWA, 2011). Sound levels may also be attenuated 3.0 to 5.0 dBA by a first row of houses/buildings and 1.5 dBA for each additional row of houses in residential environments (FHWA, 1978).

Ventilation fan noise levels at the nearby noise-sensitive receptors (see Figure 3-3) are shown in Table 3-9. These levels were determined by taking the measured noise level from the Beaver 1800 fan (91.7 dBA at 10 feet without the barrier), and applying that noise level and the above-noted attenuation of sound with distance formula to calculate the estimated combined noise level from all fans at each receptor. This approach assumes that the fan noise from the Beaver 1800 ventilation shaft (measured without the barrier) is representative of fan noise from the other ventilation shaft locations. Plugged, shaft/portal, non-operational or underground fans are not included in the table. Other factors that affect the propagation of noise were not calculated because they are relatively minor factors at the distances involved.

As can be seen in the table, ventilation fan noise levels at the nearby receptors are in the 48 to 55 dBA range, which is higher than is typically found in rural areas but less than the above-cited guidelines for residential land uses. The noise levels are comparable to what would be expected in a suburban residential area (see Table 3-6).

Table 3-9. Ventilation Fan Noise Levels at Each Receptor

		Fan Noise Level (dBA)									
Vent		**Residence #1**	**Residence #2**	**Residence #3**	**La Sal Livestock**	**Catholic Church**	**Store/Post Office**	**Road Maintenance Shed**	**Elementary School**	**Residence #4**	**Residence #5**
Beaver	500	34	35	36	39	42	38	44	37	36	34
Beaver	900 #2	33	33	34	41	44	41	44	40	39	36
Beaver	1050	32	32	33	44	44	44	43	43	41	38
Beaver	1800	14	14	15	29	23	29	22	31	34	29
Beaver	2300 #2	36	36	35	35	39	35	41	35	33	32
Beaver	2400	28	29	29	40	36	41	35	42	45	46
Pandora[1]	1	50	43	39	30	32	30	33	30	29	28
Pandora[1]	2	46	41	38	29	31	29	32	29	28	28
Pandora	8	52	44	40	30	32	30	32	30	29	28
Snowball	2	41	41	41	33	36	33	37	33	32	31
Cumulative Noise Level		**55**	**49**	**47**	**48**	**49**	**48**	**50**	**48**	**48**	**48**

Note: (1) Pandora 1 and 2 fans are off from 4 p.m. Thursday to 6 a.m. Monday.

3.3.8 Radiological Issues

Uranium is a radioactive element, and key issues were developed during scoping addressing potential effects that could be caused by the radioactivity of uranium and products of radioactive decay of uranium. The following sections describe general radiological concepts and the existing condition to support assessment of radiological issues in the effects analysis.

3.3.8.1 General Radiological Concepts

Radiation is a form of energy that consists of subatomic particles or bundles of pure energy. Radiowaves, microwaves, infrared light, and visible light are forms of low-energy non-ionizing radiation. Radioactive elements like uranium emit ionizing radiation. The term ionization refers to changes in the characteristics of atoms, which are the building blocks of the matter and organisms that comprise the human environment. Atoms are composed of a nucleus of protons and neutrons surrounded by orbiting electrons. Ionizing radiation has enough energy to knock an electron out of orbit, which changes the characteristics of the atom (Radiation Safety Institute of Canada [RSIC] 2011). At high activities, ionizing radiation can cause adverse effects to humans or wildlife (Stabin 2007, Chambers 2008).

Radioactive elements, such as uranium, are defined based on the element name (uranium), and the sum of protons and neutrons in the nucleus of the element. The number of protons in the nucleus of an atom is constant for a given element, but the number of neutrons in an element varies naturally. These variations are termed isotopes of an element. The term radioisotope is used to describe different forms of a given radioactive element. For example, the dominant radioisotope of uranium present in nature (and at the La Sal Mines Complex) is uranium-238, which contains 92 protons and 146 neutrons. Natural uranium contains approximately 99.3 percent uranium-238, 0.7 percent uranium-235, and 0.005 percent uranium-234. As the uranium radioisotope decays from a radioactive state to a stable state, it goes through a series of transformations. Isotopes that form in this process are called daughter products of the original radioisotope. Emission of various types of ionizing radiation termed alpha, beta, and gamma are associated with these transformations. This process is shown diagrammatically in Exhibit 3.3-2 for uranium-238. Characteristics of alpha, beta and gamma radiation are summarized as follows:

- **Alpha** radiation consists of sub-atomic particles containing two protons and two neutrons. Alpha radiation is the least penetrating radiation of all commonly encountered forms. Alpha particles will travel only a few centimeters in air and will penetrate soft tissue only a distance of less than 1/10,000 of an inch.
- **Beta** radiation consists of sub-atomic particles with about 8,000 times less mass than Alpha particles. Beta particles can travel about 6 feet in air; they are stopped by glass, plastic or aluminum; and can penetrate skin to depths of only about 0.1 inches.
- **Gamma** radiation is electromagnetic energy similar to visible light, however gamma radiation has a high enough energy to cause ionization. Gamma radiation is highly penetrating, and can penetrate through human skin and cause both external and internal effects (Stabin 2007, RSIC 2012).

Each transformation of an unstable radioisotope occurs at a characteristic rate, which is described in terms of a half-life. The half-life is the amount of time required for the quantity of a given radioisotope to decrease by one half. For example, after one half-life the quantity of uranium-238 would be reduced in half; after two half-lives, the quantity would be reduced to 1/4; after three

half-lives, the quantity would be reduced to 1/8 etc. The half-lives of radioisotopes formed during radioactive decay of uranium-238 range from a few seconds to billions of years. Accordingly, the half-life is an important concept to consider in assessing potential radiological effects associated with the La Sal Mines Complex. Table 3-10 shows the half-lives of several radioisotopes important in understanding radiological issues at the La Sal Mines Complex.

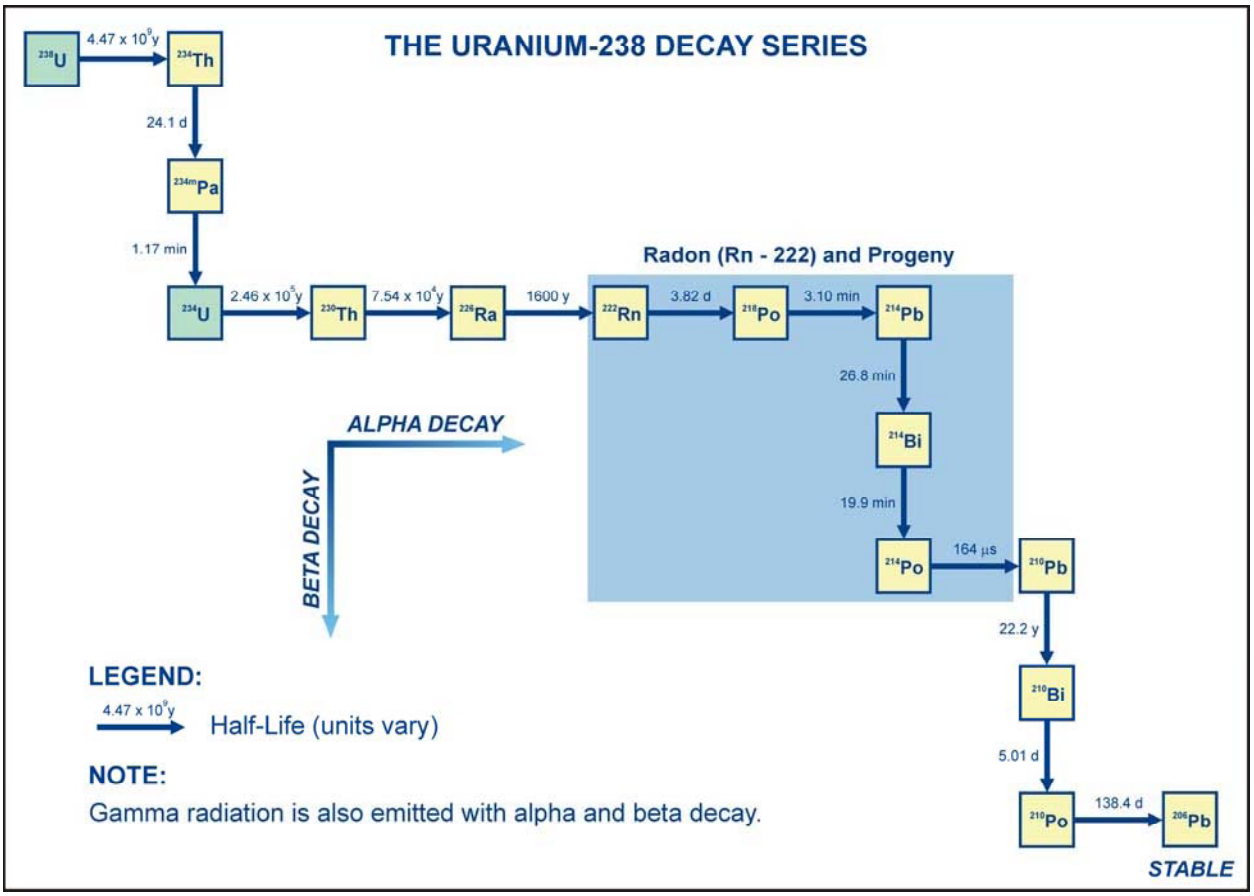


Exhibit 3.3-2. Diagram showing decay of Uranium-238, the primary radioisotope present in ore and development rock at the La Sal Mines Complex

Table 3-10. Half lives of selected radioisotopes present at La Sal Mines Complex

Radionuclide	Half Life
Uranium-238	4,480,000,000 years
Uranium-235	704,000,000 years
Radium-226	1600 years
Radon-222	3.8 days

Radiation is defined in three types of measurement units, and a general understanding of these measurement units is helpful to support discussion of existing conditions and analysis of effects. The following bullets summarize the measurement units that are used in this document:

- **Equivalent dose** is defined with a unit of measurement called the millirem (mrem), which is a measurement of the dose of radiation that a human receives when exposed to ionizing radiation. The annual equivalent dose is expressed with units of millirem per year (mrem/y), and hourly equivalent dose is expressed in units of microrems per hour (μrem/h). A microrem is 1/1000 of a millirem.
- **Exposure** is defined with a unit of measure called a microroentgen (μR). Exposure is a measurement of the effects of ionizing radiation in air, and it can be converted to millirems knowing the type of ionizing radiation. For gamma radiation, 1000 μR is approximately equivalent to 1 mrem.
- **Activity** is defined with a unit called picocuries (pCi), which is a measure of the number of nuclear transformations that are occurring in a given time. Conversion from activity to equivalent dose requires knowledge of the characteristics of the radiation and other factors.

3.3.8.2 Description of Existing Environment

Ionizing radiation is ubiquitous in the environment, and is produced by both natural and manmade sources. The most abundant naturally occurring radioactive elements are potassium, uranium and thorium (Duval et al. 2005). Naturally occurring radiation is present in soil, rock, air, rain and the food we ingest. Uranium is present in most rocks and soils at concentrations of several parts per million. Radiation from space also affects the earth's surface, and is caused by radioisotopes located within our solar system and at distances extending beyond the Milky Way Galaxy (Health Physics Society [HPS] 2010). Table 3-11 describes the average equivalent dose caused by natural environmental sources.

At high elevations in the western United States, the environmental radiation dose received from space radiation is higher, because the atmosphere is thinner. For example in Utah, space radiation ranges from approximately 60 to over 900 mrem per year (HPS 2010). Space radiation causes persons who travel by air to be exposed to higher radiation doses. For example, a person flying from New York to Seattle receives a radiation dose of approximately 2.8 mrem (Friedberg and Copeland 2003).

Table 3-11. Average annual equivalent dose of radiation received in the United States from natural environmental sources (HPS 2010)

Environmental Radiation Source	Average Annual Dose of Radiation	
	mrem/y	percent
Inhaled Radon-222	212	66
Inhaled Radon 220	16	5
Space Radiation	33	10
Terrestrial Radiation	21	7
Ingested	38	12
Total	**320**	**100**

As shown in Table 3-11, the largest equivalent dose of radiation received from natural environmental sources is caused by radon. Radon is a radioactive gas that is generated during radioactive decay of uranium. Uranium is present in most rocks and soils at concentrations of several parts per million (Rose et al 1979). Radon generated from radioactive decay of naturally occurring uranium in soils and rocks seeps into the atmosphere and into homes and buildings, where it can be inhaled into the lungs. Several daughter products of radon-decay emit alpha radiation and can cause lung cancer if inhaled in sufficient doses. Radon is a noble gas, which does not easily react with other elements. Radon gas is also heavy with respect to other gasses. This can cause radon gas accumulation in poorly ventilated homes or basements if radon seeps into the home from underlying soil or rock and is not vented into the atmosphere where it quickly disperses. Natural background radon activity is approximately 0.4 pCi/L (National Council on Radiation Protection and Measurements [NCRP] 2009).

Gamma radiation is also ubiquitous in the environment and results from space radiation and terrestrial radiation, which is caused by radioactive decay of radionuclides such as uranium, potassium and thorium that occur naturally as trace constituents in soil and rock. Gamma radiation levels associated with ore and development rock are higher than background, because of the relatively higher concentration of uranium in these materials. A gamma radiation survey of the La Sal area was conducted to evaluate natural background gamma radiation, and gamma radiation associated with existing mine facilities. This survey measured exposure in units of microroentgen per hour. Background gamma radiation in the La Sal area averages approximately 6 μR/hr (Denison 2012). The highest gamma values are associated with temporary ore stockpiles. Gamma values in these areas average 550 μR/hr. This material is located within controlled areas of the mine, and is generally present at the mine surface for approximately one week prior to haulage to the White Mesa Mill near Blanding, Utah. Gamma radiation values at

development rock piles are slightly elevated as compared to background. For example, the average gamma measurement at the Pandora development rock area was 55 uR/hr.

3.3.9 Reclamation

Mine reclamation is a process that is used to restore mined land after mining is completed. The reclamation process generally includes removal of buildings, structures and other equipment; reshaping the mine-affected landforms; and planting vegetation to restore the mined land in a manner that will support a productive post-mining land use. Reclamation generally does not entail complete restoration of mining-affected lands to pre-mining conditions, because this is often either not feasible or practicable.

The La Sal Mines Complex includes surface facilities and other disturbed areas that require reclamation after completion of mining activities. Existing facilities associated with the La Sal Mines Complex are summarized in Section 2 of this document, and are described in detail in the POA (Appendix B). Existing surface disturbance and disturbance areas include the following:

- Surface facilities such as mine portals, mine access roads, buildings, fuel storage areas, and equipment storage areas
- Development rock piles
- Ore stockpiles
- Ventilation shafts and associated access roads
- Exploration drilling sites and associated access roads

Current mining-related disturbance at the La Sal Mines Complex encompasses approximately 43 acres. This includes federal lands managed by BLM and USFS, and other lands not subject to BLM or USFS jurisdiction. Current mining-related disturbance on federal lands managed by BLM and USFS encompasses approximately 21 acres.

Denison has completed concurrent reclamation in several areas. Concurrent reclamation is reclamation that can be conducted concurrently with active mining. Examples of concurrent reclamation that have been completed to date include reclamation of ventilation shafts that are no longer necessary to support the La Sal Mines Complex, and reclamation of exploration drilling sites. Concurrent reclamation is generally conducted where feasible and practicable; however, much of the mine-related disturbance is related to infrastructure that is required to support the mine. These areas cannot be reclaimed until mining is completed.

The general area near the La Sal Mines Complex has been utilized for uranium mining and exploration since the 1950's. This area is one of several important uranium-producing districts in the United States. Accordingly, additional areas of mining-related disturbance are also present in the vicinity of the La Sal Mines Complex. Several sites are currently permitted with additional production expected in the future. Figure 3-4 shows the location of other mining-related disturbance in the general vicinity of the La Sal Mines Complex. Notable sites include the Pine Ridge mine, the Redd Block IV mine, and the Energy Queen mine. Each of these mines is currently permitted for either uranium production or mine exploration/assessment. The map shows several mines that are currently being reclaimed through the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. These are mines that are being reclaimed under government oversight in accordance with CERCLA. The map

also shows numerous mines with unknown status. These mines may also require reclamation in the future.

3.3.10 Slope Stability

Several key issues were raised during public scoping that relate to the stability of DRAs at the La Sal Mines Complex. The following sections describe the existing condition of the La Sal Mines Complex DRAs. These facilities are evaluated with respect to the key issues in Section 4.

3.3.10.1 Pandora Mine

The DRA at the Pandora Mine encompasses approximately 4.3 acres, and is located on the east side of a small ephemeral drainage. The DRA has a current slope of approximately 30 to 35 degrees from horizontal with an approximate height of 80 ft relative to the ground surface west of the pile. Development rock is currently placed on top of the DRA along a temporary access road via mine trucks. The Pandora Mine development rock pile is located on lands subject to BLM regulatory jurisdiction.

3.3.10.2 La Sal Mine

At the La Sal Mine, three separate DRAs located east of the fuel storage area. The northern, central, and southern DRAs encompass approximately 0.3, 0.5, and 1.3 acres, respectively. The northern DRA has a current slope of approximately 25 degrees while the two other DRAs have a current slope of approximately 35 degrees. The height of each DRA relative to the ground surface to the east is approximately 6 ft for the northern pile, 30 ft for the central pile, and 35 ft for the southern pile. The La Sal Mine DRAs are located on lands subject to BLM regulatory jurisdiction.

3.3.10.3 Snowball Mine

The DRA at the Snowball Mine encompasses approximately 3.3 acres, and is located south of the portal and east of the main access road to the mine. The Snowball Mine is currently an inactive mine site that is used only for emergency access and ventilation. Currently, no development rock is placed in this area. The DRA has a current slope of approximately 35 degrees with an approximate height of 40 ft relative to the ground surface to the south.

3.3.10.4 Beaver Shaft Mine

At the Beaver Shaft Mine site there are two separate DRAs, one east of the shaft area on land under the jurisdiction of BLM and one to the west on privately-owned property. The DRA to the east encompasses approximately 2.4 acres. The DRA has a current slope of approximately 15 to 20 degrees with an approximate height of 15 ft relative to the ground surface to the east. The other DRA west of the shaft on privately-owned property is located along the west edge of the disturbed area. The northern, central, and southern DRAs encompass approximately 0.6, 0.7, and 1.2 acres, respectively. The northern DRA has a current slope of approximately 20 degrees while the remaining two DRAs have a current slope of approximately 30 degrees. The height of each DRA relative to the ground surface to the west is approximately 10 ft for the northern pile, 14 ft for the central pile, and 30 ft for the southern pile.

3.3.11 Socioeconomics

According to the USCB (2010), the population of San Juan County in 2010 was 14,746 people, an increase of 333 people since 2000. In 2005-2009, the leading industries for employment in San Juan County were educational services, health care, and social assistance (30 percent); arts, entertainment, recreation, accommodation and food services (13 percent); retail trade (12 percent); construction (10 percent); and agriculture, forestry, fishing and hunting, and mining (9 percent). According to the Utah Department of Workforce Services (2010), the average number of non-farm jobs in San Juan County was 4,335 in 2010. Of these, approximately 8 percent were mining jobs. The largest number of non-farm jobs in San Juan County was in government (39 percent). San Juan County has the highest unemployment rate in the state, with 10.7 percent unemployment in 2009 (Utah Department of Workforce Services 2010).

The most recent income data available are from the 2005-2009 American Community Survey 5-Year Estimates (USCB 2010). The median income of households in San Juan County in 2005-2009 was $36,209, with 29 percent of people living in poverty. During the same time period, the median income of households in United States was $51,425, and 14 percent of people were living in poverty (USCB 2010).

In 2010, San Juan County contained 5,734 housing units, of which 4,505 (78.6 percent) were occupied. Of the occupied housing units, 892 (19.8 percent) were renter-occupied. The nearest town to the mine is La Sal Mines Complex is La Sal. In 2005-2009 (the most recent data available for La Sal), there were 47 persons living in La Sal and there were 26 households (USCB 2010).

Most of the existing work force in the La Sal area is self-employed in agriculture or employed at the existing mines. The next nearest community to the mine is Moab, Utah; however, most mine employees reside either in Monticello, Utah, or in rural areas in southwestern Colorado (CDM 2010a).

In 2010, the population in San Juan County was 49.6 percent American Indian, 43.9 percent white, 4.4 percent Hispanic, 0.2 percent Asian, 0.1 percent black or African American, and 1.7 percent two or more races (USCB 2010). The mine employees currently working in the area are estimated to be 10 percent American Indian, 30 percent Hispanic, and 60 percent white/non-Hispanic (CDM 2010a).

Currently, there are approximately 52 employees present at the Beaver Shaft Mine and 32 employees at the Pandora Mine. The proposed future development plan for the operations at the La Sal Mines Complex has the potential to employ up to 80 employees at the Beaver Shaft Mine and 50 employees at the Pandora Mine and extend the mine life to 20 years or more (CDM 2010a).

3.3.12 Surface Water

3.3.12.1 Climatic Framework

The La Sal Mines Complex is located within a semi-arid environment. Climate conditions in this area generally include moderate to cold winter night-time temperatures with hot summer daytime temperatures, large daily temperature fluctuations typical of semi-arid climates, and a large excess of evaporation over precipitation.

Weir et al. (1983) investigated climatic fluctuations within the Dolores River Basin, and observed that precipitation is correlated with elevation, with highest precipitation amounts occurring within mountain areas such as the La Sal Mountains, and markedly lower precipitation occurring within the central lower-elevation basins. Annual precipitation at the La Sal Mines Complex is estimated at 13.5 inches based on data from La Sal, Utah (National Climatic Data Center 2009), which is located approximately 1 mile south of the La Sal Mines Complex. Average precipitation for a period of record extending from 1949 to 2009 is 13.53 inches.

Evaporation greatly exceeds precipitation at the La Sal Mines Complex area. The Utah Climate Center provides estimates of evapotranspiration in the La Sal area (CDM 2009b). Evapotranspiration is the combined effect of direct evaporation of water and transpiration of water from soil plants. Exhibit 3.3.13-1 compares the monthly average precipitation to evapotranspiration for the period of record. As shown on the figure evapotranspiration greatly exceeds precipitation, with evapotranspiration exceeding precipitation by 6 to 7 times during the summer months. This results in a semi-arid environment in the project area with limited surface water.

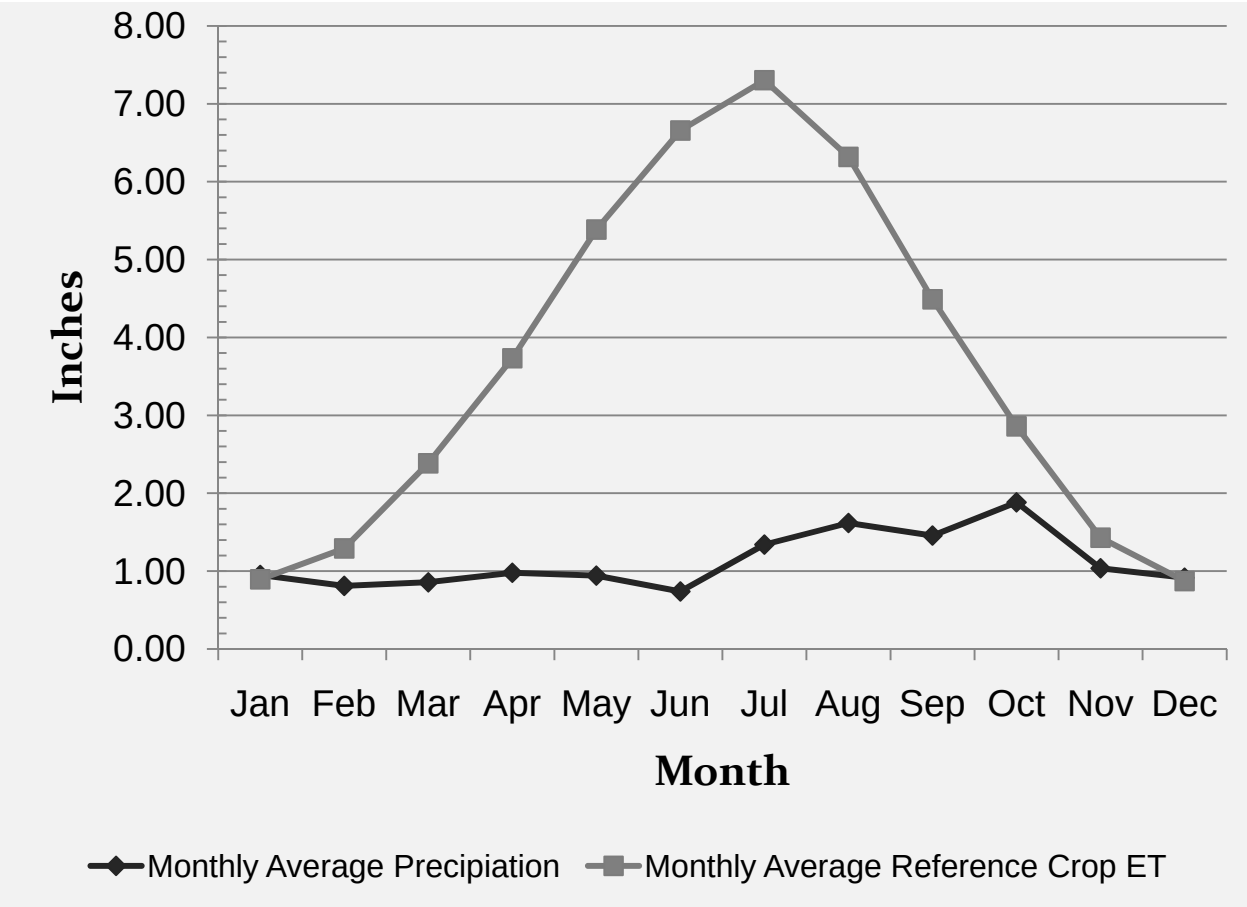


Exhibit 3.3.13-1. Comparison of evapotranspiration with precipitation in the La Sal area.

3.3.12.2 Surface Water

The La Sal Mines Complex is located in the Dolores River and Colorado River watersheds. The Beaver Shaft mine straddles the watershed boundary between the Dolores and Colorado rivers, whereas the La Sal, Pandora and Snowball mines are in the Dolores River. No perennial (i.e.; year-round) surface water is present in the vicinity of the La Sal Mines Complex, and drainages in the area are ephemeral (i.e.; they flow only seasonally or in response to intense precipitation events). The Dolores and Colorado rivers are the nearest perennial surface water to the La Sal Mines Complex, but there is generally no direct surface water flow towards either river. The Colorado River is approximately 37 drainage miles downstream from the western portion of the Beaver Mine Area. The intervening drainage is ephemeral to intermittent, and does not flow year-round. The Dolores River is approximately 24 drainage miles downstream from the eastern portion of the Beaver Mine, and the La Sal, Pandora, and Snowball mines. The intervening drainage between the mines and the Dolores River is also ephemeral to intermittent.

Stormwater discharges from the La Sal Mines Complex are permitted under an Industrial Stormwater Permit for Construction Activities in accordance with the Clean Water Act and associated state and federal water pollution control laws. A Stormwater Pollution Prevention Plan (SWPPP) for the La Sal Mines Complex is in place at the mines, and stormwater pollution control facilities are in place and operating at the mines. Additional information regarding stormwater is available in *Drainage Report for Pandora Mine, San Juan County, Utah* (CDM 2010b); *Drainage Report for La Sal Mines Complex, San Juan County, Utah* (CDM 2010c); and *Stormwater Pollution Prevention Plan for the La Sal Mines Complex* (ACE 2009a).

3.3.13 Transportation

A key issue related to transportation was identified which addresses potential effects of ore trucking on public safety. This section addresses existing conditions related to transportation in the La Sal area.

3.3.13.1 Mine-related Traffic Volume

Ore extracted from the La Sal Mines Complex is hauled to the White Mesa Mill near Blanding, Utah for processing. An independent contractor transports the ore according to the DOT regulations (CFR Title 49, Transportation), and in accordance with the Operator's "Transportation Policy for Shipments of Colorado Plateau Uranium Ores to the White Mesa Uranium Mill" (Denison 2007).

Table 3-10 summarizes current traffic volumes, or average annual daily traffic (AADT), on the roads that would be traveled by haul trucks and employees to and from the mines. The transportation route from the mines to the White Mesa Mill is west on Utah State Route (SR) 46 (about 8.75 miles), and then south (about 59.8 miles) along U.S. Highway 191.

Table 3-10. Current Average Annual Daily Traffic (AADT) along haul route.

Route From La Sal to White Mesa Mill	SR 46 at SR 191 La Sal Junction	SR 191 at SR 46 La Sal Junction	SR 191 at 600 North Monticello	SR 191 at 200 North Blanding	SR 191 at SR 95 South of Blanding
AADT (vehicles)	690	4,310	3,575	2,970	2,820
% Truck Traffic (double axle)	11%	30%	32%	13%	12%

[1] *UDOT 2010*

Employees of the mine live either in La Sal, Monticello, or rural areas in southwestern Colorado. Employees drive personal or company cars to the mine sites and park at the La Sal Mines Complex. It is likely that some car-pooling occurs. Passenger vans or buses are used to get employees to the Beaver Shaft site. The Pandora mine is operated by a contract mining company. Their cars are parked at the Pandora Mine site.

Denison currently has 52 employees at the Beaver and La Sal Mines. The contractor at the Pandora Mine currently has 32 employees. The mines operate on two 10 hour shifts four days per week with light maintenance on an occasional Friday. Most mining-related traffic occurs Monday through Thursday when an estimated 60 vehicles travel to the La Sal/Pandora Mines (total) during two shifts. Fewer vehicles are present during these times on Friday since only light maintenance is conducted.

3.3.13.2 Department of Transportation Requirements for Ore Transport

Denison must ensure that radiation levels associated with ore transportation fall within applicable limits. Based on the grade of the La Sal Mines Complex uranium ore, the current exposure rate is estimated to be less than 1 millirem per hour (mrem/hr) to recipients standing outside of the truck. As a result, the following requirements are satisfied:

- The requirements of 49 CFR 173.427(a)(1) that the external dose rate may not exceed a radiation level of 1,000 mrem/hr at 3 meters from the unshielded material
- The requirements of 49 CFR 173.427(a)(5) and 173.441(a) under conditions normally incident to transportation
- The radiation level does not exceed 200 mrem/hr at any point on the external surface of the package
- The transport index (TI) does not exceed 10

TI is a dimensionless number placed on the label of a package, to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined by multiplying the maximum radiation level in millisieverts (mSv) per hour at 3.3 ft from the external surface of the package by 100 (equivalent to the maximum radiation level in mrem/hr at

3.3ft. The average dose rate measurement in the occupied space of each truck cab does not exceed the DOT limit of 2 mrem/hr specified in 49 CFR 173.441(b)(4). Denison performs and document spot gamma surveys on uranium ore shipments as appropriate in order to ensure that the regulatory standards are satisfied.

Denison's transportation policy specifies that ore trucks must be covered at all times using a tarpaulin or other suitable mechanism, with or without ore, except for loading and unloading. In addition, all ore trucks are washed before leaving the White Mesa Mill to prevent transport or dispersal of dust associated with mineral processing. With regard to accidents and other incidents involving spillage of uranium ore, Denison's policy states that the transportation contractor must have an Emergency Response Plan in case of emergency (Denison 2007).

3.3.14 Vegetation

3.3.14.1 General Vegetation

The vegetation within the project area varies with topography, elevation, and geology. Twelve vegetation cover types exist within the project area, according to the Southwest Regional Gap Analysis Program (SWReGAP) data (USGS 2004) (see Figures 3-5 and 3-6). The eastern portion of the project area is primarily comprised of piñon-juniper woodland (Colorado Plateau Piñon-Juniper Woodland). The western portion is primarily comprised of sagebrush (Inter-Mountain Basins Big Sagebrush Shrubland) (USGS 2004). Descriptions of all the vegetation cover types found within the project area are listed below. These descriptions were derived from the SWReGAP definitions of each vegetation cover type (USGS 2004). These cover types have not been ground-truthed and may differ from actual vegetation within the project area.

Agriculture

This vegetation cover type is an aggregation of the Pasture/Hay cover type and the Cultivated Crops cover type. The Pasture/Hay cover type is defined as areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle, where pasture/hay vegetation accounts for greater than 20% of total vegetation. The Cultivated Crops cover type is defined as areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards, where crop vegetation accounts for greater than 20% of total vegetation.

Colorado Plateau Mixed Bedrock Canyon and Tableland

The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland may be interbedded between the harder rocks. The vegetation is characterized by a very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species include two-needle piñon (Pinus edulis), Ponderosa pine (Pinus ponderosa), Juniper (Juniperus spp.), littleleaf mountain mahogany (Cercocarpus intricatus), and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.

Colorado Plateau Piñon-Juniper Shrubland

This ecological system is characteristic of the rocky mesatops and slopes on the Colorado Plateau and Western Slope of Colorado, but these stunted tree shrublands may extend farther upslope along the low-elevation margins of taller piñon-juniper woodlands. This vegetation cover type is drier than Colorado Plateau Piñon-Juniper Woodland. Substrates are shallow/rocky and shaley soils at lower elevations (3,900–6,500 feet amsl). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland. The vegetation is dominated by dwarfed (usually <10 feet tall) piñon pine (Pinus edulis) and/or Utah juniper (Juniperus osteosperma) trees forming extensive tall shrublands in the region along low-elevation margins of piñon-juniper woodlands. Other shrubs, if present, may include black sagebrush (Artemisia nova), Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis), yellow rabbitbrush (Chrysothamnus viscidiflorus), or blackbrush (Coleogyne ramosissima). Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids.

Colorado Plateau Piñon-Juniper Woodland

This ecological system occurs in dry mountains and foothills of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim of Arizona and east into the northwestern corner of New Mexico. It is typically found at lower elevations ranging from 4,900 to 8,000 feet amsl. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of piñon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. Piñon pine and/or Utah juniper dominate the tree canopy. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, one-seed juniper (Juniperus monosperma) and hybrids of juniper may dominate or codominate the tree canopy. Rocky Mountain juniper (Juniperus scopulorum) may codominate or replace Utah juniper at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include greenleaf manzanita (Arctostaphylos patula), big sagebrush (Artemisia tridentata), littleleaf mountain mahogany, mountain mahogany (Cercocarpus montanus), blackbrush, Stansbury cliffrose (Purshia stansburiana), antelope bitterbrush (Purshia tridentata), Gambel oak (Quercus gambelii), blue grama (Bouteloua gracilis), James' galleta (Pleuraphis jamesii), or mutton grass (Poa fendleriana). This system occurs at higher elevations than Great Basin Piñon-Juniper Woodland and Colorado Plateau shrubland systems where sympatric.

Developed, Medium–High Intensity

Developed, Medium Intensity includes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50% to 79% of the total cover. These areas most commonly include single-family housing units. Developed, High Intensity includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

Inter-Mountain Basins Big Sagebrush Shrubland

This ecological system occurs throughout much of the western United States, typically in broad basins between mountain ranges, plains, and foothills between 4,900 and 7,500 feet amsl. Soils

are typically deep, well-drained, and non-saline. These shrublands are dominated by basin big sagebrush (Artemisia tridentata ssp. tridentata) and/or Wyoming big sagebrush. Scattered juniper, greasewood (Sarcobatus vermiculatus), and saltbush (Atriplex spp.) may be present in some stands. Rubber rabbitbrush (Ericameria nauseosa), yellow rabbitbrush, antelope bitterbrush, or mountain snowberry (Symphoricarpos oreophilus) may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include Indian ricegrass (Achnatherum hymenoides), blue grama, thickspike wheatgrass (Elymus lanceolatus), Idaho fescue (Festuca idahoensis), needle and thread grass (Hesperostipa comata), basin wildrye (Leymus cinereus), James' galleta, western wheatgrass (Pascopyrum smithii), Sandberg bluegrass (Poa secunda), or bluebunch wheatgrass (Pseudoroegneria spicata).

Inter-Mountain Basins Montane Sagebrush Steppe

This ecological system includes sagebrush communities occurring at montane and subalpine elevations across the western United States from 3,250 feet amsl in eastern Oregon and Washington to over 9,750 feet amsl in the southern Rocky Mountains. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. It is composed primarily of sagebrush (Artemisia spp.). Antelope bitterbrush may codominate or even dominate some stands. Other common shrubs include snowberry (Symphoricarpos spp.), serviceberry (Amelanchier spp.), rubber rabbitbrush, wild crab apple (Peraphyllum ramosissimum), wax currant (Ribes cereum), and yellow rabbitbrush. Most stands have an abundant perennial herbaceous layer (over 25% cover), but this system also includes mountain big sagebrush (Artemisia tridentata ssp. vaseyana) shrublands. Common graminoids include Arizona fescue (Festuca arizonica), Idaho fescue (Festuca idahoensis), needle-and-thread (Hesperostipa comata), muttongrass (Poa fendleriana), slender wheatgrass (Elymus trachycaulus), California brome (Bromus carinatus), Sandberg bluegrass, spike fescue (Leucopoa kingii), tufted hairgrass (Deschampsia caespitosa), pinegrass (Calamagrostis rubescens), and bluebunch wheatgrass (Pseudoroegneria spicata). In many areas, frequent wildfires maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.

Rocky Mountain Cliff and Canyon

This ecological system of barren and sparsely vegetated landscapes (generally <10% plant cover) is found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. It is located throughout the Rocky Mountains and northeastern Cascade Ranges in North America. Also included are unstable scree and talus slopes that typically occur below cliff faces. There may be small patches of dense vegetation, but it typically includes scattered trees and/or shrubs. Characteristic trees includes species from the surrounding landscape, such as Douglas-fir (Pseudotsuga menziesii), ponderosa pine (Pinus ponderosa), limber pine (Pinus flexilis), quaking aspen (Populus tremuloides), white fir (Abies concolor), corkbark fir (Abies lasiocarpa), or two-needle piñon and juniper (Juniperus spp.) at lower elevations. There may be scattered shrubs present, such as species of oceanspray (Holodiscus sp.), gooseberry (Ribes sp.), ninebark (Physocarpus sp.), and rose (Rosa sp.), as well as juniper, and fivepetal cliffbush (Jamesia

americana), creeping barberry (Mahonia repens), threeleaf sumac (Rhus trilobata), or alderleaf serviceberry (Amelanchier alnifolia). Soil development is limited, as is herbaceous cover.

Rocky Mountain Gambel Oak-Mixed Montane Shrubland

This ecological system occurs in the mountains, plateaus, and foothills in the southern Rocky Mountains and Colorado Plateau including the Uinta and Wasatch ranges and the Mogollon Rim. These shrublands are most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 6,560 to 9,500 feet amsl in elevation, and are often situated above piñon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. The vegetation is typically dominated by Gambel oak alone or codominant with Saskatoon serviceberry (Amelanchier alnifolia), Utah serviceberry (Amelanchier utahensis), big sagebrush (Artemisia tridentata), alderleaf mountain mahogany (Cercocarpus montanus), chokecherry (Prunus virginiana), Stansbury cliffrose (Purshia stansburiana), antelope bitterbrush (Purshia tridentata), New Mexico locust (Robinia neomexicana), and snowberry (Symphoricarpos spp.). There may be inclusions of other mesic montane shrublands with Gambel oak (Quercus gambelii) absent or as a relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics. Density and cover of Gambel oak and serviceberry (Amelanchier spp.) often increase after fire.

Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rocky Mountains, north and west into Utah, Nevada, western Wyoming, and Idaho. These are mixed-conifer forests occurring on all aspects at elevations ranging from 3,900 to 10,800 feet amsl. Rainfall averages less than 30 inches per year (15–24 inches) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. Douglas-fir (Pseudotsuga menziesii) and white fir (Abies concolor) are most frequent, but Ponderosa pine (Pinus ponderosa) may be present to codominant. Douglas-fir forests occupy drier sites, and Ponderosa pine is a common codominant. White fir-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. Blue spruce (Picea pungens) is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including Kinnikinnick (Arctostaphylos uva-ursi), Oregon grape (Mahonia repens), mountain lover (Paxistima myrsinites), mountain snowberry (Symphoricarpos oreophilus), Gambel oak, and Arizona fescue (Festuca arizonica). This system was undoubtedly characterized by a mixed severity fire regime in its "natural condition," characterized by a high degree of variability in lethality and return interval.

Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland

These are mixed-conifer forests of the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 3,900 to 10,800 feet amsl. Occurrences of this system are found on cooler and more mesic sites than Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland. Such sites include

lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions, and north- and east-facing slopes which burn somewhat infrequently. Douglas-fir and white fir are most common canopy dominants, but Engelmann spruce (Picea engelmannii), blue spruce, or Ponderosa pine may be present. This system includes mixed conifer/quaking aspen stands. A number of cold-deciduous shrub species can occur. Naturally occurring fires are of variable return intervals, and mostly light, erratic, and infrequent due to the cool, moist conditions.

Southern Rocky Mountain Ponderosa Pine Woodland

This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin, and in the Black Hills of South Dakota and Wyoming. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 6,200 feet amsl in northern Wyoming to 9,200 feet amsl in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. Northern Rocky Mountain Ponderosa Pine Woodland in the eastern Cascades, Okanagan, and northern Rocky Mountain regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the central Rocky Mountains. Ponderosa pine (primarily var. scopulorum and var. brachyptera) is the predominant conifer; Douglas-fir, two-needle piñon, and juniper may be present in the tree canopy. The understory is usually shrubby, with common species such as black sagebrush (Artemisia nova), big sagebrush (Artemisia tridentata), greenleaf Manzanita (Arctostaphylos patula), kinnikinnick (Arctostaphylos uva-ursi), Alderleaf mountain mahogany, Stansbury cliffrose, antelope bitterbrush, Gambel oak, mountain snowberry (Symphoricarpos oreophilus), chokecherry (Prunus virginiana), Saskatoon serviceberry, and rose. Bluebunch wheatgrass (Pseudoroegneria spicata) and species of needle and thread (Hesperostipa spp.), needlegrass (Achnatherum spp.), fescue (Festuca spp.), muhly (Muhlenbergia spp.), and grama (Bouteloua spp.) are some of the common grasses. Mixed fire regimes and ground fires of variable return intervals maintain these woodlands, depending on climate, degree of soil development, and understory density.

Biological Soil Crusts

In addition to these vegetative communities; another biological resource includes soil crusts. In arid and semi-arid regions where vegetative cover is generally sparse, open spaces are often covered by biological soil crusts. Also known as cryptogamic, microbiotic, cryptobiotic, and microphytic crusts, these crusts are highly specialized communities formed by living organisms and their by-products, they create a surface crust of soil particles bound together by organic materials. Biological soil crusts in the Colorado Plateau are usually darker than the surrounding soil, due in part to the density of the organisms and to the often dark color of their cyanobacteria, lichens, and mosses.

Biological soil crusts are typically found on barren soil near shallow and surfacing bedrock. Biological soil crusts are not present on bedrock exposures or talus slopes where no soil is present, cliff faces, or 2-track routes where vehicle use discourages growth. Crusts are well

adapted to severe growing conditions, but poorly adapted to compression disturbances. Disruption of the crusts results in decreased organism diversity, soil nutrients, stability, and organic matter in the immediate area, and may lead to soil instability and ultimate reduction of areas which can support other vegetation. Downslope plant communities, however, may receive a higher flux of nutrients in water and sediments in a post-disturbance environment.

3.3.14.2 Special Status Species

A list of federal threatened, endangered, proposed, and candidate species and USFS, Utah State, and BLM sensitive wildlife species known to occur within San Juan County, Utah, was compiled from information provided by the BLM, USFS, and the State of Utah (USFWS,2011, UDWR 2011, BLM 2008a). These species, their habitat, and potential for occurrence in the project area are discussed below for vegetation and in Section 3.3.14.1 for wildlife. The federal Endangered Species Act (ESA) (16 U.S.C. 1531-1543) protects listed threatened and endangered species and their critical habitats. The BLM's Special Status Species Management Policy 6840 (6840 Manual Section) (Rel. 6-121) directs it to identify and protect sensitive species and species identified as candidates for federal listing.

Beaman's Townsendia (Townsendia beamanii)

Beaman's townsendia is listed as a BLM sensitive plant species. It is endemic to San Juan County, and grows in piñon-juniper and ponderosa pine communities between 6,200 to 7,215 feet amsl. It is a stemless, perennial herb that grows in loose tufts. It is in the sunflower family (Asteraceae), and has yellow disc flowers and pink to lavender ray flowers (Welsh et al. 2008). The Flora of North America states: "Taxonomic disposition of Townsendia beamanii S. L. Welsh is not clear; the type may have resulted from hybridization between T. annua and T. incana" (Flora of North America 2011). However, A Utah Flora (Welsh et al. 2008) does recognize Beaman's townsendia as a species.

3.3.15 Visual Resources

One key issue was identified that relates to visual resources. This section addresses existing condions to support analysis of this issue in the effects analysis. In response to NEPA and subsequent agency-specific regulations, BLM and USFS developed systems specifically designed to inventory, evaluate and manage scenic (visual) resources on public lands. To evaluate visual resources under BLM jurisdiction and to develop management objectives for those resources, the BLM developed the Visual Resource Management (VRM) system. BLM's VRM policy consists of three primary components; 1) Maintaining an up-to-date Visual Resource Inventory (VRI), 2) establishing VRM Classes as part of resource management plan, and 3) evaluating project planning for physical effects and plan conformance (BLM 2007). All BLM lands are assigned one of four VRM classes, ranging from Class I, which reflects the highest value and protection for scenery, to Class IV, which reflects the least value and protection for scenery.

The USFS's Scenery Management System is similar to the BLM VRM system. The Manti-La Sal National Forest Land and Resource Management Plan states, as a Forest Management Goal, that the USFS will "maintain, enhance, and/or rehabilitate visual resources to the planned Visual Quality Objective (VQO)" (USFS 1986).

Although land ownership of the La Sal Mines Complex is divided between BLM, USFS, state lands, and private lands, the BLM's VRM classification is used in this section to describe the project area for the purposes of evaluating the potential effects on visual resources.

3.3.15.1 Visual Resources Existing Condition

The La Sal Mines Complex consists of four existing underground mines. Surface facilities at the mines include: DRAs, ore stockpile areas, fuel and oil storage areas, mine offices and dry (i.e.; worker changing and showering facilities), maintenance shops and warehouses, parking areas and storage yards, mine access roads, electrical generators, air compressor stations, water systems, septic systems (including leach field), and vent holes and access roads. These surface facilities are located far enough from both Utah State Route (SR) 46 and U.S. Highway 191, the major roads in the vicinity, that they are not visible or are hidden from view by topography or vegetation along the road. The one exception is the Beaver Shaft, which is slightly visible from SR 46. In addition, surface facilities associated with the mines are visible from county roads and other minor roads that provide the main access to the mines. The La Sal Mountain Loop Road Scenic Backway is located partially along U.S. Highway 191 south of Moab, approximately 10 miles northwest and out of visual range of the project area.

The Moab Field Office of the BLM has described the areas in the vicinity of the project area as having high visual quality, with "scenically diverse vistas and canyon river ways, rare and unusual geological formations, colorful and highly contrasting sandstones, and numerous prehistoric rock art and structures" (BLM 2005). These visual resources attract up to 2 million visitors a year as well as companies filming commercials and motion pictures (BLM 2008a). Accordingly, visual resources are important for the local economy.

The project area falls within the Moab Ranger District of the USFS. Based on the USFS Resource Management Plan, visual resources in the vicinity of the project area include mountain peaks and passes, forested lands, canyons, and views of the surrounding desert (USFS 1986).

BLM lands within the project area itself are classified as VRM Class III or Class IV (BLM 2008a), which are under the following management guidelines for visual resources:

- Class III: The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape (BLM 2007).
- Class IV: The objective of this class is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements of the landscape.

While the surrounding vicinity of the project area has substantial scenic and visual resources, there are no visually sensitive areas in the near vicinity of the La Sal Mines Complex. In addition to mining activities, there is a substantial amount of agriculture, both open rangelands and irrigated croplands, in the project area. In addition, there are no designated state scenic highways located within proximity to the project area.

3.3.16 Affected Environment – Wildlife

Many wildlife species inhabit the project area. Species representative of the vegetation types that are most common within the project area such as sagebrush, gambel oak, pinyon-juniper woodland, and ponderosa pine forest are listed in Table 3-11. Descriptions and species listed are from Brown (1994). These vegetation communities, as defined by Brown are analogous to the vegetation cover types as defined by the Southwest Regional Gap Analysis Program (USGS 2004), which are discussed in Section 3.3.14 and are mapped in Figures 3-5 and 3-6. A variety of game species (including mule deer [Odocoileus hemionus], elk [Cervus canadensis]) and non-game wildlife species are discussed below under Management Indicator Species (MIS).

Table 3-11. Representative Wildlife by Vegetation Community

Vegetation Community (SWReGAP cover type)	**Representative Wildlife Species**
Great Basin Desertscrub (Intermountain Basins Big Sagebrush Shrubland)	A distinctive fauna is centered in the Great Basin Desertscrub vegetation community. Mammals such as Townsend's ground squirrel (*Spermophilus townsendi*), long-tailed pocket mouse (*Perognathus formosus*), and northern grasshopper mouse (*Onychomys leucogaster*) are closely associated with sagebrush in the Great Basin Desertscrub. Mule deer and bighorn sheep are known to use this vegetation community. Birds characteristic of this community include sage thrasher (*Oreoscoptes montanus*), sage sparrow (*Amphispiza belli*), and Vesper sparrow (*Pooecetes gramineus*). Characteristic reptile and amphibian species include sagebrush lizard (*Sceloporus graciosus*) and Great Basin spadefoot toad (*Spea intermontanus*), respectively. A number of reptile subspecies such as desert horned lizard (*Phrynosomo platyrhihnos platyrhinos*) and Great Basin and Plateau tiger whiptails (*Aspidoscelis tigris tigris* and *A. tigris septentrionalis*, respectively) are indicative of Great Basin Desertscrub.
Great Basin Montane Scrubland (Rocky Mountain Gambel Oak Mixed Montane Shrubland)	Great Basin montane scrub is an important vegetation type for mule deer, as it provides winter feeding areas. Numerous birds also utilize Great Basin montane scrub, including Virginia warbler (*Vermivora virginiae*), green-tailed towhee (*Pipilo chlorurus*), western scrub jay (*Aphelocoma californica*), spotted towhee (*P. maculatus*), and chipping sparrow (*Spizella passerina*). Great Basin montane scrub is considered the edge between Great Basin desertscrub and montane conifer forests, and has chararacteristics of both. Therefore, many of the species found here are also found in those communities.
Great Basin Conifer Woodland (Colorado Plateau Pinyon-Juniper Woodland)	Wildlife species closely tied to or centered within this vegetation community include pinyon mouse (*Peromyscus truei*), pinyon jay (*Gymnorhinus cyanocephalus*), gray flycatcher (*Empidonax wrightii*), bushy-tailed woodrat (*Neotoma cinerea*), gray vireo (*Vireo vicinior*), juniper titmouse (*Baeolophus ridgwayi*), black-throated gray warbler (*Dendroica nigrescens*), Scott's oriole (*Icterus parisorum*), and Plateau striped whiptail (*A. velox*). Pinyon-juniper woodlands are also seasonal habitats for a number of montane animals; as such, they are often of great importance as winter range for elk and mule deer.
Rocky Mountain (Petran) Montane	Several species of wildlife are dependent on ponderosa pine, including Abert's squirrel (*Sciurus aberti*), northern goshawk (*Accipiter gentilis*), and Merriam's turkey (*Meleagris gallopavo merriami*). The list of characteristic nesting avifauna includes flammulated owl (*Otus flammeolus*), white-breasted nuthatch (*Sitta carolinensis*),

Vegetation Community (SWReGAP cover type)	Representative Wildlife Species
Conifer Forest (Southern Rocky Mountain Ponderosa Pine Woodland)	pygmy nuthatch (*S. pygmaea*), brown creeper (*Certhis familiaris*), western bluebird (*Sialia mexicana*), yellow-rumped warbler (*Dendroica coronata*), western tanager (*Piranga ludoviciana*), pine siskin (*Carduelis pinus*), and chipping sparrow (*Spizella passerine*). Ponderosa pine forests support a wide variety of neotropical migratory songbirds.

Source: Brown 1994

3.3.16.1 Special Status Species

Special status species analyzed for the La Sal Mines Complex include U.S. Fish and Wildlife (USFWS) listed species, Bureau of Land Management (BLM) sensitive species, and U.S. Forest Service (USFS) sensitive species. A biological assessment and evaluation (BAE) was completed by SWCA (2011) for this project, and is attached as Appendix C. SWCA biologists determined that all USFWS-listed, candidate, and petitioned species for San Juan County, Utah, were unlikely to occur in the project area, and therefore the project would have no effect on those species (SWCA 2011). However, eight of the 17 wildlife species and one of the 12 plant species listed as sensitive (discussed in Section 3.3.14) for the Moab Field Office by the BLM have potential to occur in the project area. These eight wildlife species are also listed as species of concern by the State of Utah. Six of the 15 species listed as USFS sensitive have potential to occur in the project area. Of these species, three overlap both the BLM and USFS lists: bald eagle, spotted bat, and Townsend's big-eared bat. The habitat and range requirements for these sensitive species with potential to occur in the project area are futher discussed below. Information about the federally and agency-listed species without potential to occur within the project area is discussed in more detail in the BAE prepared in support of this project (SWCA 2011).

Bald Eagle (Haliaeetus leucocephalus)

The bald eagle is listed as a USFS sensitive, BLM sensitive, and as a State of Utah species of concern. This species is also protected by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Throughout the breeding range of this species, which includes Alaska, Canada, the coastal United States, and portions of the northern United States, nests are almost always in tall trees and commonly near bodies of water where fish and waterfowl prey are available. During non-breeding periods, especially during winter, bald eagles are relatively social and roost communally in sheltered stands of trees. Wintering areas are commonly associated with open water, though other habitats may be used if food resources, such as rabbit or deer carrion, are readily available. In general, bald eagles avoid areas with nearby human activity and development (Utah Conservation Data Center [UCDC] 2011).

Big Free-tailed Bat (Nyctinomops macrotis)

The big free-tailed bat is a BLM sensitive species and a State of Utah species of concern. This species is rare in Utah, occurring primarily in the southern half of the state, although individuals may occasionally occur in northern Utah. The big free-tailed bat prefers rocky and woodland

habitats, where roosting occurs in caves, mines, old buildings, and rock crevices. The species is typically active year-round, spending summers in temperate North America and migrating to warmer areas in North America and South America for the winter. Big free-tailed bats eat insects, primarily moths. Females may give birth to a single offspring during late spring or early summer each year (UCDC 2011).

Ferruginous Hawk (Buteo regalis)

The ferruginous hawk is a BLM sensitive species and a State of Utah species of concern. During breeding, flat and rolling terrain in grassland or shrub steppe is most often used. Ferruginous hawks preferred habitat includes grasslands, agriculture lands, sagebrush/saltbush/greasewood shrub lands, and at the periphery of piñon-juniper forests. Nest sites usually include cliffs, buttes, creek banks, and other elevated sites. During winter, ferruginous hawks use open farmlands, grasslands, deserts, and other arid regions where rabbits, prairie dogs, or other major prey items are present (UCDC 2011).

Flammulated Owl (Otus flammeolus)

The flammulated owl is a USFS sensitive species. It is a common raptor in montane pine forests (especially ponderosa pine forests) in the western United States. This species migrates from its wintering grounds in central Mexico, the highlands of Central America, and coastal California to its breeding grounds across western North America. Breeding areas extend from southern British Columbia southward through the western United States, and into central Mexico. This species occurs in mountain ranges throughout Utah, but it is believed that breeding occurs primarily in southwestern and the north-central parts of the state. Individuals of this species are more likely to be heard than seen due to their small size (approximately 6 inches long) and elusive nature. The species is considered to be widespread, but loss of mature forest habitat may be having a detrimental effect on population numbers. Flammulated owls are strictly nocturnal and eat insects and other terrestrial invertebrates, such as spiders, centipedes, and scorpions. These owls often capture flying insects while in flight, but will also take prey items off trees or from the ground (UCDC 2011).

Fringed Myotis (Myotis thysanodes)

The fringed myotis is a BLM sensitive species and a State of Utah species of concern. The fringed myotis is a small bat that occurs in most of the western United States, as well as in much of Mexico and part of southwestern Canada. The species is widely distributed throughout Utah, but is not very common in the state. The fringed myotis inhabits caves, mines, and buildings, most often in desert and woodland areas. Beetles are the main prey item of the fringed myotis. The species commonly occurs in colonies of several hundred individuals (UCDC 2011).

The Gunnison's prairie dog is a BLM sensitive species and a State of Utah species of concern. Its range extends from central Colorado to central Arizona, including a small portion of southeastern Utah and much of the northwestern half of New Mexico. This species' habitat includes high mountain valleys and plateaus at elevations of 6,000 to 12,000 feet above mean sea level (amsl). It uses the open grassland, sagebrush, and piñon-juniper woodland vegetation communities. Diet includes grasses, forbs, sedges, and shrubs. Gunnison's prairie dogs live in colonial burrows, usually on slopes or in hummocks. Colonies may consist of fewer than 50 to 100 individuals (NatureServe 2011).

Lewis' Woodpecker (Melanerpes lewis)

The Lewis' woodpecker is a BLM sensitive species and a State of Utah species of concern. The Lewis's woodpecker is a cavity nester, excavating a hole in tall trees, often dead or blackened by fire. This species will also nest in utility poles, or stumps, but prefers ponderosa pine, cottonwood, or sycamore. The diet of this woodpecker consists of insects during the breeding season and nuts and berries during the winter. The major breeding habitat consists of open park-like ponderosa pine forests. The Lewis's woodpecker is attracted to burned-over Douglas-fir, mixed conifer, piñon-juniper, riparian, and oak woodlands, but is also found in the fringes of pine and juniper stands, and deciduous forests, especially riparian cottonwoods. Areas with a good understory of grasses and shrubs to support insect prey populations are preferred. Dead trees and stumps are required for nesting. Wintering grounds span a wide range of habitats, but oak woodlands are preferred (UCDC 2011).

Northern Goshawk (Accipiter gentilis)

The northern goshawk is a USFS sensitive species. This species breeds in much of the Northern Hemisphere, occasionally winters outside (south) of its breeding range, and occurs as a permanent resident throughout Utah. However, it is not common in the state. The northern goshawk prefers mature mountain forest and riparian habitats. Nests are constructed in trees in mature forests; often nests previously used by northern goshawks or other bird species are re-used. Northern goshawks cruise low through forest trees to hunt, and may also perch and watch for prey. Major prey items include rabbits, hares, squirrels, and birds (UCDC 2011). Important components of its mature forest habitat include large trees, a high percentage canopy closure and snags.

Peregrine Falcon (Falco peregrinus anatum)

The peregrine falcon is listed as a USFS sensitive species. Although the peregrine falcon is still rare in Utah, it has become much more abundant throughout its range in recent years due to the ban of DDT. Birds captured in flight are the main food item for the peregrine falcon. This species utilizes a variety of habitats, but nests on high cliffs, usually in wooded or forested areas (UCDC 2011).

Spotted Bat (Euderma maculatum)

Spotted bat is a USFS sensitive and BLM sensitive species and a State of Utah species of concern. The spotted bat occurs throughout much of the western United States, as well as in southwestern Canada and northern and central Mexico. Spotted bats occur state-wide in Utah, but probably have never been abundant in any particular location. Current data suggest that the species may be becoming even rarer in Utah than it was in the past. Spotted bats may be found in a variety of habitats, ranging from deserts to forested mountains; they roost and hibernate in caves and rock crevices. Females generally give birth to a single young in late spring. Spotted bats eat insects, primarily moths, which are usually captured in flight. Similar to Utah's other bat species, the spotted bat is nocturnal (UCDC 2011).

Townsend's Big-eared Bat (Corynorhinus townsendii)

Townsend's big-eared bat is a USFS sensitive and BLM sensitive species and a State of Utah species of concern. It occurs in western North America, from southwestern Canada to Mexico. Isolated populations of the species also occur in areas of the central and eastern United States. The species occurs state-wide in Utah at elevations below 9,000 feet, although populations in

Utah are thought to be declining. Townsend's big-eared bat can occur in many types of habitat, but the species is often found near forested areas. Caves, mines, and buildings are used for day roosting and winter hibernation. Consequently, human disturbances of caves and the closures of abandoned mines may constitute threats to the species. Females congregate into nursery colonies and typically give birth to one young each year. Townsend's big-eared bats eat flying insects, particularly moths, and individuals are often seen foraging near trees. The species is nocturnal, and individuals typically do not leave their roosts until well after sunset (UCDC 2011).

3.3.16.2 Management Indicator Species

Mule deer, elk, Abert's squirrel, golden eagle (Aquila chrysaetos), northern goshawk, and macroinvertebrates are Management Indicator Species (MIS) designated in the Manti-La Sal National Forest Land and Resource Management Plan (USDA Forest Service 1986, as amended) (Table 3-12). The Forest Plan outlines specific management and monitoring requirements for MIS species to indicate the overall health of the forest as a result of forest management activities, including grazing, timber harvesting, mineral extraction, recreation, and others.

Table 3-12. Wildlife Management Indicator Species designated in the Manti-La Sal National Forest Land and Resource Management Plan (USDA Forest Service 1986, as amended)

Common Name	Scientific Name	Habitat or Habitat Component	Potential to Occur in the Project Area
Invertebrates			
Macroinvertebrates	Includes mayflies, stoneflies, and caddisflies	Riparian	No.
Birds			
Northern goshawk	*Accipiter gentilis*	Late-seral ponderosa pine	Yes. Known to occur on Pine Ridge.
Golden eagle	*Aquila chrysaetos*	Open, high desert country, nesting on cliffs or in trees	Yes. Known to occur on Pine Ridge.
Mammals			
Elk	*Cervus canadensis*	Early-seral ponderosa pine, mixed conifer, spruce-fir	Yes.
Mule deer	*Odocoileus hemionus*	Early-seral aspen and pinyon-juniper	Yes.
Abert’s squirrel	*Sciurus aberti*	Early-seral ponderosa pine	Yes. Known to occur on Pine Ridge.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates live in a variety of riparian habitats where water is present. As a group, they provide a vital link in the food chain between primary producers (algae and macrophytes) and fish and amphibians. Many species are useful indicators of aquatic habitat conditions. Aquatic macroinvertebrates include mayflies (Order Ephemeroptera), stoneflies (Order Plecoptera), caddisflies (Order Trichoptera), and true flies (Order Diptera). Aquatic macroinvertebrates were selected for monitoring the health of late-seral, riparian habitats because a diverse and abundant array of these species is indicative of healthy riparian habitats on the Manti La Sal National Forest. Aquatic macroinvertebrates are sensitive to changes resulting from

forest practices, such as timber harvest, grazing, and road building. However, within the La Sal Mines Complex, there are no perennial streams. Surface water is mostly limited to intermittent washes and constructed drainage channels that flow during storm events. Therefore, macroinvertebrates would not likely occur in the project area.

Northern Goshawk

The habitat and range requirements for this species are addressed above in Section 3.3.16.1. The northern goshawk is known to occur within the proposed project area. Historic nest data were provided by the Manti-La Sal National Forest (personal communication, Barb Smith, June 9, 2011). One historic nest site is mapped in the Pine Ridge area. Raptors exhibit high fidelity to nest sites and territories (Romin and Muck 2002). The mapped nest is within the area proposed for Phase 3 of the project.

Golden Eagle

Golden eagles breed across western North America from Alaska south to northern Mexico. Typically found in open, high desert country, golden eagles nest on cliffs or in trees. They feed mainly on small mammals, especially rabbits, prairie dogs and ground squirrels as well as insects, snakes, birds and juvenile deer, elk, and bighorn sheep. In Utah, they are considered a common resident, with an apparently secure population (NatureServe 2010). However, golden eagles meet criteria to be on the USFWS Birds of Conservation Concern list for the Southern Rockies/Colorado Plateau region related to a low relative abundance and threats in the breeding season due largely to their sensitivity to disturbance in the nesting area (Rocky Mountain Bird Observatory 2002).

A positive correlation between breeding success (eaglets/territory and proportion of active territories) and rabbit numbers has been found in Utah (Bates and Moretti 1994) and other areas (Hoffman and Smith 2003). Trends in the eagle population and reproductive success are likely related to the region-wide drought (USGS 2003) and the subsequent reduction and current rebound in prey populations. Historic nest data were provided by the Manti-La Sal National Forest (personal communication, Barb Smith, June 9, 2011). There are three mapped golden eagle nests on Pine Ridge. All three are within 0.25 mile of the area proposed for Phase 3 of the project.

Rocky Mountain Elk

In addition to occupying ponderosa pine forests, elk graze grassland and woodland habitats within the Manti La Sal National Forest. Although they prefer grasses over forbs, they are associated with deciduous thickets and early-seral stages that contain an interspersion of grasses and forbs. Elk occupy mountain meadows and forests in summer and move to lower-elevation pinyon-juniper woodland, conifer forest, and grasslands in winter, where they browse woody shrubs. Rocky Mountain elk habitat has been mapped by the Utah Division of Wildlife Resources. Crucial spring, fall, and winter habitat is associated with all three phases of the project (UCDC 2011) (Figure 3-7). Crucial habitats are those areas that wildlife depend on in order to avoid unacceptable population declines. The term “crucial habitat” does not have any regulatory or legal meaning but it meant to better define those areas that are seasonal important to migrating animals. Tables 3-13 through 3-15 quantify the acreage of elk and mule deer habitat within each Phase area, and provide a percentage of the total Phase area for each of the three Phases.

Table 3-13. Mule Deer and Elk Habitat within Phase 1 Amendments

Species	Acreage	% of Phase Area
Mule deer (*Odocoileus hemionus)*	927.6	100.0
Rocky Mountain Elk (*Cervus Canadensis)*	839.0	90.5
Total acreage	**927.6**	

Table 3-14. Mule Deer and Elk Habitat within Phase 2 Amendments

Species	Acreage	% of Phase Area
Mule deer (*Odocoileus hemionus)*	970.4	100.0
Rocky Mountain Elk (*Cervus Canadensis)*	588.1	60.6
Total acreage	**970.4**	

Table 3-15. Mule Deer and Elk Habitat within Phase 3 Amendments

Species	Acreage	% of Phase Area
Mule deer (Odocoileus hemionus)	738.5	100.0
Rocky Mountain Elk (Cervus Canadensis)	223.9	30.3
Total acreage	**738.5**	

Mule Deer

Mule deer are generalists that use ponderosa pine, mixed-conifer, woodland, and chaparral habitats. Forage items mostly consist of a variety of woody browse, but they feed more on grasses and forbs during the spring and summer months. Important forage plants include mountain mahogany (Cercocarpus ledifolius), buckbrush (Ceanothus cuneatus), cliffrose, sagebrush, buckthorn (Rhamnus spp.), juniper, and oak. Crucial summer and winter habitat is associated with all three phases of the project (UCDC 2011) (Figure 3-8).

Abert's Squirrel

This species lives, nests, and forages in ponderosa pine forests. Preferred habitat structure is intermediate-aged ponderosa pine forest intermixed with larger trees, where groups of trees have crowns that are interlocking or in close proximity. Thickets of medium-sized trees, with fewer large trees per acre, also can provide favorable habitat for Abert's squirrel. Nests are typically built in the branches of large ponderosa pines. Other nest sites include cavities in Gambel oak and in dwarf mistletoe (Arceuthobium spp.). Abert's squirrels depend on the interspersion of habitat types within the forest to provide arboreal travel routes and food both on the ground and in the trees. Closed canopies and abundant snags represent forest conditions favorable for Abert's squirrels. In Utah, the species is very narrowly distributed, occurring only in the southeastern corner of the state, primarily in the Abajo Mountains and on Pine Ridge (UCDC

2011). A low-density population of Abert's squirrel is known to occur in the Pine Ridge general area (personal communication, Barb Smith, USFS, June 23, 2011). The Pine Ridge area is associated with all three phases of the project.

3.3.16.3 Migratory Birds

The MBTA (16 USC 703–712), Executive Order 121186 for migratory bird protection, and the BGEPA (16 USC 668–668d) establish protections for migratory birds and their parts (e.g., eggs, nests, and feathers) from taking, hunting, capture, transport, sale, or purchase. Most species of birds are classified as migratory under the MBTA, except for upland game and introduced birds. Utah Partners in Flight (UPIF) has ranked those birds occurring in the Colorado Plateau physiographic region by priority of concern (Parrish et al. 2002). Due to habitat availability surrounding the project area, several bird species have been identified as priority species by UPIF. Three priority species are identified by UPIF for piñon-juniper habitat: gray vireo (Vireo vicinior), black-throated gray warbler (Dendroica nigrescens), and ferruginous hawk (Buteo regalis). Two priority species are identified for shrub-steppe habitat: greater sage-grouse (Centrocercus urophasianus) and sage sparrow (Amphispiza belli). One priority species is identified for ponderosa pine habitat: Lewis' woodpecker (Melanerpes lewis). The potential exists for breeding birds protected by the MBTA to occur within the project area.

The bald eagle (Haliaeetus leucocephalus) and golden eagle (Aquila chrysaetos) are protected under the MBTA and the BGEPA. Like the MBTA, the BGEPA also prohibits the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export, or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 USC 668[a]; 50 CFR 22). "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb (16 USC 668[c]; 50 CFR 22.3). Bald eagles have been known to winter in the general vicinity of the project area. Three active golden eagle nests have been mapped in the Pine Ridge area of the project area.

3.3.17 Worker Health and Safety

Two key issues were identified that relate to worker health and safety. Mining was historically hazardous work; however modern mine safety practices and regulatory requirements have significantly improved worker health and safety. Worker health and safety is strictly regulated by the US Mine Safety and Health Administration (MSHA). MSHA regulations govern most activities at the La Sal Mines Complex in one way or another. Each mine employee has completed a required 40-hour mine safety training program and completes annual refresher courses as required by MSHA regulations. In addition, Denison has a company safety policy, which is strictly enforced at the LA Sal Mines Complex.

4.0 ENVIRONMENTAL EFFECTS

4.1 Introduction

This section describes the probable environmental effects of the alternatives including the proposed action. This section focuses on key issues indentified during scoping and described in Section 1, and provides the scientific and analytic basis for comparison of the alternatives. Because all known mitigating measures have been included in the Descriptions of the Alternatives, the environmental consequences described below are unavoidable.

Monitoring is addressed in the proposed action and the alternatives. Monitoring is required in accordance with air and water quality permits issued by other agencies. Additional monitoring is proposed as design features of Alternative C as described in Section 2.4.10.

4.1.1 Effects Analysis Assumptions

Effects are described in terms of direct effects, indirect effects and cumulative effects:

- Direct effects are caused by the action, and occur at the same time and place
- Indirect effects are caused by the action, but occur later in time or further removed in distance from the action
- Cumulative effects are effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions

4.1.1.1 Direct and Indirect Effects Analyses

The geographical and temporal boundaries of the direct and indirect effects analyses vary based on the type of effects and resource areas being evaluated. The temporal boundaries of the direct effects analyses are restricted to areas directly affected by the development, operation and reclamation phases of the proposed mine expansion, where active ground disturbing activities are occurring. The geographical boundary of the direct effects analysis is limited to the proposed expansion areas. The temporal boundary of the indirect effects analyses encompasses the post-reclamation phase and the decades after mining and reclamation are complete. The geographical boundary of the indirect effects analysis includes the areas encompassed by the proposed expansion phases, and areas further removed in distance from the proposed expansion phases.

4.1.1.2 Cumulative Effects Analyses

Cumulative effects analyses consider the effects caused by the action when combined with past, present and reasonably foreseeable future actions. Reasonably foreseeable future actions are to those for which there are existing decisions, funding, formal proposals, or which are highly probable, based on known opportunities or trends. The geographical and temporal boundaries of the cumulative effects analyses vary based on the resource area discussed. Generally, the temporal boundaries of the cumulative effects analyses encompass prior actions that have occurred in the analysis area (i.e.; historical mining), current actions, and reasonably foreseeable actions. For public lands within the

analysis area, reasonably foreseeable future actions are limited to actions that are either currently approved or permitted. However, for mineral development activities for uranium or other locatable minerals, actions that have been formally proposed through submittal of a plan of operations to BLM or USFS for approval are also considered. For private lands within the analysis area, reasonably foreseeable future actions are the existing land uses such as ranching and residential, which are expected to continue in the future.

Past actions that are considered in cumulative effects analyses include:

- Previous mineral development associated with the area encompassed by the La Sal Mines Complex (i.e.; the Pandora, Snowball, La Sal, and Beaver mines)
- Presence of the town of La Sal and associated residences and businesses
- Historical mineral development, which occurred near the La Sal Mines Complex, and in a wider area encompassing the area near Uravan, Colorado, and Lisbon Valley, Utah
- Reclamation of historical mining disturbance

Present actions that are considered in cumulative effects analyses include:

- Operation of the La Sal Mines Complex
- Presence of the town of La Sal and associated residences and businesses
- Current use of area highways for various uses such as residential traffic, tourist traffic, and non-mining related truck traffic
- Livestock grazing on public, state, and private lands
- Ongoing reclamation of historical mining areas
- Recreational use of public lands

Reasonably foreseeable future actions that are considered include:

- Mineral development at currently permitted and proposed mines
- Mineral exploration within areas currently approved by permit or proposed in a plan of operations submitted for approval to USFS
- Continued use of area highways for various uses such as residential traffic, tourist traffic, and non-mining related truck traffic
- Continued presence of the town of La Sal and the associated land uses
- Additional oil and gas development

The bulk of past uranium mining and recovery operations, in terms of total uranium production within the general vicinity of the La Sal Mines Complex was centered around Uravan, Colorado, and in Lisbon Valley, Utah. Total production from the Uravan area is on the order of 50 million pounds (lbs) of yellow cake uranium (U_3O_8) with associated vanadium. The Lisbon Valley mines produced nearly 80 million lbs U_3O_8 with processing of ore occurring at the Rio Algom Lisbon Valley mill (now closed

and reclaimed) and at the Atlas mill (undergoing final closure) immediately north of Moab, Utah. Uranium production occurred primarily during the period between about 1950 and 1990. Prior activities in the region were directed dominantly to vanadium mining and recovery.

Figure 4-1 provides a map showing past, present, and reasonably foreseeable mineral development activities in the vicinity of the La Sal Mines Complex. This map depicts mineral-related activities that were considered during development of cumulative effects analyses areas for the various resource areas. However, the geographical extent of the analyses area for the various resource areas varies based on the needs of the cumulative effects analysis.

Reasonably Foreseeable Future Action Scenario for Uranium Production

The area addressed in this reasonably foreseeable future action scenario is an approximately 10 mile radius around the community of La Sal, Utah. Projections of possible future uranium production from the uranium deposits in the area are dependent on estimation of future U_3O_8 and V_2O_5 market prices. From a low of under $10 per lb U_3O_8 around 2000, to over $130 per lb U_3O_8 in 2007, market prices for uranium concentrate (U_3O_8) have varied widely in the past decade. Likewise, prices for vanadium concentrate (V_2O_5), a byproduct of uranium production, have ranged from around $2 per lb V_2O_5 to over $20 per lb. Current prices have settled around $50 - $60 per lb for U_3O_8 and $6 - $7 per lb for V_2O_5.

Prices for U_3O_8 over $100 per lb a few years ago were unsustainable and influenced by speculative buying. Conversely, prices under $40 per lb are generally recognized as being inadequate to sustain, let alone support increases in existing production. Market analysts project U_3O_8 prices for the next five to ten years to be in the range of $55 to $65 per lb U_3O_8. In the projected range of $55 to $65 per lb, few new projects or reactivations of historical projects in the review area can be forecast. Nonetheless, to provide a basis for analysis of the reasonably foreseeable future action scenario for mineral production, a number of reasonably foreseeable future projects are considered.

Projects that are reasonably foreseeable include:

- Denison's La Sal Mines Complex – currently operating
- Denison's Redd Block Mine – in planning stage
- Denison's Pine Ridge Mine – in evaluation stage
- Energy Fuels' Energy Queen Mine – previously developed mine presently on standby and pending reactivation

The Denison White Mesa Mill near Blanding, Utah currently processes about 120,000 tons of ore, grading about 0.21 percent U_3O_8, annually from numerous mines in Colorado and Utah, and produces 400,000 to 500,000 lbs of U_3O_8 concentrate from these sources. Energy Fuels' proposed Pinon Ridge Mill in Montrose County, Colorado would have an initial licensed capacity of 175,000 tons of ore per year and would be licensed to recover up to 850,000 lbs U_3O_8 per year. This is licensed capacity, and sustained production at the design rate may not be realized at uranium prices in the low

end of the projected range for the next several years. If Denison and Energy Fuels are both able to develop and mine sufficient ore to feed the two processing mills, annual ore feed could reach a combined level of 300,000 to 400,000 tons containing on the order of 1.2 to 1.7 million lbs of U_3O_8 annually. It is anticipated that only a portion of this ore would come from the La Sal area, with additional production expected from other areas of Colorado and Utah.

While possible sources of future production can generally be identified, projecting sustainable rates of production is highly conjectural. For purposes of developing the reasonably foreseeable future action scenario relevant to the La Sal Mines Complex EA, speculative ranges of production have been projected as follows:

- Denison Mines in La Sal area: 100,000 tons per year
- Energy Queen Mine: 60,000 tons per year

This conjectural scenario is double current projected near term production (assuming Energy Fuels starts Pinon Ridge in the next few years). The projected Denison production in the La Sal area includes production at the La Sal Mines Complex, the Redd Block Mine, and the Pine Ridge Mine. Production from the Denison mines in the La Sal area is not expected to occur in the same year. Rather future production from the Redd Block or Pine Ridge mines is expected to replace depleted reserves as production at the La Sal Mines Complex ends. This would provide for longer mineral production in the La Sal area, but would not cumulatively increase production in any given year. It is assumed that production from the Denison mines in the La Sal area would be hauled east and south to the White Mesa Mill near Blanding, Utah, whereas production from Energy Fuels Energy Queen mine would be hauled east to their proposed Pinon Ridge Mill in Montrose County Colorado.

4.4.2 Air Quality

The following key issues were identified relevant to air quality:

- How would ore loading and ore transportation affect air quality?
- Is dust generated at development rock piles a hazard with respect to potential carcinogens, silica, or other hazardous materials?
- What are the potential hazards related to air emissions from the mine including dust and other emissions from the operation?
- What are the risks to workers and the general public associated with exposure to silica in the ore and development rock?
- What is the potential for the mine to cause adverse air quality effects to the Class I air quality status of Arches and Canyonlands National Parks?
- What potential long-term effects to air quality could be caused by air emissions from the mine?
- What potential regional effects to air quality could be caused by air emissions from the mine?

- What effects are associated with the White Mesa Mineral Processing Mill?

The La Sal Mines Complex currently operates under an air AO issued by UDEQ (AO DAQE-AN0141510002-09). Denison has submitted a NOI application with UDEQ to modify the AO to allow for expanded surface facilities, additional ore production, and diesel generator and compressor usage. This modification was approved by UDEQ in March 2012.

4.2.1 Direct and Indirect Effects

Mining-related activities at the La Sal Mines Complex are a source of particulate and gaseous air pollutants. Fugitive dust emissions at the mine are generated by ore and development rock material handling, vehicle traffic, and ore and development rock storage piles. Gaseous and particulate air contaminant emissions are generated from operation of diesel generators and compressors, mine vents, and from vehicle traffic. Diesel fuel and gasoline storage tanks also produce air emissions.

4.2.1.1 Alternative A

The proposed action would increase particulate and gaseous air pollutant emissions due to the following actions:

- Modification of surface facilities at the Pandora Mine, including expanded DRA and formation of a new soil pile
- Temporary surface disturbance while drilling vent holes and exploration holes
- Temporary use of drilling equipment resulting in additional exhaust emissions

Air emissions generated from soil stripping, DRA development, and drilling operations would be localized and temporary in nature. Fugitive dust would be generated from disturbing surface soils during stripping and drilling operations. Particulate and gaseous pollutants would be emitted from operation of tracked dozers and drilling equipment.

Emission Sources and Mitigation Measures

Sources of air emissions associated with ongoing operation of the La Sal Mines Complex include diesel-fired generators, diesel-fired air compressors, mine vents, ore and development rock storage and handling, vehicle travel on unpaved roads, and other fugitive emissions. The current La Sal Mines Complex Air Approval Order issued by UDEQ addresses emissions of criteria pollutants and hazardous air pollutants (HAPs) from these sources. The criteria air pollutants as defined by EPA include:

- NO2 – measured as nitrogen oxides (NOX)
- CO
- Ozone (O3)
- PM10
- PM2.5
- SO2

- Lead (Pb)

EPA has also defined 188 HAPs, a list of which is available on the USEPA's web site (http://www.epa.gov/ttn/atw/188polls.html). Criteria pollutant and HAP emissions were calculated for all La Sal Mines Complex sources. Table 4-1 summarizes the projected maximum air emissions from the existing La Sal Mines Complex operations and from the proposed action. Detailed emission calculations are provided in Appendix C of this EA.

Based on maximum estimated emissions of criteria pollutants and HAPs, the La Sal Mines Complex is considered a minor source of air pollution as defined by UDEQ (UAC R307-415-3). The AO would be modified as necessary to address projected emissions increases associated with the proposed action.

Table 4-1. Current maximum permitted air emissions and projected air emissions from Alternative A (tons per year)

Pollutant	Current Maximum Air Emissions	Projected Air Emissions Increase from Proposed Action[1]
NO_2 (as NO_X)	0.5	8.4
CO	0.1	1.8
VOC	0.04	0.8
PM_{10}	9.8	2.1
$PM_{2.5}$	1.3	1.1
SO_2	0.03	0.55
Pb	0.00006	0.000007
Total HAPs	0.0026	0.024

Notes:
[1] Air emissions from the proposed action include proposed minor modifications to operations that are currently being reviewed by the Utah Department of Environmental Quality, surface disturbance dust emissions due to development of additional operations and from combustion exhaust from diesel drilling equipment.

Denison would implement several measures, as described below, to reduce possible impacts on air quality.

Diesel Generators: Impacts from diesel generators would be mitigated by maintaining and operating generators in accordance with the manufacturer's specifications. Impacts would also be mitigated by the use of ultra-low sulfur diesel fuel, which has sulfur content of 0.0015% or lower.

Material Handling: Material handling transfer points at the La Sal Mines Complex include truck loading/unloading, front-end loader loading/unloading, and ore transfer into haul trucks. Particulate emissions would be generated as the material moves through the transfer point. Most of the material being handled on-site (development rock and ore) includes large diameter rock (up to approximately 6 inches in diameter). Therefore, material handling PM10 emissions would be relatively low (less than 2 tons per year). Denison would implement control measures, as necessary, which include covering haul truck beds with tarps for off-site transportation.

Storage Piles: Particulate matter may be emitted from ore, development rock, and soil storage piles. The development rock and ore that would be stored on-site would be large diameter rock (up to approximately 6 inches in diameter). Therefore, storage pile PM10 emissions from these materials are relatively small (3.3 tons per year) compared with fine material storage piles. Fugitive emissions from the soil storage piles would be mitigated by seeding the piles with both a temporary fast-growing seed mix to stabilize the soil and the reclamation seed mix. The comprehensive use of dust control measures at the mine would also minimize the potential for inhalation of radioactive minerals.

Vehicle Traffic: Particulate emissions would be generated by truck and other vehicle traffic. The force of the wheels on the road surface pulverizes surface material when a vehicle travels on an unpaved road. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface.

Particulate emissions associated with vehicle traffic can be reduced by reducing the silt content of the road surface, paving the road, limiting vehicle speeds, or using control techniques such as water sprays to minimize dust formation. Potentially feasible control options for the La Sal Mines Complex include wet suppression with water and/or chemical agents and/or limiting vehicle speeds. Denison would control fugitive dust for the unpaved haul roads and active operational areas by enforcing low speed limits (15 mph for haul trucks) and applying water, magnesium chloride, calcium chloride, or equivalent to the unpaved haul roads as needed to reduce fugitive dust emissions. The frequency of chemical suppressant applications would depend on site-specific conditions such as precipitation, temperature, and observed dust generation.

Storage Tanks: Small amounts of VOC fugitive emissions would likely result from the on-site storage of petroleum-based fuels. These emissions would be mitigated by using best management practices for fueling operations and using light-colored paint for tank exteriors.

Mine Vents: Criteria pollutants and HAPs would be emitted from the mine vents. Criteria pollutant emissions are not addressed in the air AO issued by UDEQ, but rather are regulated by the Mine Safety and Health Administration (MSHA) which requires that the amount of airborne particulate matter in the mine be less than 1 milligram per cubic meter of air (mg/m3). This limit is designed to protect mine workers. Any particulate matter (in the form of either PM10 or PM2.5) emissions exiting the mine vents would be less than 1 mg/m3 and would disperse quickly in the outside air.

Denison is currently required to maintain crystalline silica respirable dust (silica) levels below the value defined by the formula 10 mg/m3 / (% silica + 2). The formula is designed to limit silica levels to 0.1 mg/m3 (MSHA 2007). Under the MSHA regulations, silica in underground mines is monitored weekly and must remain below these levels that are designed to be protective of human health. Accordingly, Denison implements dust suppression measures in the mine, such as watering, which limits dust emissions from the vent holes. As such, exposure to silica to members of the public is expected to be kept to minimal levels.

Analysis of potential effects to air quality associated with radionuclides present in dust and emissions of radon gas are presented in Section 4.9.

Air Dispersion Modeling

Total estimated emissions of NO2 and PM10 from the La Sal Mines Complex existing operations exceed the thresholds established by UDEQ that trigger dispersion modeling. Dispersion modeling studies are computer simulations that estimate the downwind transport and dispersion of air emissions and estimate the resulting pollutant concentrations in air. Dispersion modeling results for each pollutant are added to a measured pollutant background concentration (see Table 3-3) and the sum is compared to the air quality standard to determine if a facility would cause a violation of that standard.

Denison was required to submit a dispersion modeling analysis for NO2 and PM10 with its permit application to demonstrate that the La Sal Mines Complex operations would comply with the NAAQS. In addition, at the request of UDEQ, Denison modeled potential emissions of formaldehyde and chromium for comparison with UDEQ toxic screening levels (TSL). Table 4-2 shows the results of the dispersion modeling conducted by Denison and the applicable ambient air standard or screening level. The modeling results presented in Table 4-2 show that operations at the Las Sal Mines Complex would not result in violations of the air quality standards for criteria pollutants, and that concentrations of formaldehyde and chromium would be below toxic screening levels.

Table 4-2. Dispersion modeling results

Pollutant	**Averaging Time**	**Modeled Concentration ($\mu g/m^3$)[a]**	**Ambient Air Standard or Screening Level ($\mu g/m^3$)[a]**
PM_{10}	24-Hour	116.0	150[b]
	Annual	35.4	50[b]
NO_2	Annual	19.2	100[b]
Formaldehyde	1-Hour	1.9	37[c]
Chromium	24-Hour	0.01	0.11[c]

Notes:
Data from Tetra Tech (2008b) and Redhorse (2010)
[a] Micrograms per cubic meter
[b] National Ambient Air Quality Standard
[c] Toxic Screening Level

Visibility

Under UAC R307-406-2, new major PSD sources or major PSD modifications must assess the impact of emissions on visibility in any Class I area. Total emissions associated with expanded operations at the La Sal Mines Complex would not be a major source or major modification under PSD. Therefore, an assessment for impact of emissions on visibility would not be required. Furthermore, federal land managers, who are designated to protect visibility in federal Class I areas, have established a technique to screen out small and/or distant sources that would not cause or contribute to visibility

impairment at Class I areas (USFS, NPS, and USFWS 2010). The procedure examines the total emissions of NOX and SO2 from a facility (in tons per year), divided by the distance to the nearest Class I area (in kilometers). If the resulting value is less than or equal to 10, the source is considered to be too small and/or distant to have an adverse effect on visibility at the Class I area (USFS, NPS, and USFWS 2010). The screening value for the La Sal Mines Complex is 0.2 (9.4 tons per year/43 km), which is much less than 10, indicating that the La Sal Mines Complex would not cause or contribute to visibility impairment at a Class I area.

NESHAPs for Underground Uranium Mines

Underground uranium mines are ventilated to protect miners from exposure to substances such as radon (30 CFR Part 57). Ventilating mines to reduce miners' radon exposure may result in radon being emitted to the ambient air. The Underground Uranium Mine NESHAP was promulgated to protect members of the public from these potential radon emissions. Mines subject to this regulation may not emit radon-222 (Rn-222) to the ambient air in excess of those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 millirem per year (mrem/yr). Emissions are modeled using the EPA's Comply-R computer code or equivalent.

Because the estimated annual ore production rate is greater than 10,000 tons per year, the La Sal Mines Complex are subject to the Underground Uranium Mine NESHAP. Under the federal regulations, the Operator monitors for Rn-222 emissions from mine vent holes and submits an annual compliance report in conformance with the standards. Testing for Rn-222 emissions from the vent holes is completed by the Operator.

Detailed information regarding radon is presented n Section 4.9.

Air Quality Impact Summary

The proposed action includes several operations that would increase air emissions and may result in minor impacts to air quality. However, the potential impacts would be localized and temporary in nature. Denison would implement practices and controls to minimize air quality emissions at the La Sal Mines Complex. Air quality permitting has demonstrated that the Mines would comply with state and federal air quality standards and regulations. The air quality Approval Order and Notice of Intent permit applications provide the technical documentation supporting this finding.

4.2.1.2 Alternative B

Under the No Action alternative, the La Sal Mines Complex would not be expanded. No increased air emissions would occur, and the mines would continue to operate in accordance with existing permits.

4.2.1.3 Alternative C

Alternative C includes an expanded DRA at the Pandora Mine which would extend further south of the proposed DRA and have a capacity approximately 625,000 cy greater than the proposed action. The expanded DRA would result in a larger disturbed area that would be subject to wind erosion. The added surface area of the DRA would

slightly increase the fugitive particulate emissions at the Pandora Mine. However, because development rock would have relatively large diameters, fugitive particulate emissions from the DRA are expected to be small. The increased PM10 emissions associated with the expanded Pandora DRA described in Alternative C would be less than one ton per year based on emission estimates.

The expanded DRA would also require a larger affected boundary at the Pandora Mine. An additional 5 acres would be required for the Pandora DRA under Alternative C. An appropriate buffer between the DRA and areas where public access is allowed would be given to ensure that the NAAQS are protected outside the operations boundary.

Alternative C would also require pre-construction radon modeling for new shafts. The modeling would evaluate potential adverse impacts associated with radon emissions prior to commencing operation of the new vent shaft. The pre-construction modeling would assess whether the new vent shafts would be expected to comply with the requirements of 40 CFR 61, Subpart B which limit the impact of vent shaft radon emissions on members of the public.

4.2.2 Cumulative Effects

The potential impacts on air quality from the La Sal Mines Complex are expected to be localized, with minimal affect on regional air quality. Potential cumulative impacts of nearby uranium mining operations, the White Mesa Mill, and reasonably foreseeable development were addressed to estimate if there is a potential for cumulative impacts.

4.2.2.1 Alternative A

There are currently no active uranium mines within an approximate 10 mile region surrounding the La Sal Mines Complex. There are four mines that have obtained the necessary permits but have not commenced operations. These four mines are the Sunset Mine, the Energy Queen Mine, the Pine Ridge Mine, and the Gray Daun Mine. These mines range from two to eight miles from the La Sal Mines Complex. Air quality impacts from these mines would be small and any impacts would be localized, mostly occurring within the footprint of the mining area.

Ore from the La Sal Mines Complex is transported by haul trucks to the White Mesa Mill for processing. The White Mesa Mill is located near Blanding, Utah, approximately 69 miles south of the La Sal Mines Complex. Ore is transported in covered haul trucks and transport occurs primarily on US Highway (Hwy.) 191 which is a paved highway. Some dust generation occurs on all paved roads and highways due to re-suspension of loose material on the road as vehicles travel along the road, as well as from tire and brake wear from vehicles. As discussed in Section 4-14, the increased traffic on US Hwy. 191 associated with Alternative A is less than 5 percent.

Air emissions from operation of the White Mesa Mill are regulated by UDAQ through its air permitting program (UAC R307-400: Permits). Approval Order (AO DAQE-AN0112050018-11) was issued by UDAQ to the White Mesa Mill in 2011 and regulates the operations of the mill to ensure air emissions would be below levels that would ensure compliance with air quality standards. The mill is permitted to process up to

720,720 tons per year of uranium ore (UDEQ 2011b). The air emissions allowed under the permit are given below in units of tons per year:

- PM10: 34.07 tons per year
- PM2.5:17.08 tons per year
- SO2: 2.91 tons per year
- NOX: 39.61 tons per year
- CO: 10.49 tons per year
- VOC: 4.03 tons per year
- Hexane: 0.63 tons per year
- Formaldehyde: 0.03 tons per year

The White Mesa Mill is subject to New Source Performance Standard (NSPS) 40 CFR Part 60 Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units) and NESHAP 40 CFR Part 61 Subpart W (National Emission Standards for Radon Emissions from Operating Mill Tailings) (UDEQ 2011b).

While a portion of ore delivered to the mill would be from the La Sal Mines Complex, the mill accepts ore from several sources and is not reliant on the mine for its operation.

4.2.2.2 Alternative B

Under the No Action alternative, the La Sal Mines Complex would not be expanded. No increased air emissions would occur, and the mines would continue to operate in accordance with existing permits. The operation of nearby mines and the White Mesa Mill would not be affected.

4.2.2.3 Alternative C

Cumulative effects on air quality resulting from implementation of Alternative C would be identical to the proposed action except for a slight increase in particulate emissions associated with the expanded DRA at the Pandora Mine.

4.3 Cultural Resources

4.3.1 Direct and Indirect Effects

Ground-disturbing activities, such as exploration drilling, vent and road construction, and secondary surface activities, such as vehicular traffic, have the potential to directly and irreversibly damage or destroy sensitive cultural resources. Many of the known archaeological sites in the area are shallow and therefore vulnerable to the direct impacts of vegetation clearing, grading or blading of roads, and excavation of soils.

Indirect impacts could include damage to or destruction of cultural resources as a result of increased as a result of improved public access to these areas provided by project area access roads. However, these lands are currently open for public access by foot.

The project area of potential effects (APE) for cultural resources is defined as the combined area for each of the three project phases, as well as the existing facilities associated with the mines complex.

Project impacts to cultural resources considered not eligible for NRHP nomination, including all isolated occurrences, are not considered to constitute an ‘effect’ under 36 CFR 800, as these resources are not considered ‘historic properties’. Project-related effects to NRHP-eligible or NRHP-listed cultural resources (historic properties) are considered ‘adverse’ if they would diminish the aspects of integrity that contribute to the resources’ eligibility.

As of June 2011, 28 archaeological sites had been identified within 0.5 mile of the project area, all of them prehistoric in age. Most of those 28 sites are either located outside of the project APE for cultural resources or, due to gaps in the available records, it is unclear whether they are located within the APE or outside of it. Ten previously recorded archaeological sites are known to be present within the APE.

4.3.1.1 Alternative A

Alternative A has the potential to result in adverse effects to cultural resources.

Under Alternative A, the existing development rock pile at the Pandora Mine would be expanded. A Class III cultural resources inventory of the proposed expansion area was conducted (SWCA 2009), resulting in the identification of one isolated occurrence. Isolates are not considered eligible for NRHP inclusion, and as such, any project-related impacts to this resource would not be considered to constitute an ‘effect’. If the proposed expansion would exceed the area inventoried for cultural resources, a preconstruction survey for cultural resources is recommended to ensure identification and avoidance of NRHP-eligible cultural resources.

Alternative A also includes three phases of exploration drilling, vent construction, and road construction.

Phase 1

Three previously identified archaeological sites are present within Phase 1 of the proposed project. All three of the sites are prehistoric lithic scatters, and all three are recommended not eligible for inclusion on the NRHP. Any project-related impacts to these resources would not be considered ’effects’ under NHPA.

Phase 2

Within Phase 2 of the proposed project, three previously identified sites are present. One of the sites is a prehistoric open camp and the other two are prehistoric lithic scatters. The prehistoric open camp is of unknown eligibility for NRHP nomination, while the other two sites are recommended not eligible for inclusion on the NRHP. Any project-related impacts to the two non-eligible resources would not be considered ’effects’ under NHPA. Unevaluated sites are treated as NRHP-eligible for management purposes, and any project-related impacts to this site would constitute an effect to cultural resources under 36 CFR 800 if not mitigated to a less than adverse level.

Phase 3

Four previously identified archaeological sites are located within Phase 3 of the proposed project. One site is a prehistoric lithic quarry, one is a prehistoric open camp, and two are prehistoric lithic scatters. One of the sites, the prehistoric open camp, is recommended eligible for inclusion on the NRHP, while the remaining three sites are recommended not eligible for NRHP inclusion. Any project-related impact to the NRHP-eligible site would be considered an effect under NHPA. Such an effect could be considered adverse if not mitigated to a less than adverse level.

All three phases of activity have the potential to result in effects to cultural resources. Ground-disturbing activities could impact an unevaluated site in the Phase 2 area, and an NRHP-eligible site in Phase 3. Ground-disturbing activities in areas not inventoried for cultural resources could impact undocumented archaeological sites. Preconstruction surveys for cultural resources are recommended to ensure identification and avoidance of historic properties.

In addition to preconstruction cultural resource surveys, it is recommended that if ground-disturbing activities are proposed within 100 feet of an NRHP-eligible or unevaluated site, such activities should be monitored by a qualified archaeologist to ensure that the site is not impacted.

In accordance with Denison's Archaeological Findings Policy, if cultural resources are discovered during project-related operations, all ground-disturbing activities in the vicinity of the resource would cease immediately. The equipment operator would contact Denison's Environmental Coordinator, who would then notify the appropriate agency personnel, depending on jurisdiction. A BLM or USFS archaeologist, or an archaeologist permitted by the appropriate agency, would inspect and evaluate the discovery as soon as possible to assess its nature, extent, and eligibility for nomination to the NRHP.

4.3.1.2 Alternative B

Under Alternative B, no additional mining activities would take place. The La Sal Mines Complex would not be expanded. The impacts to cultural resources under the current conditions and mining operations would not change. Therefore, no additional impacts to cultural resources would occur.

4.3.1.3 Alternative C

Two components of Alternative C have the potential to affect cultural resources.

Pre-construction Cultural Resources Surveys

Alternative C would require preconstruction cultural resource surveys of the specific locations for exploration drill holes, ventilation shafts, and associated access roads, and require avoidance of any cultural resources listed on or eligible for listing on the NRHP. This component would allow for the identification and avoidance of historic properties (cultural resources listed on or eligible for listing on the NRHP) in the areas proposed for exploration drilling, vent construction, and road construction in all three phases.

Modifications to Pandora DRA

Under Alternative C, the Pandora DRA boundary would be expanded into the valley area to the south of the proposed DRA. This modification would result in an expansion of the affected boundary at the Pandora mine, from 15.39 acres proposed in Alternative A, to 20.32 acres, an expansion of approximately five acres.

If the boundary for the Pandora Mine DRA expansion is changed to include any areas not covered by the original cultural resources survey for the expansion, undocumented archaeological sites could be impacted. Preconstruction surveys of any such areas for cultural resources are recommended to ensure that NRHP-listed or -eligible cultural resources are identified and avoided.

In addition to preconstruction cultural resource surveys, it is recommended that if ground-disturbing activities are proposed within 100 feet of an NRHP-eligible or unevaluated site, such activities should be monitored by a qualified archaeologist to ensure that the site is not impacted.

In accordance with Denison's Archaeological Findings Policy (Attachment S of the proposed Plan of Operations), if cultural resources are discovered during project-related operations on public lands, all ground-disturbing activities in the vicinity of the resource would cease immediately. The equipment operator would contact Denison's Environmental Coordinator, who would then notify the appropriate agency personnel, depending on jurisdiction. A BLM or USFS archaeologist, or an archaeologist permitted by the appropriate agency, would inspect and evaluate the discovery as soon as possible to assess its nature, extent, and eligibility for nomination to the NRHP.

4.3.2 Cumulative Effects

4.3.2.1 Alternative A

Various management activities, extractive industries, and recreational activities take place on the lands in and surrounding the project area.

Mining, Oil, and Gas

The proposed project area and surrounding vicinity have been disturbed by mining-related activities. The surface disturbance associated with each past and present action has likely contributed to a cumulative degradation of prehistoric cultural resources in the area. However, infrastructure and other remnants of past mining, oil, and gas projects over 50 years old would be considered cultural resources; in this respect, past actions related to these extractive industries have contributed to the suite of historic cultural resources in the project vicinity. There are several permitted mines and exploration areas in the general vicinity of the La Sal Mines Complex that may become active in the reasonably foreseeable future. Reclamation of surface disturbance associated with mining and oil and gas projects does not mitigate damage to archaeological sites, which are non-renewable resources that cannot be restored once they have been damaged.

However, unrelated past, present, and reasonably foreseeable future actions conducted on public lands administered by BLM and USFS, as well as federally funded or permitted actions on lands with non-federal surface ownership, are subject to the NHPA. NHPA and the implementing regulations found at 32 CFR 800 require federal agencies

to consider the effects of their undertakings on cultural resources. As such, actions with federal involvement (lands, funding, or permits) typically avoid NRHP-listed and -eligible cultural resources or mitigate adverse effects to cultural resources to be in compliance with the NHPA.

Similarly, actions on SITLA and private lands are subject to Utah State Code 404, which requires state agencies, such as SITLA and UDOGM, to consider the effects of their actions on cultural resources. Therefore, the cumulative effects of unrelated actions on cultural resources are limited since many of the actions are subject to NHPA or Utah State Code 404.

Recreation

Improved access into the project area and surrounding vicinity facilitated by temporary exploration roads and other past, present, and reasonably foreseeable future actions could result in an increase in recreational activity in the area. Increased recreational activity, including hiking, hunting, and off-highway vehicle use, has the potential to result in impacts to cultural resources through disturbance and illicit artifact collection.

Grazing

Grazing occurs on BLM, USFS, state, and private land within and surrounding the project area. Cattle can trample and displace surface artifacts, as well as disturb intact subsurface archaeological deposits when soils are moist.

When combined with the impacts of these other activities, Alternative A could contribute to additional cultural resources impacts in the region.

4.3.2.2 Alternative B

Under Alternative B, the cumulative effects to cultural resources under the current conditions and mining operations would not change. Therefore, no additional cumulative effects to cultural resources would occur.

4.3.2.3 Alternative C

Cumulative effects to cultural resources resulting from implementation of Alternative C would be less than those described for Alternative A, due to the requirement for pre-construction cultural resource surveys of Phase 1, 2 or 3 exploration drilling sites, vent hole sites, and associated access roads and avoidance of any historic properties identified in surveys. This provision would ensure the avoidance of significant impacts to cultural resources associated with exploration drilling and vent and road construction.

4.4 Development Rock

The following key issues associated with development rock were identified during scoping:

- Have existing development rock piles caused adverse effects to soil or groundwater in vicinity of mine?
- Would placement of additional development rock cause adverse effects to soil or groundwater in vicinity of mine?

- Is arsenic in development rock, ore stockpiles, or soils a hazard to workers or the general public during mine operations?
- Is the capacity of the proposed Pandora mine DRA sufficient to support planned mineral production?

4.4.1 Direct and Indirect Effects

Potential direct and indirect effects associated with development rock are addressed in the following sections with respect to the key issues. This section focuses on environmental characteristics of development rock such as potential to cause acid mine drainage, deleterious leachate, or direct contact risks. Potential radiological issues associated with development rock are addressed in Section 4-9.

4.4.1.1 Alternative A

Alternative A would manage development rock through placement within previously-mined underground voids and placement in surface DRAs. However, it is not feasible to manage all development rock underground as discussed in Chapter 3. Management of development rock in surface DRAs is incident to mineral production, and common practice at underground mines.

Rock excavated from uranium mines, and other metal mines, may have the potential to affect the environment. Therefore, environmental characteristics of development rock produced at the La Sal Mines Complex were evaluated as discussed in Chapter 3. During reclamation, the slopes of the DRAs would be reduced to 3:1 or less, the DRAs would be covered with soil or other inert material, and the DRAs would be revegetated. Issues related specifically to reclamation and slope stability are addressed Section 4.10 and 4.11.

Potential effects to soil or groundwater in vicinity of mine

Alternative A would expand the existing DRA at the Pandora mine, and existing DRAs would continue to be utilized at the La Sal and Beaver Mines. It is assumed that the environmental characteristics of development rock produced at the La Sal Mines Complex in the future would be similar to development rock produced to date. As discussed in Chapter 3, the existing development rock has a low potential to cause adverse environmental effects in relation to acid mine drainage or generation of deleterious leachate. Therefore, it is unlikely that the modifications to existing DRAs associated with Alternative A would cause adverse effects to water quality.

There is potential that wind or water erosion could lead to some dispersion of fine-grained particulates from the DRAs to adjacent soil. However, as discussed in Chapter 3, the development rock itself does not present a human health risk related to direct contact. In the event that some small quantity of fine grained particulate matter is transported to adjacent soils though natural dispersion processes, any increase in total metals concentrations in the adjacent soils is expected to be negligible. This process would not result in potential human health risks in adjacent soils.

Potential for arsenic in development rock or soils to present a hazard to workers or the general public during mine operations

As discussed in Chapter 3, detailed 90-point composite sampling was completed at DRAs at the Pandora, La Sal, Beaver and Snowball mines to provide additional information regarding the average arsenic concentrations of the DRAs, and to supplement the initial three samples collected at the Pandora Mine during completion of *Evaluation of Development Rock Piles at the La Sal Mines Complex (CDM 2009a)*. Based on the assumption that future development rock would exhibit similar environmental characteristics and evaluation of this more-complete data set, it is unlikely that arsenic in development rock or soils would present a hazard to workers or the general public associated with arsenic.

Potential risks to miners are strictly regulated by MSHA in accordance with the federal Mine Safety and Health Act of 1977 as amended, and other federal laws and regulations. MSHA conducts routine inspections at the La Sal Mines Complex, and requires immediate action by Denison if violations to applicable mine safety and health of workers are observed. Because the mining process is strictly regulated by MSHA, it is considered unlikely that arsenic would pose a hazard to workers.

4.4.1.2 Alternative B

Under Alternative B, the proposed expansion to the Pandora DRA would not occur, and development rock would be placed at all existing DRAs. In addition, the ventilation shafts and exploration drilling required to facilitate mine expansion would not occur. Because the environmental characteristics of additional development rock produced under Alternative B are expected to be similar to development rock produced to date, it is unlikely that alternative B would cause adverse effects with respect to the key issues.

4.4.1.3 Alternative C

Under Alternative C, DRA would be managed in a similar manner to Alternative A. However, Alternative C would provide for an expansion of the existing DRA at the Pandora Mine by additional 5 acres as compared to Alternative A. This would provide additional capacity to manage development rock produced at the Pandora mine. Because the environmental characteristics of additional development rock produced under Alternative C are expected to be similar to development rock produced to date, it is unlikely that the larger capacity of the Pandora DRA under Alternative C would cause adverse effects with respect to the key issues.

Alternative C also requires annual environmental characterization of development rock produced at the La Sal Mines Complex. This would further reduce the risks of adverse effects caused by development rock placement, because in the event that the environmental characteristics of the development rock produced at the La Sal Mines Complex changes over time, the characteristics would be identified and appropriate modifications to the plan of operations could be made, if necessary. Therefore, Alternative C is relatively more protective of the environment as compared to Alternatives A or B.

4.4.2 Cumulative Effects

Production of development rock is incidental to mining, and is commonplace at uranium mines and other metal mines. Therefore, it is likely that development rock is present at the existing mines in the vicinity of the La Sal Mines Complex, and that reasonably foreseeable future mines would produce additional development rock.

4.4.2.1 Alternative A

As discussed previously, Alternative A is unlikely to cause adverse effects to soil and groundwater, or to cause effects associated with direct contact to arsenic to workers or the general public. Therefore, Alternative A is not expected to cause cumulative effects with respect to the key issues when combined with effects of past, present or reasonably foreseeable future actions.

4.4.2.2 Alternative B

Similarly, Alternative B is also not expected to cause cumulative effects with respect to the key issues when combined with effects of past, present or reasonably foreseeable future actions.

4.4.2.3 Alternative C

Alternative C is also not likely to cause cumulative effects with respect to the key issues when combined with effects of past, present or reasonably foreseeable future actions. Alternative C would be relatively less likely to cause cumulative effects, because the environmental characteristics of the develop rock produced at the La Sal Mines Complex would be monitored annually. Modifications to the plan of operations could be then completed, if they were necessary to address potential changes in environmental characteristics of the development rock that were not foreseen in this evaluation, and that could lead to potential cumulative effects.

4.5 Geology

The following key issues are related to geology:

- Would the project affect future oil and gas development?
- How would the project affect uranium production and reserves?

The La Sal Mines Complex project is located in the Paradox Basin south of the La Sal Mountains. Oil and gas resource in this part of the basin occur in the fractured interbed, buried fault block and salt anticline plays within the Pennsylvanian Hermosa Group. These plays have a high potential for development in the area of the proposed project (BLM 2004). Currently, there are two oil and gas leases overlying the proposed project area, but there is no oil and gas development.

4.5.1 Direct and Indirect Effects

4.5.1.1 Alternative A

Alternative A would not interfere with any future oil and gas development because the oil and gas targets are deeper than the uranium-bearing deposits and drilling and production facilities could be sited outside the active areas of the mining operation.

The uranium deposits within the La Sal Mines Complex occur primarily in channels of the Salt Wash Member of the Morrison Formation. This area of San Juan County provides other opportunities for extraction of uranium resources. The La Sal Mines Complex proposal could have a positive impact for the uranium minerals industry by potentially increasing the understanding of ore deposition. For the extraction of every 100,000 tons of uranium ore there would be a yield of approximately 600,000 lbs of U_3O_8, which would constitute an irretrievable loss of the same.

4.5.1.2 Alternative B

Alternative B would not approve the proposed expansion to mining operations at the La Sal Mines Complex, and would not lead to direct or indirect effects to oil and gas development or uranium production and reserves.

4.5.1.3 Alternative C

Direct and indirect effects related to oil and gas development or uranium production and reserves for Alternative C would be the same as discussed for Alternative A.

4.5.2 Cumulative Effects

4.5.2.1 Alternative A

As discussed in the RFFAS, additional uranium mining is expected in the cumulative effects analysis area. This would lead to additional uranium production, and an irretrievable loss of additional uranium resources.

Alternative A would not lead to cumulative effects on oil and gas development, because oil and gas targets are deeper than the uranium-bearing deposits and drilling and production facilities could be sited outside the active areas of the reasonably foreseeable mining operations.

4.5.2.2 Alternative B

Alternative B would not approved the proposed expansion to mining operations at the La Sal Mines Complex, and would not lead to cumulative effects to oil and gas development or uranium production and reserves.

4.5.2.3 Alternative C

Cumulative effects of Alternative C would be the same as discussed for Alternative A.

4.6 Groundwater

The following key issues associated with groundwater were identified during scoping*:*

- What are the potential effects on water quality from water collecting in the underground mine workings?
- What are the potential effects of mining on the drinking water of La Sal?
- What are the potential effects of ore stockpiles on drinking water of La Sal?

- What are the potential effects of ventilation shafts on Groundwater Quantity and Quality?
- What are the potential effects of exploration drilling on Groundwater Quantity and Quality?
- What are the potential effects to groundwater during the post-reclamation period?

The following discussion focuses on the key issues. Additional information regarding groundwater is presented in *Hydrogeologic Evaluation of Denison Mines (USA) Corp. La Sal Mines Complex* (CDM 2009b).

4.6.1 Direct and Indirect Effects

4.6.1.1 Alternative A

Aspects of Alternative A that could affect groundwater quality or quantity include construction, operation, and reclamation of ventilation shafts; exploration drilling; and surface and underground mining practices. These aspects are discussed in the following sections in relation to the key issues.

Potential Effects on water quality from water collecting in the underground mine workings

The underground mine workings are located in the upper portion of the Salt Wash Member of the Morrison Formation, in a geologic unit called the Top Rim Sandstone. Based on geologic reconnaissance conducted in the underground workings, this rock unit is not saturated. Therefore, groundwater does not flow into the mine from the Salt Wash Member. The Salt Wash Member is overlain by several hundred feet of shale, which serves as a confining layer. A confining layer is a layer that restricts vertical movement of groundwater between aquifers. This shale layer is called the Brushy Basin Member of the Morrison Formation. Two aquifers overlie the Brushy Basin Member: the D–aquifer (Lowe 1996) and an alluvial aquifer. Both the D-aquifer and the alluvial aquifers are fragmented, because the rock units that host the aquifers are truncated in some areas. The D-aquifer is present in the area south of the proposed mining areas, and it is the primary aquifer utilized for drinking water by residents in La Sal and nearby areas.

During the underground mine reconnaissance (CDM 2009b), some water was observed to be leaking through several mine ventilation shafts into the underground workings. This water was collected in sumps and was utilized for dust control in the underground mine. Water used for dust control in the underground mine evaporates into the mine ventilation system and is exhausted as water vapor through the ventilation shafts into the atmosphere. Therefore the quantity of water that could potentially infiltrate through the Salt Wash Member and flow into deeper aquifers is expected to be negligible. Therefore, it is unlikely that leakage of water into the underground mine workings from overlying aquifers was affecting groundwater quality within a deeper aquifer.

Leakage of groundwater through the ventilation shafts is not ideal with respect to engineering functions of the shafts, and it is reported that by mine operations staff have

mitigated this leakage. The current water supply for the underground mine is an existing well utilizing a water right owned by UMETCO Minerals Corporation. Denison is in the process of transferring this water right to Denison in accordance with state water rights law (C. Woodward, Denison Mines (USA) Corp, personal communication, 2011).

As underground mining progresses towards the west in Phases 2 and 3, it is possible that saturated conditions would be encountered within the Salt Wash Member based on data presented in *Energy Queen Mine Groundwater Discharge Permit Application and Supporting Documents* (Tetra Tech 2008c). If this occurs, groundwater would be expected to seep slowly into the underground workings based on the hydraulic conductivity data for the Salt Wash Member discussed in Section 3-3.5. This water may require pumping to the surface.

The underground mine would follow the trend of strongly mineralized rock, which contains naturally enriched concentrations of uranium and other elements. Groundwater in contact with these enriched rocks would be expected to be in geochemical equilibrium with the uranium-enriched rocks, and this groundwater may not be suitable for use as drinking water. Geochemical conditions associated with areas of ventilated mine workings may also influence quality of water within the underground mine. In the event that this water flows into the underground workings and then out of the underground workings at a different location, the geochemical conditions of water flowing through the Salt Wash Member would be expected to return to the natural ambient conditions. This type of interaction is permitted by rule in the state of Utah as set forth by Utah Administrative Code R317-6-6.2.

In the event that mine water must be pumped to the surface, it would be managed in accordance with applicable state and federal laws, which require treatment of mine water before discharge, if necessary.

Potential Effects of Mining on Drinking Water of La Sal

As discussed previously, most drinking water wells in the La Sal area utilize groundwater from the D-aquifer or from unconsolidated eolian/alluvial aquifers for drinking water. The drinking water aquifers overlie the Brushy Basin Shale and the Salt Wash Member, which is unsaturated in the current mining areas. Groundwater within the drinking water aquifers has a downward vertical hydraulic gradient, which means that groundwater would tend to flow downward from the drinking water aquifers towards the Salt Wash Member, rather than upwards from the underground mine towards the drinking water aquifers. Therefore, it is unlikely that Alternative A would affect the drinking water quality of La Sal. Standard engineering practices for construction of the mine ventilation shafts are designed to prevent groundwater from flowing into the shafts. Therefore, it is also unlikely that Alternative A would affect well water levels or the water supply for La Sal.

Surface mining operations could potentially affect the quality of the aquifers used for drinking water in the La Sal area if pollutants are released from surface facilities into groundwater. A potential cause of effects to drinking water could be leakage of petroleum products from fuel storage areas. Denison currently has a Spill Prevention, Control, and Countermeasure Plan in place (ACE 2009b), which complies with federal

regulations at 40 CFR Part 112. This plan addresses proper storage of petroleum products at the mine and provides information regarding facility management, a description of facilities, spill information, and spill prevention and control measures. Accordingly, the risk of adverse effects to drinking water supplies caused by a release of petroleum products is considered low.

Storage of development rock could potentially cause effects to drinking water in the La Sal area if deleterious leachate were generated at the DRAs, and this leachate infiltrated into groundwater. The potential for development rock to generate deleterious leachate is addressed in Section 4.4. As discussed in that section, the risk of generation of deleterious leachate from DRAs is low. Accordingly, the associated risk to drinking water resources resulting from leachate generation and subsequent infiltration to groundwater is also low.

Potential Effects of Ore Stockpiles on Drinking Water of La Sal

Ore stockpiles are currently present at the Pandora and Beaver Mines, and an additional ore stockpile may be present in the future at the La Sal Mine. Generally, these stockpiles contain less than a few thousand tons of ore, because ore is regularly hauled to the White Mesa Mill to achieve a continuous supply of ore to the mill. The potential for leachate generation from the ore stockpiles is considered low based on the evaluations conducted for development rock and described in Section 4.4, because ore exhibits similar particle size and water holding capacity. Although precipitation may fall on the ore stockpiles and increase the pore water content of stockpiled ore, pore water stored within the stockpiles is expected to evaporate rather than percolate downwards into groundwater. Furthermore, ore placed into the stockpiles is generally present for less than one week before being hauled to the White Mesa Mill. In the event that the pore water content of the stockpiled ore is temporarily increased by precipitation falling on the pile, the relatively wetter ore may be hauled to the mill along with any associated pore water.

Potential Effects of Ventilation Shafts on Groundwater Quantity and Quality

Alternative A would include installation of 59 ventilation shafts in three phased areas. These ventilation shafts may penetrate eolian/alluvial aquifers or the D-aquifer before reaching the Salt Wash Member, which is the mining unit. The downward vertical hydraulic gradient that is present between the eolian/alluvial aquifers and the D-aquifer would cause groundwater to move downward from overlying aquifers into the Salt Wash Member. A small amount of groundwater was observed leaking through an existing ventilation shaft during a reconnaissance of the underground mine conducted in 2009 (CDM 2009b); however it is reported that this leakage has since been mitigated through improvements in ventilation shaft infrastructure (C. Woodward, Denison Mines (USA) Corp, personal communication, 2011). If uncontrolled downward flow occurred through ventilation shafts occurred, it could lead to a decrease in the water table within the eolian/alluvial aquifers or the D-aquifer. This could affect the water levels of nearby wells used for drinking water. However, ventilation shaft construction methods such as lining and sealing shafts that penetrate aquifers are designed to prevent this leakage, and any resulting effects to water levels of area wells are expected to be negligible.

It is unlikely that the ventilation shafts would affect water quality, because the downward hydraulic gradient would restrict upwards movement of water from the underground mine to the overlying aquifers. In addition, as described in the POA, the ventilation shafts would be constructed by first drilling a pilot hole into the underground workings and then reaming the hole to a diameter of 6 to 10 ft. In this process drill cuttings would fall into the underground mine, and would not be placed at the surface at the ventilation shaft site. These drill cuttings may be deposited in previously mined-out voids within the underground mine, or they could be hauled to the surface and be disposed of in a DRA.

Potential Effects of Exploration Drilling on Groundwater Quality and Quantity

Exploration drilling is conducted in accordance with state law, which provides requirements for proper plugging and abandonment of drill holes. Drill holes would be abandoned in accordance with Utah Administrative Code (UAC) Rule R647-4-108. Exploration drill holes that do not encounter groundwater would be plugged by setting a nonmetallic perma plug at a minimum of 5 ft below the surface and filling the hole above with concrete. Holes that encounter groundwater would be plugged by placing a 50-ft cement plug immediately above and below the aquifer(s) or filling the hole from the bottom up with a high-grade bentonite/slurry mixture in accordance with UAC Rule R647-4-108. These plugging approaches would prevent movement of groundwater between aquifers via the drill hole, after drilling is completed. During drilling, it is possible that some groundwater could move between aquifers via the drill hole. However, these potential effects to groundwater quantity would be very local and would only occur over a short period of one to two days while exploration drilling is taking place.

Exploration drilling would include placement of drill cuttings into a shallow sump excavated next to the drilling site. Drill cuttings are small rock fragments that are created during the drilling process. After drilling is completed, the drill cuttings would be reclaimed by covering the pit with the soil that was excavated from the pit and revegetating. The majority of these drill cuttings would be generated from non-mineralized rock units that overlie the ore host unit. The bottom of the drill hole would penetrate the ore host unit, which is the Salt Wash Member of the Morrison Formation. Drill cuttings from the Salt Wash Member may contain naturally enriched concentrations of uranium and other trace metals.

Drill cuttings from the Salt Wash member may contain a small percentage of uranium minerals such as coffinite [$U(SiO_4)1\text{-}x(OH)_4x$] or uranite ($UO_2$). The solubility of these minerals is low under reducing conditions. Under oxidizing conditions, these mineral can alter in other mineralogical forms and uranium and associated trace metals can dissolve into infiltrating water, providing a potential pathway that could affect groundwater quality.

The potential for this to cause adverse effects to groundwater quality is constrained by the low rate of groundwater recharge in the area, and the relatively small areal extent of the sumps in relation to the overall area subject to infiltration. Lowe (1996) reports that most of the groundwater recharge within San Juan County occurs at elevations in excess of 8,000 ft. The La Sal Mines Complex lies well below this elevation, and the relatively

low rate of groundwater recharge in the area would tend to limit potential effects of drill cuttings on groundwater quality.

Alternative A proposes completion of up to 3,800 exploration drill holes in Phases 1, 2 and 3. However, the cumulative areal extent of the sumps at the drill sites is relatively small in relation to the areal extent of the recharge area. For example, assuming that each sump was 10 ft in diameter, the areal extent of the sump would be 78 square feet (ft^2), and the overall areal extent of drill pits would be 314,000 ft^2 (7.2 acres). The cumulative area of the three phases is approximately 2,600 acres. Therefore, the areal extent of the drill sumps is only 0.3 percent of the area encompassed by the three phases. The overall area contributing to groundwater recharge is much larger. The relatively small areal extent of the sumps in relation to the overall recharge area would also limit potential affects to groundwater from exploration drilling.

Potential Effects to Groundwater during the Post-reclamation Period

During the post reclamation period, all ventilation shafts and mine portals would be sealed, and the DRAs would be reclaimed. Shaft penetrations potentially interconnecting the D-Aquifer with the Salt Wash Member of the Morrison Formation aquifers in production and ventilation shafts would be reclaimed by backfilling the shafts with development rock, placing a concrete cover over the shaft and covering with soil.

The proposed shaft reclamation procedure could cause long-term affects to groundwater quantity in the event that the existing shaft liner and associated groundwater seals were damaged during reclamation or degraded over time. If this occurs, water from the D-aquifer could enter the shaft and flow downwards through the backfill into the underlying Salt Wash Member of the Morrison Formation. This could result in an eventual decrease in water levels within the D-aquifer over time, particularly if this occurrence was widespread at reclaimed ventilation and production shafts. This decrease in water level within the D-aquifer could cause water levels in vicinity of the La Sal Mines Complex to decrease.

This would not be expected to cause water quality effects to the D-aquifer, because a downward hydraulic gradient is present in the area. This downward hydraulic gradient would cause groundwater to move downwards from the D-aquifer into the underlying Salt Wash Member. Therefore, groundwater that interacted with natural enrichments of uranium minerals and associated trace metals in the Salt Wash Member would not be expected to move vertically upwards into the D-aquifer, the drinking water source for many residents in the La Sal area.

4.6.1.2 Alternative B

Under Alternative B, mining would continue under existing plans of operations until mining was forced to cease as a result of lack of mine ventilation, lack of exploration drilling, and lack of capacity within existing DRAs. Specific procedures for reclamation of ventilation and production shafts are not set forth in existing plans of operations. Therefore, effects to water quantity could occur depending on the reclamation approach utilized for the existing ventilation shafts.

4.6.1.3 Alternative C

Alternative C is similar to Alternative A with specific design criteria, which were developed to address the Key issues while meeting the purpose and need of the action. One design feature of Alternative C is pertinent to groundwater: Installing low permeability seals during reclamation to prevent reclaimed ventilation and production shafts from leading to problematic interaction of groundwater between adjacent aquifers. As discussed in relation to Alternative A, there is potential that groundwater in the D-aquifer could flow vertically downward into the underlying Salt Wash Formation after reclamation is complete if the shafts are backfilled with development rock.

Alternative C would require engineering mitigations to be implemented to reduce the potential for interaction of development rock with the D aquifer. This may include installation of low-permeability seals within backfilled ventilation shafts above and below the D-aquifer, use of inert rock fill for shaft backfill within the portion of the shaft that could potentially interact with the D-aquifer, or other appropriate engineering methods. Dension would provide engineering designs and specifications for reclamation of shafts that penetrate the D-aquifer to BLM or USFS, as appropriate, before shaft reclamation. This design feature of Alternative C would be more protective of the D-aquifer, the primary aquifer used by residents in the La Sal area for drinking water, as compared with the other alternatives.

4.6.2 Cumulative Effects

The spatial extent of this cumulative effects analysis includes the general area extending from the Pine Ridge mine to the Energy Queen mine, as shown previously on Figure 4-1. Past and reasonably foreseeable future actions that could lead to cumulative effects include historical exploration drilling, historical ventilation shaft construction, and previous reclamation activities associated with exploration drilling and ventilation shaft construction.

4.6.2.1 Alternative A

Groundwater in the cumulative effects area is used for various uses including drinking water. Effects of historical exploration drilling, historical ventilation shaft construction, and previous reclamation activities associated with exploration drilling and ventilation shaft construction are not affecting current uses. One local area of potentially mining affected groundwater is present at the Energy Queen mine. Groundwater within this area exhibits uranium concentrations that typically exceed Utah's groundwater standard, which may be a result of historical mining practices. Umetco Minerals Corporation extracted groundwater from the Energy Queen Mine, and treated the water for radium-226 from the early 1980's to approximately 1993. The treated water was pumped into two unlined storage ponds after treatment. During that period, there was no groundwater quality standard for uranium, and the treated water is reported to have contained uranium concentrations that exceeded the current groundwater standard. The areas of potentially affected groundwater may be attributable to seepage of this treated water from the unlined water storage ponds (TetraTech 2008c).

The other past mining area within the cumulative effects analysis area did not extract groundwater, because the Top Rim Sandstone, the rock unit that hosts uranium

mineralization, is not saturated in those areas. Therefore, past water management practices conducted at the Energy Queen Mine did not occur at the other mines in the cumulative effects analysis area, and associated affects to groundwater quality are unlikely.

Reasonably foreseeable future mining activities include resumption of mining at the Energy Queen Mine and the Pine Ridge Mine, and development of a mining shaft and other surface infrastructure at the Redd Block IV mine. The Top Rim Sandstone may be saturated at the Redd Block IV site, and mine dewatering may be necessary. It is unlikely that these reasonably foreseeable future actions would cause cumulative effects to groundwater quality because any storage or treatment of mine water at surface facilities of the Energy Queen Mine or the Redd Block IV Mine would require a permit issued by the state of Utah, and modern water storage and treatment methods. For example, the state permit addressing these facilities at the Energy Queen mine requires double lined water storage ponds with leak detection systems, and treatment of mine water to meet all water quality standards. Therefore, it is unlikely that these reasonably foreseeable future actions would cause cumulative effects to groundwater.

As discussed previously, there is some potential that ventilation shaft reclamation practices could affect ground water quality, if development rock is used within the ventilation shafts for backfill within aquifers. This proposed reclamation practice has the potential to cause cumulative effects to groundwater.

4.6.2.2 Alternative B

Under Alternative B, no additional mining would be approved and the existing mines would be reclaimed in accordance with existing Plans of Operations. These Plans of Operations do not include specific requirements for backfill of ventilation shafts. Accordingly, there is some potential that ventilation shaft reclamation practices could affect ground water quality under Alternative B. This could lead to cumulative effects to groundwater.

4.6.2.3 Alternative C

As discussed previously, Alternative C includes additional requirements for ventilation shaft reclamation, which are designed to protect groundwater quality. Therefore, it is unlikely that Alternative C would lead to cumulative effects to groundwater.

4.7 Hazardous Waste

An issue was brought up during scoping regarding whether the La Sal Mines Complex would generate toxic waste. This section addresses the effects of the proposed alternative and alternatives with respect to generation of hazardous wastes as defined by RCRA. This federal law addresses hazardous wastes that exhibit the characteristic of toxicity, as well as other characteristic or listed hazardous wastes.

Development rock is not classified as a hazardous waste under RCRA as discussed in Section 3.6. Potential environmental and radiological effects associated with development rock are addressed in Sections 4.4 and 4.9 respectively.

4.7.1 Direct and Indirect Effects

4.7.1.1 Alternative A

Under Alternative A, the La Sal Mines Complex would continue to operate through approximately 2030. However, the life of the mine and the rate of uranium production is uncertain and dependant on uranium prices, mining costs and other factors. The La Sal Mines Complex would produce hazardous wastes at approximately the same rate as current conditions. Small quantities of hazardous wastes would be generated over the life of the mine such as used aerosol paint cans and spent parts cleaning solvents. These wastes would continue to be disposed of in accordance with applicable regulations.

4.7.1.2 Alternative B

Under Alternative B, hazardous wastes would be generated at the current rate until the mine ceased production. After that date, generation of hazardous wastes would cease.

4.7.1.3 Alternative C

The direct and indirect effects of Alternative C would be similar to Alternative A.

4.7.2 Cumulative Effects

4.7.2.1 Alternative A

Small quantities of hazardous wastes are likely generated at other homes and businesses in the La Sal area. Reasonably foreseeable future actions such as additional mining or continued oil and gas development would also be expected to generate small quantities of hazardous wastes. However, it is assumed that these wastes would be managed in accordance with applicable regulations. Therefore cumulative effects of Alternative A with respect to hazardous waste generation are considered minor.

4.7.2.2 Alternative B

Cumulative effects related to hazardous waste generation are not anticipated under Alternative B, because mining at the La Sal Mines Complex would cease.

4.7.2.3 Alternative C

Alternative C would not change the hazardous waste management practices or the rate of hazardous waste generation. Therefore, cumulative effects of Alternative C would be the same as Alternative A.

4.8 Noise

The following Key issue was identified regarding noise:

- What are the potential effects of noise on wildlife, hunters, recreationists, and the town of La Sal?

Ventilation fans were identified during scoping as a major cause of noise in the mine area.

4.8.1 Direct and Indirect Impacts

4.8.1.1 Alternative A

Under Alternative A, new ventilation shafts would be developed in three phases, generally northeast of the Pandora Mine surface facilities and west of the Beaver Shaft Mine.

Phase 1 Ventilation Shafts

In Phase 1, 17 ventilation shafts would be developed in an over 400-acre area just north and west of existing residences #4 and #5 (see Figure 4-2, Noise Receptors Located near Exploration Phases). Since the new ventilation fans would not be concentrated in the southeast corner of this area, the area closest to residences #4 and #5, the distances of the fans from the nearest receptors, residences #4 and #5, would be on the order of a half-mile to 2 miles away. Based on the 91.7 dBA noise level (at 10 ft) of the existing Beaver 1800 fan (without the barrier) and the attenuation of noise with distance (see Section 3.3.7.5), the noise level of a surface fan more than half-mile from a receptor would be reduced to less than 46 dBA and would be expected to have an imperceptible impact on the existing noise level at that receptor during the day and an imperceptible to moderate impact at night, depending on distance between the receptor and the future fan location.

Seven vents would be developed in Phase 1 in an area northeast of the Pandora Mine surface facilities and southeast of residence #1. The area encompasses approximately 450 acres. Since the ventilation fans would not be concentrated in the far western end of this area, the distances of the fans from residence #1 would be 0.5 miles or more and the noise level of a surface fan would be reduced to less than 46 dBA; the noise level increase at residence #1 would be expected to be imperceptible during the day and imperceptible to moderate at night, depending on distance between the receptor and the future fan location.

Phase 2 Ventilation Shafts

In Phase 2, 10 ventilation shafts would be developed in a 400 acre area approximately 2 miles west of the Beaver Shaft Mine and 13 ventilation shafts would be developed in two 250-300 acre areas north of the Pandora Mine surface facilities (see Figure 4-2). There are three existing receptors inside the western Phase 2 area and a cluster of receptors southeast of the western Phase 2 area. Because the exact location of the ventilation shafts is not known at this time, the potential would exist for a noise impact on one or more of the existing receptors inside the western Phase 2 area if the ventilation fans were located close to the affected receptors. In the case of the cluster of receptors southeast of the Phase 2 area, because the fans would not be expected to be concentrated in the southeast corner of the Phase 2 area, the majority of the Phase 2 fans would be 1 mile or more from the receptor cluster. At these distances, the noise level of a fan at these receptors would be less than 40 dBA and would be expected to be imperceptible.

Residences #1, #2, and #3 are about 0.25 miles from the boundaries of the two eastern Phase 2 areas. Because the new fans would not be expected to be concentrated near the Phase 2 area boundaries closest to these residences, the noise from the fans at these

residences would be less than 50 dBA, which would likely be imperceptible during the day and, depending on distance, imperceptible to noticeable at night.

Phase 3 Ventilation Shafts

In Phase 3, 8 ventilation shafts would be developed in the vicinity of the Pandora Mine surface facilities and 4 shafts in a 200-acre area 3 miles west of the Beaver Shaft Mine (see Figure 4-2). Residences #1 and 2 are within 3,500 ft of the eastern Phase 3 area and there is one receptor 800 ft east and two receptors ½ mile east of the western Phase 3 area (the receptors inside the Phase 2 area). Because the new fans would not be expected to be concentrated near the southeast corner of the Phase 3 area, the boundaries closest to these receptors, the distances of the fans from the residences would be 0.5 miles or more and the noise from the fans at the residences would be reduced to less than 46 dBA, which would be imperceptible during the day and imperceptible to moderate at night, depending on the distance between the receptor and the future fan location.

4.8.1.2 Alternative B

Under Alternative B, the No Action alternative, mining operations would continue under existing permits until operations are ceased. Because mining operations would continue as they do now, noise levels at the nearby receptors from ventilation fan operations would remain as discussed in Section 3.3.7.5 and shown in Table 3-9.

4.8.1.3 Alternative C

Alternative C would require installation of ventilation fans underground in all new shafts to the extent practicable and feasible. This would place the fans approximately 1,000 ft below the surface. Noise levels from the new underground fans would be more than 10 dBA lower at a given distance to nearby receptors than the existing fan noise levels shown in Table 3-9 at the same distance from the receptors. Assuming current fans are shut down as areas are mined out and new areas are developed, average noise levels in the community would be expected to be reduced.

4.8.2 Cumulative Effects

4.8.2.1 Alternative A

No cumulative noise impact is expected because as new mining areas (phases) are opened and ventilation fans are installed, mining of older areas would be completed and the ventilation shafts would be reclaimed. Also, the new ventilation fans would be installed in areas farther from the receptors than the existing fans; this would reduce the fan noise level at existing receptors compared to existing conditions. Furthermore, other mines in the area (Redd Block IV, Energy Queen, Pine Ridge—see Figure 4-2) are too far away to have a noticeable cumulative noise effect on the study area receptors. Other concurrent activities in the area such as activities in the town of La Sal and highway traffic are part of the existing noise environment and are not expected to increase markedly.

4.8.2.2 Alternative B

There would be no cumulative impacts under the No Action Alternative.

4.8.2.3 Alternative C

No cumulative noise impact is expected because as new mining areas (phases) are opened and ventilation fans are installed, mining of older areas would be completed and the ventilation shafts would be reclaimed. Also, the new ventilation fans would be installed underground and in areas farther from the receptors than the existing fans; this would be expected to substantially reduce the combined fan noise level at existing receptors compared to existing conditions.

Furthermore, other mines in the area (Redd Block IV, Energy Queen, Pine Ridge—see Figure 4-2) are too far away to have a noticeable cumulative noise effect on the study area receptors. Other concurrent activities in the area such as activities in the town of La Sal and highway traffic are part of the existing noise environment and are not expected to increase markedly.

4.9 Radiological Issues

Radiological issues identified during scoping are summarized as follows:

- Would adverse effects be caused by air emission of radioactive particulates from the mine vents and mine surface facilities?
- What are the potential hazards related to emissions of radon gas from the mine?
- What potential long-term effects to air quality could be caused by radioactive air emissions from the La Sal Mines Complex?
- Would adverse effects be caused by external gamma radiation from mine surface facilities?
- Would the proposed action or alternatives increase cancer risk for La Sal residents?
- Would uranium, radon, radium, or other radionuclides bio-accumulate in vegetation?
- Would radon emissions from vent holes affect vegetation, wildlife, soil and water?
- What are the risks associated with exposure to uranium, radium, radon, and radon daughter products after mine reclamation?
- What are the risks associated with emission of radon from exploration drill cutting disposal areas?
- What is the appropriate reclamation performance criterion for emission of radiation from reclaimed areas?

Some of these issues relate to resources discussed in other sections such as wildlife and vegetation. However, these issues are described in this section to present effects analysis of radiological issues in one location within this EA.

4.9.1 Direct and Indirect Radiological Effects

Direct and indirect effects are described in the following sections with respect to Alternatives A and C, the action alternatives; and Alternative B, the no action alternative.

4.9.1.1 Direct and Indirect Effects of Alternatives A and C

The expected radiological effects associated with Alternatives A and C are similar, because both alternatives would approve continued mining at the La Sal Mines Complex, installation of additional ventilation shafts, and continued production of ore. One difference between Alternatives A and C is that Alternative C would approve a larger DRA at the Pandora mine. However, this difference would not substantially change expected radiological effects associated with the alternatives.

The following discussion is organized by the key issues.

Would adverse effects be caused by air emission of radioactive particulates from the mine vents and mine surface facilities?

Two types of radioactive particulates would be emitted from mine vents and mine surface facilities:

- Particulates generated as radon decays into its daughter products
- Particulates associated with uranium ore dust.

<u>Particulates Formed from Radon Decay Products</u>

Radon is a noble gas that decays through a series of short-lived radionuclides which, when they become attached to airborne dust particles, behave as solid particulates. In terms of exposure, the most important radionuclides are the short-lived radon decay products which can deposit in the lungs when inhaled. Similar to current operations at the mine, under Alternatives A and B, clean ventilation air would be provided to mine workplaces to remove the radon and short-lived radon decay products from the workplaces and out of the mine.

According to the US EPA *Background Information Document - Standard for Radon-222 Emissions from Underground Uranium Mines* (EPA 520/1-85-010, 10 April 1985), based on studies at multiple uranium mines in the southwestern US, radon emissions from surface facilities, including ore stockpiles, development rock piles, and ore loading, are so small in comparison to emissions from vents, that they can be considered negligible in estimation of total radon emissions from a mine site. That is, the contribution to airborne radon concentration from ore loading operations is immeasurably small. That is why the radon emission standards in 40 CFR Part 61 Subpart B are limited to radon emissions from mine vents.

Under NESHAPs requirements, Denison would model dispersion of vent emissions over each operating year to determine exposure and the resulting dose to exposed individuals in the area potentially resulting from radon emitted from the mine. Moreover, the mine

must comply with a radon dose limit of 10 mrem/year above background to any member of the public. Denison currently models the dose from radon vented from the mine using EPA's approved COMPLY-R model, a very conservative model which demonstrates that as a result of atmospheric dispersion, the radon concentration drops rapidly with increasing distance from the mine vents. Denison also performs air dispersion modeling with the EPA's approved regulatory model for air dispersion, AERMOD, which unlike COMPLY-R, takes into account effects of local topography and actual hour-by-hour meteorology. This model shows even more rapid decreases in radon concentration with increasing distances from the mine vents.

Radon dispersion modeling demonstrates that radon emitted even at high concentrations from an up-cast (exhausting) vent disperses quickly when mixed with air. For example, even in the case of mine vents exhausting air containing radon concentrations greater than 1,000 pCi/L, upon mixing with air, the resulting concentration of radon is reduced to less than 0.2 pCi/L within a few hundred meters away from the vent. These concentrations are below the average outdoor level of radon in the US caused by natural environmental sources of about 0.4 pCi/L and within the range of natural variability (NCRP Report No. 160, 2009). At these concentrations, the mass concentrations (weight per volume) of particulates produced as radon daughter products are negligible. For general comparison, the EPA does not recommend any action in a home unless radon concentrations are greater than 4.0 pCi/L (EPA 2010).

Additional vent holes would be installed under Alternatives A and C. It is expected that radioactive particulates generated as a result of radon discharge from vents installed in accordance with Alternatives A and C would be similar to current conditions. Accordingly, the potential adverse effects of this discharge would be negligible.

Particulates from Dust Containing Uranium

Conservative estimates of the emission rate of radioactive dust from the La Sal Mine vents were prepared. The estimates were based on measured particulate concentrations in air collected underground in the La Sal Mines Complex. The uranium content of ore at the La Sal Mines Complex was then used to develop conservative estimates of uranium, radium and other radioactive constituents in ore dust. As is common in most uranium ores, at the La Sal Mines Complex, the ore is in radioactive equilibrium which means that each of the radionuclides in the uranium-238 decay sequence are all present at the same activity as the uranium-238.

The uranium dust emission rate from each existing mine vent was calculated by multiplying the flow rate in cubic meters per second by a dust concentration of 1 milligram per cubic meter (1 mg/m^3). The dust emission rate was then converted to a uranium dust emission rate using a uranium content of 0.1 percent (i.e., 1/1,000 of the dust concentration). The 0.1 percent value was based on the assumptions that the dust is 2/3 ore and 1/3 development rock, and that the ore in dust is present at the average uranium concentration of 0.2 percent. The dust emission factor of 1 mg/m^3 is conservative as actual dust concentrations are lower. For example, actual measurement data for silica dust concentrations on personal samples worn by workers in the La Sal

Mine Complex provided by Denison averaged only 0.1 to 0.3 mg/m^3, 20 to 30 percent of the assumed dust emission factor. The resulting total uranium dust emission rate from the underground mine was estimated to be 0.454 grams per second (g/s).

The estimated dust emissions from ore and development rock piles on the surface were also evaluated. These estimates were taken from an air emissions report prepared for Denison (Redhorse 2010). The total estimated dust from the ore and development rock piles was 0.112 g/s. This rate of emission would not be visible to the human eye.

AERMOD was then used to assess dust concentrations at 10 receptor locations near the mine based on current conditions. The receptor locations consist of residences and non-residential locations, specifically the elementary school, church, post office, maintenance shed and livestock area. The estimated annual ore/development rock dust, expressed as PM_{10}, and predicted concentrations of uranium dust from surface (ore and development rock piles) and underground sources at each receptor location are presented in Table .

Table 4-3. Annual PM10 and Uranium Predicted Concentration

Receptor	**Annual Concentrations (µg/m^3)**	**Annual Concentrations (µg/m^3)**
	PM_{10}	**Uranium**
Residence #1	0.130	0.000130
Residence #2	0.0599	0.0000599
Residence #3	0.0389	0.0000389
La Sal Livestock	0.196	0.000196
Catholic Church	0.213	0.000213
Store/Post Office	0.198	0.000198
Road Maintenance Shed	0.287	0.000287
Elementary School	0.208	0.000208
Residence #4	0.223	0.000223
Residence #5	0.142	0.000142

Note: Residences #1 through #5 are residences located near the La Sal Mines Complex

The inhalation exposure pathway is the dominant exposure pathway for airborne dust. For each receptor, the inhalation dose used in the calculations was estimated for an adult receptor using the most recent Dose Coefficients (DCs) taken from the International Commission on Radiological Protection 72 (ICRP 1996) for the least soluble form (i.e., the form resulting in the highest dose). These DCs are reasonable because uranium ores are relatively insoluble. The DCs used in the calculations included the uranium-238 chain with its decay products in equilibrium.

The dose due to inhalation of airborne uranium (including the dose from all of the radionuclides in the uranium-238 decay chain) at each receptor location is presented in Table 4-4. The calculations assume continuous occupancy (365 days per year) at each location, which is very conservative, that is, it overstates the occupancy rate and exposure.

Table 4-4. Uranium concentrations in air and associated inhalation dose

	Annual Concentrations (µg/m^3)	
Receptor	Uranium	Annual Equivalent Dose (mrem/year)
Residence #1	0.000130	0.045
Residence #2	0.0000599	0.021
Residence #3	0.0000389	0.014
La Sal Livestock	0.000196	0.068
Catholic Church	0.000213	0.074
Store/Post Office	0.000198	0.069
Road Maintenance Shed	0.000287	0.10
Elementary School	0.000208	0.073
Residence #4	0.000223	0.078
Residence #5	0.000142	0.050

As discussed previously in Section 3.3.8, the average annual equivalent dose received in the United States from natural environmental conditions is approximately 320 mrem/year. The predicted doses resulting from uranium in PM_{10} emissions are extremely small, with the maximum being less than 1/1,000th of the dose from natural environmental conditions. Actual inhalation doses using less conservative assumptions would be even lower.

Alternatives A and C would approve construction of additional vent holes and expansion of the DRA at the Pandora mine. These activities would increase dust emissions somewhat, but given that the estimated dose associated with particulate conditions is less than 1/1,000th of the dose from natural environmental conditions as shown in Table 4-4, additional particulate matter generated in association with Alternatives A or C are expected to be extremely small with respect to natural environmental conditions.

Another potential contribution to airborne radionuclide levels would be from uranium content of dusts generated during ore loading. Based on site-specific data from the La Sal Mines, as prepared for the La Sal Mines Complex Air Approval Order issued by UDEQ, the anticipated PM_{10} emissions from all surface operations are estimated to be 0.12 g/s. Using an overly conservative assumption that all surface dusts contain the same uranium content as dust emissions from ores, and adding dust emissions from underground, also conservatively estimated, results in a maximum uranium PM_{10} concentration of 0.000287 µg/m^3, which is negligibly low. In actuality, the uranium levels in airborne dust would be lower, since a portion of PM_{10} at the site would be from development rock, road surface dusts, and ambient dusts that are of far lower uranium content than ores. Radium, a radioactive daughter product of uranium-238 decay, would form a very tiny percentage of the mass of PM_{10}. Therefore, exposure and associated health risks associated with radium are expected to be negligibly small and indistinguishable from background.

Moreover, ore piles, development rock piles and loading operations occur in controlled areas of the site with no public access. During operations, the public has no access to on-

site piles or to dust generating equipment or activities. In addition, water is used within the mine to suppress dust. After cessation of operation, ore will be removed from the site, development rock will be returned to the mine or above-ground piles covered in accordance with the reclamation plan, and dust generating activities will cease. As a result, any potential health risks will drop accordingly.

What are the potential hazards related to emissions of radon gas from the mine?

Under Alternatives A and C, Denison would continue to perform radon monitoring at vents, model the dose at potential receptor locations, and report to EPA to demonstrate that the mine is in compliance with the annual radon dose limit of 10 mrem per year. AERMOD modeling was performed to estimate atmospheric dispersion of the current radon emissions from mine exhausts for the calendar year of 2010 at the La Sal Mine Complex. The estimated annual radon dose at each of the 10 receptor locations is shown in Table 4-5. Estimated annual radon dose

Table 4-5. Estimated annual radon dose

Receptor	Dose (mrem/year) [a,b]
Residence #1	7.5(2.6)
Residence #2	4.4
Residence #3	2.6
La Sal Livestock	8.4
Catholic Church	7.5
Store/Post Office	8.3
Road Maintenance Shed	8.1(1.9)
Elementary School	8.6
Residence #4	8.1
Residence #5	4.3

Source: SENES (2011).

Notes: a) Harms Way meteorology (April 2010-March 2011)

b) (Values in brackets) adjusted for occupancy. Residence R1 has partial occupancy during the year (from April 1 to October 31).

It can be seen from Table 4-5 that the modeled doses to all receptors assuming full-time occupancy are currently lower than the EPA's (40 CFR 61.22) 10 mrem/y standard for radon emissions from an underground uranium mine. When actual occupancies are considered at Receptor 1 and the Road Maintenance Shed, the likely actual exposures are much lower. For context, these incremental radon exposures are a small fraction of the radon dose from natural environmental conditions described in Section 3.3.8. The average radon dose received from natural environmental conditions in the US is 212 mrem/y (NCRP Report No. 160, 2009).

Under both Alternatives A and C, additional mine vent holes would be constructed as the underground mine expands towards the east and west. Although the specific location of each vent hole is not yet defined, the vent locations are described in three phases as discussed in Section 2. In general, the proposed ventilation shafts would be constructed at locations that are further from potential receptor locations, which would result in more dispersion of radon and lower radon doses at potential receptor locations. Under both

Alternatives A and C, monitoring of radon emissions after construction would be conducted in accordance with 40 CFR 61, Subpart B or other EPA or UDEQ approved methods. Alternative C would include a requirement that Denison conduct pre-construction radon modeling to evaluate radon concentrations at prospective vent locations, and provide this assessment to BLM and/or USFS to demonstrate that the vent hole would be expected to meet the 10 mrem/y standard for radon emissions. If preconstruction radon modeling does not demonstrate that the vent hole would be expected to comply with the regulation, design modifications would be implemented to comply with the regulation, or the ventilation shaft would not be constructed. Therefore, Alternative C would be relatively more protective of the public than Alternative A.

Variation in radon emissions during three mine phases and after reclamation

During each phase of Alternatives A and C, it would be important to provide miners with clean fresh air. This air would be exhausted from the mine via the mine vents. The highest radon emissions are expected to arise from actual ore mining with lower release arising during mining of development rock or during periods of interim shutdown. The amount of radon released from the underground mine is dependant on the uranium content of the mined rock, and the process of breaking the rock during blasting, which releases radon from the rock into air within the mine.

The federal NESHAPs regulations require that Denison limit total radon emissions from all vents to limit the radon dose to less than 10 mrem per year to any member of the public. The radon dose level of 10 mrem per year has been determined by US EPA to be protective of human health. Denison would be required to meet this standard, regardless of which phase of operations the mine is in. The NESHAPs standards continue to apply during interim shutdown so long as the mine is being ventilated. However during interim shutdown, the quantity of radon emissions would be reduced considerably, because mining of rock containing uranium would cease. Therefore, interim shutdown would generally result in a reduction of radon emissions.

The ventilation holes will be backfilled or capped during mine reclamation eliminating discharge of radon from ventilation holes. Therefore, reclamation will result in a reduction in radon release, for practical purposes to near background levels.

Affect of weather on radon dispersion

Daily and seasonal weather changes create variations in dispersion of radon emissions. However, the short-term variations in dispersion are reflected in the calculated annual average concentrations and in the dose calculations. Consistent with the EPA's NESHAPs requirements, the maximum allowable dose of 10 mrem is an annual dose. The cumulative dose to any receptor is calculated for a period of one year, and the dose is compared to the regulatory limit of 10 mrem. Radon emissions reports provide estimates of radon emissions and associated doses for all months of the year, and therefore reflect seasonal influences on radon dispersion. This approach accounts not only for month-to-month changes in radon emissions, but also for the month-to-month variations in atmospheric dispersion.

Potential effects of radon emissions to wildland firefighters

Dispersion modeling demonstrates that radon, emitted even at high concentration from an up-cast (exhausting) vent, disperses quickly when mixed with air. For example, as previously noted, radon exhausting from a vent is rapidly diluted upon mixing with air. Also, the 10 mrem radon standard is an annual dose. Wildland firefighters would be expected to be in the area of a vent for a shorter period of time. Thus, exposure to radon and its decay products from the vents would not pose a hazard to firefighters who work near the vent for short periods of time.

More importantly, the mine would have the ability to turn off a vent if a nearby fire requires firefighter access to areas near vents. Mine activities could be temporarily ceased or modified, venting patterns changed, or vent fans shut off, as required for protection or convenience for firefighters or other emergency response personnel, if necessary. Firefighters may also don self-contained breathing apparatus ("SCBAs") when entering areas with hazardous levels of airborne soot, smoke, other particulates, hazardous chemicals, combustion by-products, or reduced oxygen. The SCBA provides for full protection from short-term exposure to radon decay products in breathing air.

Effects of radon to the recreating public

The NESHAPs regulations require that Denison limit total radon emissions from all vents from the mine to less than 10 mrem per year to any member of the public. The radon dose level of 10 mrem per year has been determined by the US EPA to be protective of human health. The dose from the allowable radon emissions is a small fraction of the dose from natural environmental conditions.

The models used to determine radon doses from the La Sal Mine Complex's measured vent emissions of radon make the assumption that exposed individuals are all residents, and are present 24 hours per day, 365 days per year (that is, 8,760 hours per year). This assumption is very conservative for the recreating public, who may be present in the area of a mine vent for periods ranging from hours, to several days, to several weeks per year. Because radon emissions from the mine vents comply with the 10 mrem per year standard which is protective of individuals who are assumed to be present full time 365 days per year, it is also protective of members of the recreating public who are present for shorter periods of time.

What potential long-term effects to air quality could be caused by radioactive air emissions from the La Sal Mines Complex?

Under Alternatives A and C, radioactive air emissions from the La Sal Mines Complex are expected to have little or no long-term effect on air quality. Under both alternatives, the surface disturbed areas of the mine would be reclaimed, which would reduce potential releases of uranium in dust from the area. In addition, vent holes would be backfilled and reclaimed after mining is complete, which would further reduce discharge of radon from the underground mine after mining is complete. During the mine operational period, radon would continue to be released from the active vent holes. However, the potential for long-term effects of radon emissions from vent holes would be limited, because radon quickly dissipates in the atmosphere and has a brief half-life.

Radon is a short-lived radionuclide, with a half-life of 3.8 days. The daughter products of its decay are primarily isotopes of bismuth, lead and polonium which are not gases but are charged atoms which attach to particles in the air and are removed from the atmosphere by deposition onto soil during transport. Based on dispersion models for the La Sal Mine Complex vents, the incremental contributions of radioactive dust or radon during mine operations decrease rapidly with increasing distance from the vent hole and surface installations, and in any event, are extremely small, well within the variability of natural environmental conditions in Utah.

Would adverse effects be caused by external gamma radiation from mine surface facilities?

Previous discussions have focussed on potential effects of radon emissions. Radon is a gas that is generated during radioactive decay of uranium, which forms short-lived daughter products that emit alpha and beta radiation, and can be inhaled into the lungs. Inhalation of radon and associated daughter products at high doses can cause increased cancer risk, and the radon-specific air quality standard of 10 mrem/y applies specifically to the effective dose associated with radon. Gamma radiation is electromagnetic radiation released during radioactive decay of uranium and other radioisotopes such as potassium and thorium. Gamma radiation affects a potential receptor differently than radon, and other standards and guidelines that are protective of human health are used to assess effects of external gamma radiation. The gamma radiation occupational limit set forth by MSHA regulations at 30 CFR §57.5047 is an effective dose of 5,000 mrem/y. Recommended dose limits for the general public are lower than occupational limits. The NCRP (2003) recommends a public effective dose limit of 100 mrem/y from all sources except natural background and medical procedures.

The ore present at the La Sal Mines Complex has a relatively low uranium content as compared to other uranium mines worldwide. Gamma radiation exposure levels depend largely on the uranium content in the ore being recovered, and at the La Sal Mines Complex, the uranium content is low and typically ranges between 0.05 and 0.25 percent uranium oxide (U_3O_8). Gamma radiation exposure measured in close proximity to temporary ore stockpiles averages approximately 550 µR/hr (Denison 2012). Gamma radiation measured at the DRAs is approximately 10 times lower than the ore stockpiles, with average exposure measured at the Pandora DRA of 54 µR/hr. The ore stockpiles and DRAs are located within areas that are restricted from public access. Assuming exposure of a miner working full time in close proximity to an ore stockpile, the effective dose rate from gamma radiation would be approximately 1,100 mrem/y, which is well below the occupational limit. This is a conservative value, because it is unlikely that a miner would work in such close proximity to the ore stockpile for 40 hours per week, 52 weeks per year. Therefore, gamma radiation emitted from the La Sal Mines Complex surface facilities would not occur at levels that cause an effective dose to miners from gamma radiation to exceed the 5,000 mrem/y occupational limit.

NCRP Report No. 160 (2009) indicates that natural background external gamma exposure in the Colorado Plateau area is on the order of 5 to 8 µR/h. The gamma

radiation survey conducted in the La Sal area (Denison 2012) shows that gamma radiation from all sources averages approximately 6 µR/hr in areas outside of La Sal Mines Complex facilities, which is approximately the same as the background value reported by NCRP (2009). Therefore, the gamma radiation levels in the La Sal area are at background concentrations, and are well below the recommended exposure limit for the general public.

Under Alternatives A and C, mining would continue, ore would be placed into temporary stockpiles, and additional development rock would be placed in DRAs. The radiological characteristics of these materials are expected to be similar to the materials mined to date at the La Sal Mines Complex. Accordingly, Alternatives A and C would be not be expected to pose a hazard to mine workers or the general public associated with gamma radiation.

Would the proposed action or alternatives increase cancer risk for La Sal residents?

Radon and Cancer Risk

The public is protected from potential health effects caused by release of radon from uranium mines by NESHAPs regulations which set standards for the maximum allowable dose of radon to an individual from regulated emissions sources. As discussed in Section 3.3.8, the average annual dose from natural environmental conditions (including radon) is approximately 320 mrem per year (likely a bit higher in the Colorado Plateau area). Thus, the NESHAPs standard for radon, which allows a maximum dose of 10 mrem/y to any member of the public, is no more than about 1/30 of the dose that an individual would receive from natural environmental conditions. This dose of 10 mrem/y is the same dose an individual would receive on two round trip airplane flights from New York to Seattle as discussed in Section 3.3.8. As discussed previously, radon exposure to La Sal residents from mining activities under Alternatives A and C would be less than the 10 mrem/yr standard.

Particulates and Cancer Risk

The public would likewise not incur increased health risk from radionuclides in other air particulate emissions. Exposure of residents and the public to particulates, and the associated health risks, are expected to be immeasurably low and indistinguishable from natural environmental conditions. Very conservative estimates of particulate emissions from vents result in a dose to receptors of less than 0.1 mrem/y, or a small fraction of the dose from natural environmental conditions; that is, it is indistinguishable from local natural environmental conditions.

Moreover, ore piles, development rock areas and loading operations would be located in controlled areas of the site with limited public access. During operations, the public would have no access to ore piles or to dust generating equipment or activities. After cessation of operation, ore would be removed from the site, development rock would be returned to the mine or development rock piles would be covered in accordance with the reclamation plan, and dust generating activities would cease. As a result, long-term potential dust exposure and health risk will drop accordingly.

Would uranium, radon, radium, or other radionuclides bio-accumulate in vegetation? Although some radionuclides are known to accumulate in vegetation through uptake from soil or water in root systems, bioaccumulation requires deposition of sufficient amounts of radionuclides in vegetated soils to result in any measurable concentration in plant tissues. Deposition of radionuclides caused by either radon daughter products or particulates containing uranium at the La Sal Mine Complex area would be minimal, because these particulates would not be released at the La Sal Mines Complex in sufficient quantities to cause measurable accumulation in soils. This was discussed previously with respect to key issues: *Particulates Formed from Radon Decay Products*; and *Particulates from Dust Containing Uranium*. Because radionuclides would not be expected to accumulate in soils, radionuclides would also not be expected to accumulate in vegetation through uptake from soil or water in root systems.

Would radon emissions from vent holes affect vegetation, wildlife, soil and water?

Vegetation and Wildlife

The primary source of potential radiation exposure near vent holes would be from radon and radon daughter products from vent emissions. Various international and national authorities have developed approaches to assessing radiation doses to non-human biota addressing both direct radiation and the soil and food chain uptake pathways, and the potential effects of such exposures (including for example, UNSCEAR 2008, IAEA 1992 and the US DOE 2002 amongst others).

The procedure for evaluating risks to non-human biota involves estimating dose rates to populations of plants and animals, and comparing the estimated dose rates to reference dose rates which are expected to have no effects on populations of plants and animals. As previously noted, a recent evaluation by UNSCEAR (2008) concluded that chronic dose rates of 10,000 µrem/h to the most highly exposed biota are unlikely to have an effect on populations of terrestrial biota. The radiation dose to plants and animals living in the vicinity of the mine site would be indistinguishable from natural background levels. NCRP report No. 160 (2009) indicates the external gamma doses in the Colorado Plateau area are on the order of 5 to 8 µrem/h. A gamma radiation survey conducted in April 2011 shows that gamma radiation dose rates around the La Sal Mine Complex from all sources of radiation are of the same order as background and hence several orders of magnitude lower than the dose rates which UNSCEAR has determined are unlikely to have an effect on populations of terrestrial biota.

Deposition on Soil

Indirect effects could include deposition of ore dust off-site resulting in subsequent exposures via direct gamma radiation or via ingestion of produce. Such exposure pathways were modeled assuming a fixed dust concentration and long-term (40 years) dust deposition to conservatively estimate the amount of deposited dust and potential exposures via these indirect pathways. These results show that the dominant radon exposure pathway after 40 years of operations would be inhalation and that deposition on soil was a negligible dose contributor.

Water

The long-term deposition of radionuclides in soil around the vent holes would be very small, a fraction of natural background, even adjacent to a vent. Therefore it would be very unlikely for long-term deposition of radionuclides in soil to subsequently impact water quality.

What are the risks associated with exposure to uranium, radium, radon, and radon daughter products after mine reclamation?

Radon and Radon Daughter Products

As discussed in the US EPA Background Information Document - Standard for Radon-222 Emissions from Underground Uranium Mines (EPA 520/1-85-010, 10 April 1985), based on studies at multiple uranium mines in the southwestern US, the radon emissions from surface facilities, including ore stockpiles, development rock piles, and ore loading, are very small in comparison to emissions from mine vents and can be considered negligible regarding estimations of total radon emissions from uranium mines. Under Alternatives A and C, all mine vents would be closed and reclaimed after mining is complete. As a result, the contribution to airborne radon gas concentrations from surface sources would be immeasurably small, and radon hazards would not be present after mine reclamation is complete.

Uranium and Radium

During reclamation and closure, any ore remaining on the surface would be shipped to the White Mesa Mill for processing, or replaced inside the mine workings. Therefore, there would be no opportunity for public exposure to uranium contained in the ores and no post-reclamation risk from ore. Uranium and radium levels in development rock would be substantially lower than levels in the ore. After reclamation, development rock would be covered with inert material thereby virtually eliminating any potential for dispersion of uranium or radium at concentrations that are above natural background levels. Covering these materials would also effectively reduce gamma radiation levels to those of the cover materials.

What are the risks associated with emission of radon from exploration drill cutting disposal areas?

Exploration drilling would yield approximately 1 to 3 holes per day, or an average of 2 drill holes per day. Drill holes would be approximately 5 to 6 inches in diameter, and approximately 700 feet deep. The upper portion of the drill holes would be non-mineralized rock, that is, rock that contains uranium at natural background concentrations. The ore zone at the La Sal Mines Complex averages approximately 3.5 feet thick. Therefore, approximately 0.5 percent of the cuttings would be expected to contain uranium ore. At these dimensions, the proposed drilling would produce approximately 65 to 95 pounds (lbs) of drill cuttings from the ore zone per day for each hole. In comparison, the mine produces and hauls to the surface an average of approximately 536,000 lbs per day of ore. The risks from surface ore piles associated with particulates, radon and gamma radiation would be negligible both during and after operations as discussed previously.

The potential risks from drill cuttings would be negligible for two reasons. First, the mass of mineralized drill cuttings would be small. Second, drill cuttings would not be left on the surface. Cuttings would be placed in excavated drill pits and covered with inert surface soils after completion of drilling and closure of the pits. Pits would be closed and covered within days of excavation, resulting in no opportunity for public contact with the pit contents. Surface gamma surveys would be conducted after closure of drill sites as a further step to ensure that no ore remains on surface.

What is the appropriate reclamation performance criterion for emission of radiation from reclaimed areas?

Emission of radiation from the La Sal Mines Complex would decrease after mining is completed and the area is reclaimed. As discussed previously, the DRAs are not currently significant sources of radon gas, and radon gas emissions from vent holes would cease after mining is completed and the vent holes are reclaimed. Ore would either be shipped to the White Mesa Mill for processing or would be placed back underground. Therefore, these sources of radiation would not be present after mine reclamation. However, the development rock will be reclaimed in place, and development rock does contain trace concentrations of uranium. As discussed in Section 3.3.8.2, development rock currently emits gamma radiation at levels approximately 10 times higher than background. During mining operations, access to these areas is restricted, but these areas would be opened to pubic access after reclamation is complete. Therefore, there is some potential that a member of the public could be exposed to gamma radiation from reclaimed DRAs.

Emission of gamma radiation from DRAs would be reduced by placement of soil or other inert materials on the DRAs during reclamation in accordance with Alternatives A and C. No federal or state radiological standards currently exist for reclamation of DRAs at uranium mine sites. In fact, under Section 6.2 of the Atomic Energy Act (42 USC. 2092), and as set out in 10 CFR 40.13(b), the Nuclear Regulatory Commission has specifically excluded natural ores from regulation under the Atomic Energy Act. However, despite the fact that there are no current state or federal standards for reclamation of development rock areas at uranium mine sites, Alternatives A and C would require areas to be reclaimed such that the potential dose to a member of the public, assumed to be a person camping on or near a reclaimed development rock area for 14 days, is less than 100 mrem/year above background. Fourteen days is the regulatory time limit for camping in one location on BLM lands.

This reclamation performance criterion is supported technically by recommendations from the NRCP [See NRCP Statement 10, Recent Applications of the NCRP Public Dose Limit Recommendation for Ionizing Radiation, (NCRP, 2004), and NCRP's Report No. 116, Limitation of Exposure to Ionizing Radiation (NCRP, 1993)]. It is also consistent with the numerical public dose protection standard set by the Nuclear Regulatory Commission (NRC) for uranium milling facilities as set forth at 10 CFR Part 20, Subpart D §20.1301 - Dose limits for individual members of the public, which provides in part:

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem [100 mrem] in a year, exclusive of the dose contributions from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with §20.2003.

The state of Utah has adopted the same criterion for uranium mills in UAC R313-15-301. Accordingly, implementation of this reclamation performance criterion under Alternatives A and C is appropriate.

4.9.1.2 Alternative B

Under the no action alternative, the POA would not be approved and mining operations would continue in accordance with existing approvals until either no additional space was available for development rock storage or mining had to cease because of a lack of exploration drilling. The La Sal Mines Complex would then be reclaimed in accordance with existing plans of operations.

Alternatives A and C include design criteria that would increase reclamation requirements and improve reclamation performance. For example, Alternatives A and C would require areas to be reclaimed such that the potential dose to a member of the public, assumed to be a person camping on or near a reclaimed DRA for 14 days, is less than 100 mrem/year above background. Alternative B would not include these design criteria, and would therefore not require reclamation to meet this performance standard. Because Alternative B would not include design criteria to increase reclamation requirements and improve reclamation performance, it would be relatively less protective of the public and the environment as compared to Alternatives A and C.

4.9.2 Cumulative Effects

4.9.2.1 Alternatives A and C

In the future, there is potential that uranium mining could be conducted at several mines concurrently in the general vicinity of the La Sal Mine Complex. However, this is speculative and dependant on uranium prices and other factors as discussed in Section 4.1.1.2. There is potential for cumulative effects to occur associated with radon emissions from multiple producing uranium mines in the La Sal area in addition to radon emission that would be associated with Alternatives A or C.

Potential cumulative effects were modeled and an isopleth map of regional radon activity was prepared assuming concurrent operation of three underground uranium mines in the area: the La Sal Mines Complex, the Rim Mine, and the Sunday Mine. An isopleth map is an area model showing lines of equal radon concentrations at various distances from operating vents (Exhibit 4-1). The isopleth map shows that the contribution of radon from mine vent emissions to the regional air would quickly become indistinguishable from background concentrations of radon within a few

hundred yards to a mile from the La Sal Mines Complex. In addition, the isopleths indicate that the contribution of radon from the La Sal Mine Complex vent emissions would not overlap the areas of effect from other potentially operating mines in the area. Therefore, cumulative effects to air quality associated with radon emissions would not be expected under Alternatives A or C.

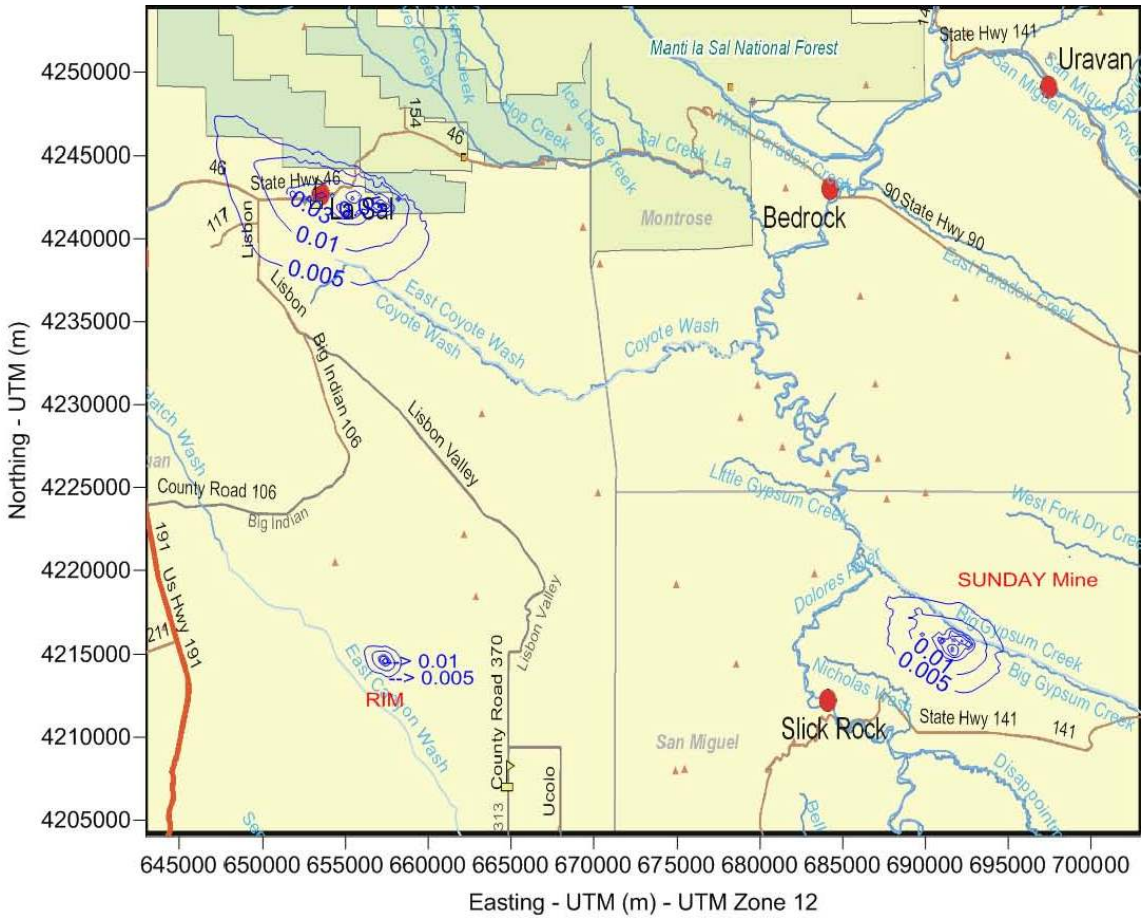


Exhibit 4-1. Isopleth map showing cumulative effects analysis of radon activity assuming concurrent mining at La Sal Mines Complex, Rim Mine and Sunday Mine. Activity shown in pCi/L. Natural background radon activity is approximately 0.4 pCi/L (NCRP 2009).

4.9.2.2 Alternative B

Under the no action alternative, additional mining at the La Sal Mines Complex would not be approved, and mining would eventually cease. Under Alternative B, reclamation of the DRAs may not achieve the proposed reclamation performance criterion described for Alternatives A and C, because the mine would be reclaimed in accordance with existing permits. When combined with historic mines in the area, Alternative B could result in slightly higher risk of exposure to gamma radiation for recreational users of public lands in the La Sal area as compared to Alternatives A and C.

4.10 Reclamation

The following key issues associated with mine reclamation were identified during scoping:

- How long would it take to reclaim affected areas?
- What is the risk of human and animal intrusion into development rock piles after reclamation is complete?
- Would adequate growth media be available to support reclamation?
- Would reclaimed development rock areas support a vegetative cover?
- Would reclamation be stable after it is completed?

4.10.1 Direct and Indirect Effects

In general, reclamation activities under each of the alternatives would entail removal of structures, backfilling, re-grading, and contouring, scarifying soil to alleviate compaction, and revegetation. This section describes the differences in reclamation activities among the alternatives and evaluates effects associated with these reclamation activities.

4.10.1.1 Alternative A

<u>Planned Reclamation Activists</u>

With Alternative A, there would be additional surface disturbance that would require reclamation as compared to the No Action Alternative (Alternative B). Under Alternative A, the existing DRA at Pandora Mine would be expanded, exploration drilling would occur, new ventilation shafts would be installed, and new access roads constructed. Expansion of the DRA at the Pandora Mine would result in surface disturbance of approximately 6 acres. Construction of exploration drilling sites and access roads would result in:

- Total surface disturbance of approximately 75 acres during Phase 1 (2011 to 2013), 74 acres during Phase 2 (2014 to 2018), and 63 acres during Phase 3 (2019 to 2030), for a total of 212 acres
- Disturbance on federal lands managed by BLM of approximately 14 acres during Phase 1 (2011 to 2013), 0 acres during Phase 2 (2014 to 2018), and 32 acres during Phase 3 (2019 to 2030), for a total of 46 acres
- Disturbance on federal lands managed by USFS of approximately 19 acres during Phase 1 (2011 to 2013), 19 acres during Phase 2 (2014 to 2018), and 10 acres during Phase 3 (2019 to 2030), for a total of 48 acres

Exploration drill sites and access roads would be reclaimed on an ongoing basis, and therefore, the total surface disturbance would be temporary with reclamation occurring on a concurrent basis.

Additional surface disturbance under Alternative A would occur during installation of ventilation holes and construction of ancillary access roads with an additional approximately 10 acres of disturbed area on BLM lands and 14 acres of disturbed USFS

lands during the three general phases of future development. New vent holes and shafts would be reclaimed at the time of mine reclamation.

Under Alternative A, reclamation activities of existing and proposed mine-affected areas at the Pandora, Snowball, La Sal and Beaver mines would be conducted in compliance with the standards in 43 CFR Part 3809.420 and 36 CFR 228A §228.8 (f) and (g) and §228.10 (as applicable on USFS and BLM managed lands), and state regulations (which are applicable to all mining-affected lands). The main reclamation activities in these areas associated with Alternative A include the following:

- Removal/disposal of petroleum products
- Demolition, removal or burial of facilities/structures
- Grading, backfilling, contouring and ripping of facilities areas, DRA tops and slopes, and other compacted areas such as access roads
- Drainage reconstruction
- Soil redistribution
- Revegetation (soil preparation, seeding, etc.)
- Post-reclamation vegetation monitoring

Each of these reclamation activities is described below.

Removal and Disposal of Petroleum Products

Petroleum products such as fuels, oil, hydraulic fluids, and transformer oil are present at the La Sal Mines Complex. These materials are stored in above ground storage tanks, drums, and smaller containers within designated fuel storage areas at the mine sites. Additional fuel or oil is contained in mobile equipment located at the mine sites. Under Alternative A these petroleum products would be on-site for the life of the mine. During reclamation, all petroleum products would be removed consistent with federal, state, and local laws and regulations for the handling, transport, and disposal of hazardous materials.

Demolition, Removal or Burial of Facilities/Structures

Buildings and trailers would be demolished and/or reused at another facility. Metal would be reused or recycled. Solid waste meeting the definition of “inert waste” under UAC Rule R315-301-2 (e.g., concrete, blocks, brick, incidental rebar, and glass) would be broken up and buried on site. Buried material would be covered with a minimum of three feet of soil or development rock, or alternately, it may be hauled to and disposed of within the mine before closing the portals. In addition, the septic system components would be removed and properly disposed of in the underground mine workings or in an off-site landfill. All power lines and poles owned by Denison would be recycled or disposed in an approved off-site landfill.

The mine portals would be sealed by pushing development rock 30 ft into each opening and then backfilling additional material against the opening to create a 2:1 slope. The shaft at the Beaver Shaft Mine would be filled with development rock from adjacent

DRAs. Drill holes would be abandoned in accordance with UAC Rule R647-4-108. All water wells installed at the mines would be permanently abandoned by a licensed driller in accordance with UAC Rule R655-4-12. Vent holes would be plugged using methods similar to those previously used for site closure and reclamation.

Regrading/Ripping, Backfilling, Grading and Contouring

All slopes created by mining activity would be regraded to achieve reclaimed slopes of 3H:1V gradient or less. Slopes would be ripped along the contour of the reestablished post-mine topography to a minimum depth of 12 inches using a tracked dozer. All areas affected by soil compaction would be ripped to aid in water infiltration and retention of precipitation, and to deter soil loss due to wind erosion.

Development Rock Areas (DRAs)

DRAs are currently located at each of the four mines. During reclamation, the top of the DRAs would be re-contoured to create natural appearing surfaces and slopes with a gradient of 3H:1V or less. One exception to this is the DRA east of the Beaver Shaft Mine which would be graded to a 2.5H:1V slope. To the extent practicable, material from DRAs at the Beaver Shaft Mine would be placed inside the Beaver Shaft upon reclamation. Following soil placement, the surface would be ripped to support seed germination.

Ore Stockpiles

Ore stockpiles are currently located at the Pandora, La Sal and Beaver Shaft mines. The Pandora and La Sal stockpiles are located on lands subject to BLM jurisdiction. Most stockpiled ore is temporarily stored for one week or less before being hauled to the White Mesa Mill. A low-grade stockpile is also present at the Beaver Shaft Mine, which is planned to be hauled to the White Mesa Mill at some time in the future.

During reclamation, any remaining ore stockpiles would be shipped to the mill for processing if market conditions are favorable. If the ore stockpiles cannot be shipped to the mill, remaining ore would be placed underground within the mined out areas, because the ore stockpiles are likely to contain low levels of uranium, vanadium, and radionuclides. After ore has been either removed to the mill or placed underground, the ore stockpile areas would be covered with soil, ripped, and seeded.

Access Roads

Under alternative A, Dension would reclaim temporary access roads, which they constructed to access exploration drilling sites or ventilation shafts. Most of the temporary access roads to vent holes and exploration drilling sites would be reclaimed by pushing back the stockpiled soil that was placed along the roads during their development. Roads would then be seeded with BLM, USFS, and UDOGM approved seed mix(es). In some areas, access roads that would require re-grading to re-establish approximate original ground contours and drainages. Road areas would then be ripped to a depth of 12 to 18 inches to alleviate soil compaction. Six inches of loose soil would be placed in locations where soil was removed and not stockpiled in windrows. After soil placement, roads would be seeded with the BLM, USFS, and UDOGM approved seed mix.

Most access roads to the main surface facilities at each mine would also be reclaimed post-closure. Existing roads utilized by Denison for access in areas where road construction was not necessary would not be reclaimed.

Drainage Reconstruction

Drainage channels at the La Sal Mines Complex were designed as permanent facilities to handle the 100-year, 24-hour storm event. These drainage channels would remain in place following closure of the mine sites to minimize the amount of runoff flowing down the slopes of the reclaimed DRAs and the across the mine sites. At the Pandora Mine, culverts would be removed to recreate the natural drainage and route flow west of the DRA. Soil would be bermed on either side of the drainage channel to prevent access.

Soil Redistribution

Salvaged soil would be placed on disturbed soil areas before revegetation. Using a dozer, front-end loader, and either scrapers or trucks, soil would be placed loosely over regraded DRAs and slopes to cover the areas to the greatest extent practicable.

Revegetation

Under Alternative A, revegetation would be conducted as follows. All disturbed soil areas would be revegetated to control erosion and restore habitat for wildlife. Before seeding, soil would be placed on all disturbed soil areas as available. Following the placement of soil, the surface would be roughened by “ripping” the soil. A roughened soil surface exhibits lower soil loss potential, increased moisture retention, cooler surface soil temperatures, and greater seed germination.

Compacted areas and slopes would be ripped to minimum depth of 12 inches in accordance with UAC Rule R647-4-110.5 (b). Revegetation would consist of broadcast seeding with the BLM, USFS, and UDOGM approved seed mix(es) in accordance with UAC Rule R647-4-110.5. Seed mix(es) would be designed to reflect the species composition observed within the project area and surrounding landscape, as well as those not observed, but typically associated with the landscape, soil type, elevation, and precipitation of the La Sal Mines Complex.

Seeding of all species would be achieved with a broadcast applicator in late fall (after November 1). This would provide for natural cold scarification of seeds and sufficient moisture. A broadcast application would prevent unnecessary soil disturbance associated with a drill seeder, or equipment weight (as it relates to compaction) associated with a hydroseeder. To minimize surface compaction and timeliness of the initial seeding efforts in late fall, broadcast seeding would be conducted concurrent with surface ripping. Ripping of the surface provides a roughened and irregular surface that minimizes surface erosion and helps trap rain and snow melt, improving available precipitation, and thus promoting better germination of distributed seeds. Based on post-mine topography, the regraded surface would be accessed with a tracked-dozer with ripper and a broadcast seeder (or equivalent method) would be used to seed along (parallel to) the re-contoured surface. Loosened soil resulting from the ripper on the back of the tracked-dozer should allow for adequate cover over concurrent broadcasted seed.

Because fertilization may result in proliferation of invasive plant species, no fertilizers would be applied to re-seeded areas. Irrigation is not proposed, thus plant establishment would be dependent upon natural precipitation. Areas where spotted knapweed or other noxious weeds are found on the development rock area or low grade ore piles would be marked and growth medium from these areas would be handled so seed or plant parts do not contaminate any other soil.

Post-reclamation Vegetation Monitoring

Revegetation is anticipated to require 3 to 5 years, depending on seasonal growth patterns, precipitation, weather, and natural disturbances. Upon the completion of all reclamation activities, revegetation success would be measured in accordance with UAC Rule R647-4-111, such that revegetation has achieved 70 percent cover. In addition, the vegetation must survive three growing seasons following the last seeding unless agriculture is to continue as part of the post-mining land use. The standards of success for revegetation efforts are based on agency determination that the revegetation work has been satisfactorily completed within practical limits. Results of bi-annual assessments of reclamation progress would be reported to the agencies on an annual basis.

An important part of post-reclamation vegetation monitoring would consist of monitoring for noxious weeds and invasive plants, which can outcompete native plants and hinder restoration of suitable wildlife habitat. During and following reclamation, a weed management plan would be implemented to prevent and control the spread of noxious weeds and invasive plants. These measures include the following:

- Before construction, Denison and its contractors would be trained on methods for cleaning equipment, identification of problem plant species in the project area, and procedures to follow when an invasive or noxious weed infestation is located. To assist in identification, the contractor would be supplied with a list and pictures of noxious and invasive species that may exist within the project area.
- Before any construction disturbance, all known noxious weed infestations would be flagged so that they may be properly managed.
- Equipment, materials, and vehicles would be stored at specified work areas or construction yards. All personal vehicles, sanitary facilities, and staging areas would be confined to a limited number of specified weed-free locations to decrease chances of incidental disturbance and spread of noxious weeds and invasive plants.
- Disturbed areas would be promptly seeded following completion of activities to reduce the potential for the spread and establishment of noxious weeds and invasive plants. Seeding should occur as soon as possible following construction and during the optimal time period. Only BLM, USFS, and UDOGM approved mixture(s) of certified “weed-free” seed would be used. All other introduced reclamation materials used, such as straw mulch, shall also be certified weed-free. Pesticide/herbicide treatments may be utilized to promote healthy, native vegetation, and prevent the spread and proliferation of noxious weeds.

4.10.1.2 Alternative A- Evaluation of Direct and Indirect Effects

Required Time to Reclaim Affected Areas

Areas affected by mining, exploration drilling and ventilation hole construction would be reclaimed at various times. Surface disturbance associated with exploration drilling would be reclaimed concurrently, and would be seeded the first fall after the areas have been disturbed. Therefore, disturbance associated with exploration drilling would generally be reclaimed within 12 months after construction. Reclamation of ventilation shafts and associated access roads would be conducted concurrently as practicable based on the progression of underground mining areas. However, most ventilation shafts and associated disturbance would be reclaimed after mining ceases. This is currently anticipated to be approximately 2030. However, the life of the mine is subject to change based on economic factors and other considerations. Mine-affected areas at the Pandora, Snowball, La Sal, and Beaver mines would be reclaimed after mining ceases.

In accordance with BLM regulations at 43 CFR 3809.420, Denison is required to reclaim disturbance on federal lands managed by BLM at the earliest feasible time after mining is complete. Similarly, USFS regulations at 36 CFR 228.8 require reclamation to commence at the earliest practicable time after mining ceases. Therefore it is assumed that reclamation would commence in approximately 2030. After major reclamation work has been conducted, and reclaimed areas have been seeded with BLM/USFS approved seed mixtures, it is anticipated that it would require 3 to 5 years for revegetation to mature to a point that meets reclamation performance criteria. During this time, Denison would manage the reclaimed site and provide bi-annual assessments of reclamation progress to BLM and USFS during this period.

Risk of Human and Animal Intrusion into Development Rock Areas after Reclamation

After reclamation is complete, the area is deemed to meet reclamation performance criteria, and the reclamation surety is released, the areas would revert to other land uses. Any ground disturbing activities in reclaimed areas under the jurisdiction of BLM or USFS would require NEPA analysis and agency approval. Potential ground disturbing activities on private lands would be conducted at the discretion of the landowner with oversight by state agencies as applicable. It is possible that local intrusion through the vegetative cover by borrowing animals could occur, or that local areas of the vegetative cover could erode over time. However, these local areas of potential disturbance to mine reclamation are not anticipated to pose an appreciable risk to humans or wildlife after reclamation is complete.

Availability and Suitability of Growth Media to Support a Vegetative Cover

Alternative A would cover development rock piles with soil, as available, and other inert material to support revegetation. However, the quantity of stockpiled soil is limited, because soil stockpiling was not conducted at the site during historical mineral development activities. This is not uncommon at mines that operated before implementation of modern state and federal mine reclamation laws. Currently, approximately 2,150 cy of soil is stockpiled at the La Sal Mine, and 480 cy of stockpiled soil are stockpiled at the Beaver Mine. In addition, it is proposed that approximately 8,000 cy of additional soil would be stockpiled during expansion of the Pandora DRA. This would provide approximately 10,630 cy of stockpiled soil for reclamation.

The minimum thickness of growth media required to provide adequate water holding capacity in this semi-arid environment has not been established. The preferred soil thickness for mine reclamation in Utah is 12 inches (UDOGM 2000). Based on a soil thickness of 12 inches, 10,630 cy of stockpiled soil would be adequate to reclaim 6.6 acres of land. Under Alternative A, total disturbance at the Pandora mine would increase from approximately 6 acres to approximately 15 acres. Existing disturbance at the other mines in the La Sal Mines Complex currently total approximately 43 acres. Although the thickness of soil required for reclamation could potentially be reduced to 6 inches, it is apparent that there is an insufficient quantity of stockpiled soil available to reclaim the expected mining-related disturbance under Alternative A.

The specific materials that would constitute inert fill materials are not specified in Alternative A. Therefore it is unknown if these materials would have adequate physical and chemical characteristics to support revegetation, and attain the reclamation performance criteria of 70 percent of pre-mining vegetative cover.

Stability of Reclamation

If revegetation efforts are not fully successful in establishing a vegetative cover, there would be potential for erosion from bare soil areas, particularly on slopes. Erosion caused by wind and rain on exposed soil could hinder long-term reclamation performance. A potentially indirect effect could also occur if loose soil from unvegetated areas is transported to surface waters. In addition, there would be potential for noxious weed infestations to develop on bare soil areas. Further indirect effects could occur if the weed infestation spread to adjacent native plant communities over the long term.

4.10.1.3 Alternative B- Planned Reclamation Activities

Under the No Action Alternative, reclamation would be conducted following completion of current mining operations. It is assumed that reclamation activities would be conducted consistent with current approved reclamation plans. In general, current reclamation plans call for removal of all surface facilities, recontouring of disturbed areas, placement of soil, and revegetation. Revegetation would entail reseeding during the October to December season following abandonment of the mine using a seed mix determined by BLM. Revegetation efforts would be inspected by BLM or USFS during the following April to June season to determine success. Reseeding would be repeated as

needed based on evaluation of reclamation performance in relation to the reclamation performance criteria.

4.10.1.4 Alternative B- Evaluation of Direct and Indirect Effects

As with Alternative A, it is uncertain whether sufficient growth media is available to support revegetation of disturbed areas with the No Action Alternative. Under Alternative B, the existing soil stockpiles at the La Sal and Beaver mines would be the only stockpiled soil available for reclamation. The total stockpiled volume at these piles is 2,630 cy. Assuming placement of 12 inches of soil during reclamation, this volume of stockpiled soil is only sufficient to reclaim 1.6 acres of mine-affected lands. The existing disturbance at the La Sal Mines Complex is approximately 43 acres.

Therefore, Alternative B is unlikely to meet the required reclamation performance criteria, and may lead to unnecessary and undue degradation as set forth by BLM regulations at 43 CRF 3809.415.

4.10.1.5 Alternative C- Require Modifications to the Proposed Action before Approval

Reclamation activities under Alternative C would be the same as those under Alternative A, with some notable differences. Alternative C would include measures to be conducted over the next 20 years of operation to support successful reclamation. Revegetation test plots would be established at the La Sal Mines Complex to evaluate parameters for growth media, including evaluation of the required soil thickness and water holding capacity to support vegetation. The test plots would determine if inert cover materials from the local area have the capacity to support the desired plant species during revegetation or if other growth media are necessary.

The revegetation test plots would also provide for evaluation of soil amendments such as fertilizer and organic matter. Various seed mixes would be tested to determine the mix of species best suited to the local climate, precipitation, and other conditions of the site. This would enable selection of a diverse composition of native plant species for revegetation, which are consistent with BLM, USFS and state of Utah requirements. These efforts would be expected to result in successful revegetation. This would restore wildlife habitat, prevent noxious weed infestations, control erosion, and meet reclamation performance criteria. Therefore, reclamation activities under Alternative C would not result in adverse effects related to reclamation, and would not be likely to cause unnecessary and undue degradation as set forth by BLM regulations at 43 CFR 3809.415. Alternative C is also likely to meet USFS regulations for Environmental Protection at 36 CFR 228.8.

Alternative C would provide for stockpiling of additional soil for use during reclamation. Assuming that soil removed to a depth of 3 ft before construction of the DRA expansion, this would provide for stockpiling of approximately 23,800 cubic yards of additional soil, an important resource to support mine reclamation. The depth of soil placed during mine reclamation would likely be in the range of 6 to 12 inches. Therefore, Alternative C would provide additional soil resources to use in reclamation as compared to Alternatives A or B.

4.10.2 Cumulative Effects

4.10.2.1 Alternative A

Under Alternative A, there would be potential cumulative effects if revegetation efforts are not successful. If an effective self-sustaining vegetative cover is not established, noxious weeds or other invasive plants may infest reclaimed areas and then spread to areas outside the project site. Lack of a self-sustaining vegetative cover could also result in loss of soil, which would further hinder vegetation in the future. Alternative A could contribute to cumulative effects if noxious weeds or invasive plants are transported or spread to disturbed areas located on adjacent lands or outcompete native plant communities in the long term. There could also be a cumulative effects related to soil loss and associated sedimentation from wind and water erosion in areas where revegetation was not successful.

As shown on Figure 4-1, there are a number of existing mines within the general vicinity of the La Sal Mines Complex. These mines are in various stages of exploration, production and reclamation. In addition, some of these mines may be abandoned. Noxious weeds are a common issue at abandoned mines. Therefore, if noxious weeds become a problem in reclaimed areas at the La Sal Mines Complex, they could lead to cumulative effects that are additive to existing noxious weed issues at abandoned mines.

Alternative A includes a control plan for noxious weeds, which would be followed throughout the development, operation and reclamation phases in all existing and proposed disturbance areas associated with the La Sal Mines Complex. In the event that an effective self-sustaining vegetative cover is not established during reclamation, it could result in failure to meet state, BLM or USFS reclamation performance criteria. This would require continued control of noxious weeds until reclamation performance criteria are met. This would mitigate the potential for noxious weeds to spread beyond the reclaimed areas under Alternative A.

4.10.2.2 Alternative B

As with Alternative A, Alternative B could contribute to cumulative effects related to the spread of noxious weeds or invasive plants and the loss of soil and sedimentation from erosion of bare soils. The existing plans of operations do not specifically address control of noxious weeds, and does not include reclamation performance criteria. Therefore, it is more likely that Alternative B would lead to cumulative effects.

4.10.2.3 Alternative C

Under Alternative C, revegetation efforts are expected to be fully successful. Revegetation tests plots would be conducted before mine reclamation, which would establish the specific needs to achieve successful reclamation of past, current and proposed mining-related disturbance at the La Sal Mines Complex. Therefore, there would be no cumulative effects related to noxious weeds, invasive plants, or loss of soil.

4.11 Slope Stability

The following key issues associated with mine reclamation were identified during scoping*:*

- Is the current Pandora development rock pile stable?
- Would the proposed final configuration of the Pandora development rock pile be stable?

4.11.1 Direct and Indirect Effects

The following sections address the key issues associated with slope stability. Potential direct and indirect effects associated with erosion and sediment transport are addressed in Section 4.13 – Soils and Section 4.14 – Surface Water.

4.11.1.1 Alternative A

Under Alternative A, potential effects to slope stability could be associated with expansion of the Pandora DRA. During construction of the Pandora DRA, the slopes would be built at the approximate angle of repose. The angle of repose is the steepest slope angle that unconsolidated rock would form without the material sliding down-slope. The actual angle of repose is a function of the grain size, grain shape and other inherent factors of the rock or soil. An example of a natural angle of repose slopes is a scree slope in steep mountainous terrain, which lies at the natural angle dictated by the physical characteristics of the rock. At the Pandora mine, the angle of repose ranges from approximately 30 to 35 degrees measured from a horizontal plane. During reclamation, the Pandora DRA would be re-contoured to create natural appearing surfaces to the extent practicable, and the current angle of repose slopes would be reduced to 3H:1V or less (18.4 degrees).

Although not relevant specifically to the key issues, Alternative A would also modify and modernize the existing reclamation plans for all DRAs, and require slope reduction before reclamation to improve slope stability and reclamation performance at all DRAs.

Current Pandora Development Rock Pile Stability

Currently, the slopes of the Pandora DRA are relatively steep, with some areas at the angle of repose. These existing slopes are stable in the short term, and the angle of repose slope provides for efficient development rock placement during construction. However, in the long term, some rock may continue to move down-slope along the angle of repose slopes. More importantly from a mine reclamation standpoint, an angle of repose slope is difficult and expensive to reclaim, and most common mine reclamation equipment is not capable of safely traversing angle of repose slopes to place soil before reclamation.

Future Stability of the Pandora Rock Pile

During reclamation, the slope of the Pandora DRA would be reduced to 3H:1V to facilitate soil placement and revegetation. Construction of 3H:1V slopes is common practice during mine reclamation, and the final slopes of the reclaimed Pandora DRA would be stable. These gentler slopes would also facilitate soil placement and revegetation using standard mine reclamation equipment, and the gentler slopes would reduce the likelihood of problematic erosion occurring after reclamation is complete.

4.11.1.2 Alternative B

Under Alternative B, the Pandora DRA would continue to be used in accordance with the existing Plan of Operations until mining ceases because of insufficient mine ventilation or lack of exploration drilling. Existing plans of operation do not specifically require reduction of slopes to 3H:1V or less, and Denison would need to construct steep slopes to maximize development rock storage capacity within the currently approved footprint of the DRA. Therefore, these slopes would be relatively less stable in the long term as compared to Alternative A, there would be risk of excessive soil erosion or small-scale slope failures after reclamation is complete.

4.11.1.3 Alternative C

Alternative C includes approval of all existing activities/disturbances described in Alternative A with the exception of several modifications. One modification proposes expansion of the Pandora DRA to the south by approximately 5 acres as compared to Alternative A to provide more capacity for rock storage. This component of Alternative C would provide for more rock storage capacity in the future. It would also provide additional available area to create natural looking slopes during reclamation. The slopes at the Pandora rock pile would be expected to be stable in the long term, because they would be reduced to 3H:1V or less, which is common practice in mine reclamation.

4.11.2 Cumulative Effects

Alternatives A through C would not be expected to cause cumulative effects. The slope stability of the Pandora DRA is a local issue, and potential failure of the Pandora DRA slopes would not affect slope stability of other past, present or reasonably foreseeable DRAs.

4.12 Socioeconomics

The following key issues associated with mine reclamation were identified during scoping*:*

- What are the socioeconomic effects of the proposed action and alternatives?
- Would ore truck travel cause adverse effects to area income from tourism?

4.12.1 Direct and Indirect Effects

The following sections discuss potential direct and indirect effects relevant to the key issues.

4.12.1.1 Alternative A

With Alternative A, mine operations would continue to provide long-term employment opportunities that are much needed within San Juan County where the unemployment rate is the highest in the state. These mining jobs are relatively high-paying jobs and provide a dependable long-term tax base to San Juan County.

In addition, expansion of the mine sites would bring an estimated 46 additional jobs to San Juan County, using the existing local work force from the County to the greatest extent practicable. Temporary construction jobs would be created as well as long-term jobs. Adequate housing to support this work force would be available among the nearby residential centers of La Sal and Monticello. Thus, there would be no adverse effects related to housing.

Alternative A would also provide continued ancillary employment for Denison's mine offices in Colorado. It would also extend the life of the La Sal Mines Complex such that it can continue to support local mining-related industries and companies including ore trucking companies, the White Mesa Mill near Blanding, Utah, mine equipment manufacturing, sales, and delivery, and other technical services such as mechanics and electricians.

Under Alternative A, ore haul truck travel is anticipated to increase 11 percent on SR 46, and up to 4 percent along US Hwy. 191. This increase is not anticipated to adversely affect travel on these routes to regional tourist destinations. No effects related to tourism are anticipated.

4.12.1.2 Alternative B

Under Alternative B, mining operations would continue until the mine is required to cease as a result of lack of adequate mine ventilation or lack of exploration drilling. Until that time, the La Sal Mines Complex would continue to support the local economy and provide tax revenue to San Juan County. However, once the La Sal Mines Complex is forced to shut-down, adverse effects would be expected for existing mine employment, mine support industries, and the area economy.

4.12.1.3 Alternative C

As with Alternative A, Alternative C would support the local economy through the creation of new mining jobs and continued tax revenue to San Juan County. No adverse effects related to housing are anticipated, as adequate housing is locally available for the estimated number of new workers. Temporary construction jobs as well as long-term jobs would be created, and mining-related industries and local companies would benefit from continued and expanded mine activities. No effects related to tourism from an increase in local haul truck traffic are anticipated.

4.12.2 Cumulative Effects

4.12.2.1 Alternative A

Reasonably foreseeable future actions are not anticipated to result in effects on tourism, an important part of the local and regional economy, from an increase in haul truck traffic. Furthermore, cumulative effects on housing availability are anticipated to be

minor, because adequate housing exists in the project area. Eventual production at Denison's Redd Block or Pine Ridge mines may replace depleted production after production at La Sal Mines Complex ceases, potential long-term employment opportunities and associated economic benefits in the La Sal area. In addition, in the event that production starts at Energy Fuels Energy Queen mine, this could lead to increased economic benefits in the La Sal area.

4.12.2.2 Alternative B

Since there would be no change in truck traffic or housing needs with Alternative B, there would be no cumulative effects related to socioeconomics.

4.12.2.3 Alternative C

Cumulative effects related to truck traffic and housing availability would be the same under Alternative C as with Alternative A, because the components of the alternatives that are relevant to socioeconomic effects are the same for both alternatives.

4.13 Surface Water

The following key issues associated with mine reclamation were identified during scoping*:*

- Would flooding and storm events cause adverse environmental effects as a result of sediment transport and erosion of mine waste piles?
- Is there potential for storm water to transport contaminants away from the mine site?

4.13.1 Direct and Indirect Effects

4.13.1.1 Alternative A

Under Alternative A, the proposed action would require management of stormwater for at the Pandora Mine facilities, as well as locally managing areas associated with exploration drill and installation of vent holes. The expansion of the Pandora Mine would require stormwater management on approximately 6.5 acres of additional land to accommodate the increased footprint of the development rock area. The exploration drilling and installation of vent holes would be conducted over three separate phases. Phase 1 would affect 75 acres on BLM, USFS, and private lands; Phase 2 would affect 74 acres on USFS, SITLA, and private lands; and Phase 3 would affect 63.1 acres on BLM, USFS, and private lands.

Currently, the La Sal Mines Complex manages stormwater in accordance with the federal Clean Water Act and associated state and federal regulations using the existing SWPPP. Alternative A would include modification of the existing SWPPP to address additional mine disturbance. To control erosion and sediment transport, best management practices (BMPs) would continue to be utilized and include sediment and erosion controls, inspections, and maintenance schedules to control potential migration of sediment in surface water runoff. Further, all drainage control structures route offsite surface flow around the affected areas, and BMPs in the affected areas would be designed to detain the 100-year, 24-hour storm event.

The areas of existing and proposed mining disturbance are relatively small compared to contributing watersheds for the nearest perennial surface water bodies. The La Sal Mines Complex straddles a watershed boundary between watersheds that drain to the Colorado River to the west and the Dolores River to the east. The Colorado and Dolores rivers are the nearest perennial surface water bodies in the mine area. The western portion of the Beaver mine drains to a series of ephermeral and intermittent drainages that eventually reach the Colorado River approximately 37 miles downstream from the mine area. The contributing area of this watershed is 232,000 acres. The eastern portion of the Beaver Mine, the La Sal Mine, the Snowball Mines, and the Pandora Mine drain towards the east. The Dolores River is the nearest perennial surface water in this watershed, and is located approximately 24 miles downstream from the La Sal Mines Complex. This watershed has a contributing area of approximately 115,000 acres. Relatively speaking, the existing and proposed disturbance areas associated with the La Sal Mines Complex are minor when compared to the contributing watersheds to the nearest perennial surface water. This further illustrates that it is unlikely the mine would affect surface waters.

4.13.1.2 Alternative B

Alternative B would not approve modifications to the existing plans of operations. Surface water discharges from the La Sal Mines Complex are currently permitted under an Industrial Stormwater permit for construction activities as required by the Clean Water Act and associated state and federal water pollution control laws. A SWPPP for the La Sal Mines Complex is currently in place at the mines, and stormwater pollution control facilities are currently in place and operating at the mines.

4.13.1.3 Alternative C

Alternative C includes approval of all existing activities/disturbances described in Alternative A with the exception of several modifications. During reclamation, silt fences, rock filters or detention ponds would be implemented during the reclamation phase to reduce suspended solids in the stormwater.

Because the direct and indirect effects were determined to be minor for Alternative A, and Alternative C provides for installation of additional erosion control structures (slope breaks) during reclamation, the direct and indirect effects from erosion and sediment transport during flooding and storm events would be lower as compared to Alternative A.

4.13.2 Cumulative Effects

4.13.2.1 Alternative A

The cumulative effects from erosion and sediment transport are likely to be minor because surface water would be managed in accordance with approved permits, the federal Clean Water Act, and associated state and federal regulations. The existing SWPPP would be modified to address additional disturbance. No cumulative effects to surface water quality are anticipated if Alternative A is implemented.

4.13.2.2 Alternative B

Alternative B would not approve any expansion or modification of activities at the LA Sal Mines Complex. Therefore, it would not cause cumulative effects.

4.13.2.3 Alternative C

Alternative C includes approval of all existing activities/disturbances described in Alternative A with the exception of several modifications. These modifications would improve management of stormwater, which would be conducted in accordance with approved permits, the federal Clean Water Act, and associated state and federal regulations. No cumulative effects to surface water quality are anticipated as a result of Alternative C.

4.14 Transportation

The following key issues associated with mine reclamation were identified during scoping*:*

- What are the effects of ore trucking on public safety?

4.14.1 Direct and Indirect Effects

4.14.1.1 Alternative A

The transportation route from the La Sal Mines Complex to the White Mesa Mill would be west on Utah SR 46 (about 8.75 miles), and then south (about 59.8 miles) along US Hwy. 191. In 2010, The Pandora and Beaver Shaft Mines produced approximately 48,000 and 43,000 tons of ore respectively, which was hauled to the White Mesa Mill. However, the annual volume mined under Alternative A in the future would depend on the price of uranium and other factors. Alternative A proposes annual production of up to 121,000 and 119,000 tons from the Pandora and Beaver Shaft Mines respectively.

Effects from Haul Trucks

To determine the AADT from haul trucks, the total volume of ore from the proposed action is subtracted from the existing volume of ore hauled to the mill since the baseline estimates in Chapter 3 have already accounted for the haul truck traffic as a result of the La Sal Mines Complex.

Based on the estimate of ore listed above, the current quantity of ore generated in 2010 from Pandora and Beaver Shaft Mines is 91,000 tons. The proposed quantity of ore to be generated is 240,000 tons. Therefore, the difference would be 150,000 tons per year.

Assuming that the haul trucks would operate 5 days per week (260 days per year) and the realistic capacity of the haul trucks is 23 tons, then the 150,00 tons would result in a total of 25 haul trucks per day. Since the haul trucks would leave the mine sites full and return empty, the number of two way haul trucks should be increased to 50 trucks per day. Per the Utah DOT, AADT counting takes into account traffic in both directions.

Effects from Employee Vehicles

Employees of the mine live either in La Sal, Monticello, or rural areas in southwestern Colorado. Employees drive personal or company cars to the mine sites and park at the La Sal Mines Complex. It is likely that some car-pooling occurs. Passenger vans or buses are used to get employees to the Beaver Shaft site. The Pandora mine is operated by a contract mining company. Their cars are parked at the Pandora Mine site.

As stated in Chapter 3, Denison currently has 52 employees at the Beaver and La Sal Mines and a contractor has 32 employees at Pandora, for a total of 84 employees at all facilities. An estimated 60 personal vehicles is assumed for these workers.

As stated in Section 9 of the Plan of Operations, the proposed action would require an estimate of 80 employees at the Beaver and La Sal Mines and 50 at the Pandora Mine, for a total of 130 employees at all facilities. A total of up to 100 personal vehicles are expected for the mining facilities.

The differential between the current number of employee vehicles and the proposed action would be approximately 40 vehicles per day. Since the employee vehicles would arrive at the start of each shift and leave at the end, the number of employee vehicles is estimated toincrease to 80 vehicles per day.

Summary of Truck and Vehicle Impacts

Table 4-3 provides a comparison of baseline traffic data with increases in traffic resulting from ore haul trucks and employee vehicles. In the table below, “T” indicates associated truck traffic and “V” indicates general vehicular traffic. The route analyzed was the main haul route from the La Sal Mines Complex west along SR 46 to US Hwy. 191, then south through Monticello, Utah, to the White Mesa Mill near Blanding, Utah. For the purposes of the assessment, it is assumed that the majority of employees arrive from Monticello, Utah (assume 80 percent of total vehicles arrive from west on SR 46, and that 60 percent of the vehicles from SR 46 travel south towards and/or through Blanding, Utah).

Based on the estimated change between the current and proposed AADT and the proportion of truck traffic, the results show that a minor effect to traffic would occur along the US Hwy. 191 corridor.

All ore would be transported in covered trucks and in accordance with US DOT requirements. Effects are not expected related to release of uranium ore or other materials from the ore haulage trucks. Air quality effects associated trucking were addressed previously in Section 4.2, and visual effects associated with trucking are addressed in Section 4.16.

Table 4-6. Evaluation of effects to traffic associated with Alternative A

Location along route from La Sal to White Mesa Mill	**SR 46 at US Hwy. 191 La Sal Junction**	**US Hwy. 191 at SR 46 La Sal Junction**	**US Hwy. 191 at 600 North Monticello**	**US Hwy. 191 at 200 North Blanding**	**US Hwy. 191 at SR 95 South of Blanding**
2010 Average Annual Daily Traffic (AADT)	690 V	4,310 V	3,575 V	2,970 V	2,820 V
2010 Truck Traffic (double axle)	11% (76)	30% (1,293)	32% (1,144)	13.0% (386)	12% (338)
Increased traffic-Alternative A	50 T /64 V	50 T/38 V	50 T/38 V	50 T/38 V	50 T/38 V
Estimated AADT-Alternative A (vehicles per day)	804	4,398	3,663	3,058	2,908
Estimated change AADT-Alternative A	+16.5%	+2.0%	+2.5%	+3.0%	+3.1%
Estimated Truck Traffic-Alternative A	15.7% (126)	30.5% (1,343)	32.6% (1,194)	13.2% (394)	15.5% (450)

Abreviations: Trucks (T), vehicles (V), percent (%), Average Annual Daily Traffic (AADT), Highway (Hwy.)
Data: UDOT AADT (2010)

4.14.1.2 Alternative B

The direct and indirect effects for Alternative B – No Action would not change from those conditions currently described as baseline. However, once the current ore deposit has been depleted, ore haul trucks and employee vehicle traffic would be reduced to zero from the La Sal Mines Complex, which would reduce traffic on areas roads.

4.14.1.3 Alternative C

Alternative C includes approval of all existing activities/disturbances described in Alternative A with the exception of several modifications. Since the modifications would have no impact on transportation, the direct and indirect effects associated with Alternative C would be as described above in Alternative A. Therefore, direct and indirect effects on public safety associated with transportation are expected to be minor, because all ore is transported in accordance with Utah DOT requirements and the relative increase in the level of traffic is small.

4.14.2 Cumulative Effects

4.14.2.1 Alternative A

Based on the regional activities along SR 46 near La Sal, mining related activities from adjacent mines would contribute most to the cumulative effects on transportation in the form of haul trucks traveling east to the Piñon Ridge Uranium Mill and west to the White Mesa Mill; in lieu of other agricultural, commercial, or recreational vehicles since

no major developments are anticipated that would increase traffic from these types of vehicles.

While possible sources of future production can generally be identified, projecting sustainable rates of production is highly conjectural. For purposes of a cumulative impact analysis, speculative ranges of production have been projected as follows (again, it should be specifically noted these rates are not fully incremental and would in some cases be "replacement" of production from depleted mines, hence an extremely conservative assessment is generated if projected rates are assumed).

- La Sal Mines Complex (La Sal Complex, Redd Block, Pine Ridge, etc.): 100,000 tons per year
- Energy Queen: 60,000 tons per year

Energy Fuels owns and operates the Energy Queen Mine located 3 miles southwest of La Sal, Utah. Uranium ore from the mine would be transported via haul truck to the Piñon Ridge Uranium Mill located 12 miles west of Naturita, Colorado in Montrose County on Hwy 90. Haul trucks would access the mill via eastbound Utah SR 46 to Colorado Hwy 90. Speculative estimates of ore production rates at the Energy Queen Mine suggest that approximately 60,000 tons per year would be produced. Assuming that 23 tons are hauled per truck and transportation would only occur Monday through Friday (260 days of the year), the total daily tonnage would be 230 tons per day. Therefore, the total increase in truck traffic would be approximately 10 trucks per day traveling east towards Colorado. This total volume of traffic is low. If trucks are loaded and hauled throughout a 12 hour day, this increase in truck traffic would result in less than one truck per hour leaving and entering the mine sites.

Pine Ridge and Redd Block IV are two mines owned by Denison Mines, which are currently in the planning and/or evaluation stages. The cumulative ore production rate at these facilities is estimated to be 100,000 tons per year. Using the same assumptions that were developed to estimate truck traffic from the Energy Fuels Mine; the total daily tonnage would be 384 tons per day. Therefore, the total increase in truck traffic would be approximately 17 trucks per day travelling to and from Blanding, Utah. This total volume of traffic is low. If trucks are loaded and hauled throughout a 12 hour day, this increase in truck traffic would result in slightly more than one truck per hour leaving and entering the mine sites. Cumulative effects related to employee vehicle traffic are considered negligible based on the assessment made for the direct and indirect impacts.

Overall, cumulative effects on public safety associated with transportation are expected to be minor based on the limited number of current or reasonably foreseeable future actions planned, and the relatively small changes to the traffic volume. In addition, the majority of the land use is rural agricultural; therefore, effects associated with agricultural activities is expected to remain relatively steady since no major developments are anticipated.

4.14.2.2 Alternative B

The cumulative effects for Alternative B – No Action would not change from those conditions currently described as baseline. However, once the current ore deposit has

been depleted, ore haul trucks and employee vehicle traffic would be reduced to zero from the La Sal Mines Complex, which would have a positive impact on transportation, particularly along SR 46. However, some impact from adjacent mining operations (i.e., Energy Queen) could continue to provide a small impact along SR 46 from 3 miles east of La Sal to the Colorado border and along Colorado Hwy 90.

4.14.2.3 Alternative C

Alternative C includes approval of all existing activities/disturbances described in Alternative A with the exception of several modifications. Since all modifications have no impact on transportation, the direct and indirect effects associated with Alternative C would be as described above in Alternative A. Therefore, cumulative effects on public safety associated with transportation are expected to be minor based on the limited number of current or reasonably foreseeable future actions planned.

4.15 Vegetation

Key issues identified during scoping that are relevant to vegetation consist of:

- Are sensitive or otherwise protected plant species present in the project area?
- What are the baseline vegetation conditions?
- What are the effects of historic, current, and proposed disturbance to vegetation?

4.15.1 Direct and Indirect Impacts

4.15.1.1 Alternative A

Vegetation is a fundamental and vitally important component of the biological resources in the project area. Direct effects of Alternative A to vegetation would include the mechanical removal of vegetation during construction activities, road building, and other ground-disturbing activities. Mining-related disturbance would have localized impacts on vegetation community structure and species abundance, as well as overall vegetation productivity on an ecosystem level.

Construction of the vent holes, drill holes and improvement and construction of the access roads for all three phases (approximately 20 year time period) would result in direct short-term and localized impacts to approximately 212.1 acres and long-term loss of approximately 42.4 acres of vegetation. Short-term effects would occur in areas where vegetation is disturbed but reclaimed following construction. Long-term effects would occur where well drill holes, vents and roads are constructed or improved and are needed for the life of the project. In addition to acres of impacts, plant diversity would also be reduced in the reclaimed areas as compared to pre-mining conditions. Over time vegetative recruitment from adjacent lands would off-set this reduced plant diversity. This reduced plant diversity has additional impacts to wildlife as discussed in more detail in Section 4.

The Denison La Sal proposed reclamation plan establishes the reclamation performance criteria to achieve 70% of the pre-mining vegetative cover. The following tables show the proportion of each SWReGAP vegetation cover type within each phase of the project (Tables 4-4, 4-5, and 4-6). The actual acreage of each type of vegetation that would be

removed is assumed to be proportional to the distribution of vegetation types within the proposed phases since the exact locations of drilling sites and ventilation shafts would be determined later.

Table 4-7. SWReGAP Vegetation Cover Types within Phase 1 Amendments

Vegetation Cover Type	**%**
Inter-Mountain Basins Big Sagebrush Shrubland	41.1
Colorado Plateau Pinyon-Juniper Woodland	38.6
Agriculture	9.4
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	7.6
Rocky Mountain Ponderosa Pine Woodland	2.3
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	0.4
Rocky Mountain Cliff and Canyon	0.4
Colorado Plateau Pinyon-Juniper Shrubland	0.2

Vegetation removal would occur on approximately 75 acres of the area identified for Phase 1, which is 15.5% of the area.

Table 4-8. SWReGAP Vegetation Cover Types within Phase 2 Amendments

Vegetation Cover Type	**%**
Inter-Mountain Basins Big Sagebrush Shrubland	38.4
Colorado Plateau Pinyon-Juniper Woodland	34.6
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	13.4
Agriculture	9.8
Rocky Mountain Ponderosa Pine Woodland	2.1
Inter-Mountain Basins Montane Sagebrush Steppe	0.7
Colorado Plateau Pinyon-Juniper Shrubland	0.4
Developed, Medium - High Intensity	0.2
Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	0.2
Colorado Plateau Mixed Bedrock Canyon and Tableland	0.1
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	0.1

Vegetation removal would occur on approximately 74 acres of the area identified for Phase 2, which is 7.6% of the area.

Table 4-9. SWReGAP Vegetation Cover Types within Phase 3 Amendments

Vegetation Cover Type	**%**
Colorado Plateau Pinyon-Juniper Woodland	60.5
Inter-Mountain Basins Big Sagebrush Shrubland	24.3
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	4.4
Agriculture	3.7
Colorado Plateau Pinyon-Juniper Shrubland	2.8

Vegetation Cover Type	%
Developed, Medium - High Intensity	2.2
Rocky Mountain Cliff and Canyon	1.8
Rocky Mountain Ponderosa Pine Woodland	>0.2
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	>0.1

Vegetation removal would occur on approximately 63.1 acres of the area identified for Phase 2, which is 8.5% of the area.

Impacts to Special Status Species

Beaman's townsendia is endemic to San Juan County, and grows in piñon-juniper and ponderosa pine communities between 6,200 to 7,215 feet amsl. Site specific surveys for this species have not occurred. Potential habitat for Beaman's townsendia exists within the project area. Ground disturbing activities may cause mortality to Beaman's townsendia and a reduction in potential habitat.

Indirect Effects

Indirect effects to vegetation may occur as a result of disturbance to vegetative communities. Potential indirect effects to vegetation include:

- Fugitive dust deposition on plants, which may interfere with plant viability;
- The introduction or spread of noxious weeds and/or non-native invasive plants due to surface disturbance, seed transport, and/or altered soil nutrient cycling;
- Minor changes in drainage and exposure caused by road construction may reduce the vitality of localized trees such that they are more vulnerable to insect and disease attack, or more easily broken or uprooted by the wind.

These indirect effects are explored in more detail below.

<u>Dust</u>

Dust accumulation on the surface of vegetation immediately adjacent to roads or drilling sites may cause reduced vigor or death of vegetation due to the reduced capacity for photosynthesis. Where plants are situated near frequently disturbed soils, such as dirt or gravel roads, plant health may be indirectly impacted when fine particulate dust accumulates on leaf surfaces. Sandy soils on roads and well drill and vent holes may contain rock fragments that may erode into fine particulates. Frequent travel on unpaved access roads and drill and vent sites would occur mostly during construction and drilling operations and routine monitoring of vent holes as required by state permits. Adhering to safe driving speeds on the unpaved roads would minimize ambient dust deposition. Although average shoot growth has been shown to decline with increasing dust accumulation, seasonal net photosynthesis may increase, likely as a result of higher leaf temperatures of dusted individual plants (Wijayratne et al., 2009). Small impacts to vegetation may result from dust associated with construction and drilling operations, but increased photosynthesis may increase plant growth.

Decreased Water Flow to Vegetation and Soil Compaction

Vehicular travel, construction, drilling, and mining activities would cause soil compaction in the project area. In addition, stormwater may be diverted to designed detention ponds or other engineering structures, reducing the amount of water received by vegetation in some areas and increasing the water in others. This may cause lowered vigor or death of plants and changes in plant abundance and/or species composition. Modified nutrient cycling due to soil compaction may also decrease the health and diversity of vegetion in affected areas.

Removal of cryptobiotic soil crusts and vegetated cover, which help hold soils in place, would contribute to these impacts within the project boundaries and adjacent areas.

Noxious Weeds

Native species richness, abundance, productivity, and structure may be decreased due to the inadvertent introduction of noxious weeds during the process of mine operations and the associated disturbance. An increase in invasive species in the region can also be attributed to increased recreation use of the area by the general publics' uses of federally managed land. Denison prepared a Weed Control Plan for the La Sal Mine complex (Denison, 2009a).

4.15.1.2 Alternative B

Under Alternative B, mining activities would continue under the existing permits. The La Sal Mines Complex would not be expanded. The impacts to vegetation under the current conditions and mining operations would not change. Therefore, no additional impacts to vegetation would occur.

4.15.1.3 Alternative C

Alternative C would be identical to Alternative A with the exception of the specific modifications. The following components of Alternative C may affect vegetation.

Conduct Pre-construction Vegetation Surveys

Vegetation surveys would be conducted prior to exploration drilling, road construction, ventilation shaft construction, or other ground disturbing activities. As described above, the specific location for exploration drill holes and ventilation shafts would be provided to BLM or USFS for approval prior to Phase 1, 2 or 3 activities. These surveys would define baseline vegetative cover to inform reclamation activities, which would restore vegetation to 70% of pre-mining vegetative cover.

Additionally, pre-construction species-specific surveys for Beaman's townsendia would be performed in areas designated for ground disturbing activities on BLM land. If Beaman's townsendia is discovered on BLM land, the BLM should be informed and mitigation measures would be directed by the BLM. Mitigation measures may include avoidance. Surveys for Beaman's townsendia would prevent habitat loss and destruction of this rare plant.

4.15.2 Cumulative Effects

4.15.2.1 Alternative A

Various management activities, extractive industries, and recreation take place on the lands in and surrounding the project area.

Mining, Oil, and Gas

There are several permitted mines and exploration areas in the general vicinity of the La Sal Mines Complex that may become active in the reasonable foreseeable future. Additional road building, maintenance, and construction activities would cause increased disturbance to vegetation. Increased vegetation loss would further decrease habitat for wildlife.

Recreation

Improved access into the study area associated with new mine roads could result in an increase in human activity prompting additional disturbances to vegetation. Though not designed for recreational purposes, the new roads have the potential to facilitate recreational activities and could lead to degradation of vegetation. Recreational vehicle use can lead to crushing or removal of vegetation. Invasive species are also transported by recreational vehicles and foot traffic. In this way, recreation may lead to introduction of invasive species to the project area.

Grazing

Grazing occurs on BLM, USFS, state, and private land within and surrounding the project area. The Manti-La Sal National Forest Land and Resource Management Plan (USDA Forest Service 1986, as amended) states the forest has permits for 20,730 cattle and 84,913 head of sheep, and there are 1,212,846 acres of range suitable for grazing and browsing. The BLM *Moab Field Office Approved Resource Management Plan* (2008a) states there are 106,479 animal unit months (AUMs) allotted to livestock and 1,690,481 acres of range available for grazing, which is in accordance with the Standards for Rangeland Health and Guidelines for Grazing Management.

When combined with the impacts of these other activities, Alternative A could contribute to additional impacts on vegetation.

4.15.2.2 Alternative B

Under Alternative B, the cumulative effects to vegetation under the current conditions and mining operations would not change. Therefore, no additional cumulative effects to vegetation would occur.

4.15.2.3 Alternative C

Cumulative effects for Alternative C would be the same as described for Alternative A with some modifications. Pre-construction surveys would inform the reclamation activities to ensure that 70% of the baseline vegetative cover is restored. Pre-construction surveys would also ensure that no individuals of Beaman’s Townsendia are removed or damaged. Revegetation test plots and slope breaks would increase the

potential success rates of reclamation activities. Overall, the modifications in Alternative C would result in less impact to vegetation in the project area.

4.16 Visual Resources

One Key issue was identified during scoping, which relates to visual resources:

- Would truck traffic cause an adverse effect on visual resources and tourism?

4.16.1 Direct and Indirect Effects

4.16.1.1 Alternative A

Alternative A would authorize activities on public lands managed by BLM and USFS at the La Sal Mines Complex that would result in surface disturbance. This could result in direct effects on visual resources if there is more than a moderate contrast in the Class III (the more protective of the two BLM classifications for the project area) landscape's form, line, texture, or color. Indirect effects could occur if the project activities impacted visual resources at another place or time, such as increased presence of vehicles that adversely affected scenic vistas or tourism.

With Alternative A, there would be additional surface disturbance of 6.49 acres at the Pandora Mine. New rock and disturbed soil areas would be created and a drainage channel would be realigned. In addition, under Alternative A there would be temporary construction of drilling sites and access trails for exploration drilling throughout the project area in three phases. Approximate surface disturbance would be 75 acres during Phase 1 (2011-2013), 74 acres during Phase 2 (2014 to 2018), and 63 acres during Phase 3 (2019 to 2030). Drilling sites and access roads would be reclaimed concurrently with new disturbance. Therefore, the total surface disturbance at any one time would likely be less than approximately 60 to 80 acres.

Additional surface disturbance under Alternative A would occur during installation of ventilation holes and construction of ancillary access roads with an additional approximately 10 acres of disturbed area on BLM lands and 14 acres of disturbed USFS lands during the three general phases of future development.

Surface disturbance activities under Alternative A are expected to meet the objectives of BLM's VRM Class III, in that no more than a moderate contrast in the landscape's form, line, texture, or color would occur. Therefore, direct effects on visual resources from these activities would be minor.

Destinations including National Parks, National Monuments, National Forest, and other recreation areas and scenic vistas in the vicinity of the project area support the tourism industry that is a vital part of the local economy. Increases in truck traffic from mine operations could impact visual resources, if trucks are numerous and visible along scenic corridors or main roads that provide access to tourist destinations. Under Alternative A, the transportation route that ore haul trucks would take from the mines to the White Mesa Mill would be east on SR 46 (about 8.75 miles), and then south (about 59.8 miles) along US Hwy. 191. This route is not a designated scenic corridor; however, it does provide access to tourist destinations.

The increase in haul-truck along SR 46 and US Hwy. 191 would not affect visual resources for tourists, because truck traffic on state and federal highways is a common and expected occurrence. Residents that live along the haul truck route would likely notice the increase in truck traffic. However, this would be a minor impact as trucks would adversely affect their views of the landscape only during the brief moment that the truck passes the residence. Therefore, direct and indirect effects on visual resources from increases in traffic along roads travelled for tourism and scenic viewing would be minor. Effects on transportation from increases in traffic in the project area are discussed further in Section 4.15, Transportation.

4.16.1.2 Alternative B

The No Action Alternative assumes that the La Sal Mines Complex would not be expanded and there would be no change from those conditions currently described as baseline. Current operations would continue until the ore deposit has been depleted, at which time mining operations would end. Surface areas would be reclaimed, and no new surface disturbances would occur. Mine site reclamation would have a positive effect on visual resources, because it would reduce landscape contrasts in form, line, texture, and color that had resulted from preoperational and operational activities. The lack of new surface disturbances in the long term would benefit visual resources, because the landscape would not be changed.

With the cessation of mining, the number of haul trucks would be reduced to zero. This would eliminate the minor impact on visual resources from the presence of haul trucks along major roads. Therefore, under Alternative B, there would be no direct or indirect effects on visual resources.

4.16.1.3 Alternative C

Under Alternative C, the primary effects on visual resources would be the same as those described for Alternative A. Proposed activities would meet the objectives of BLM's VRM Class III, in that no more than a moderate contrast in the landscape's form, line, texture, or color would occur from project activities. Since reclamation and revegetation activities under Alternative C are expected to be more effective and timely than under Alternative A, there would be some benefit to visual resources in the long term. The increase in haul truck traffic under Alternative C would be the same as for Alternative A.

4.16.2 Cumulative Effects

4.16.2.1 Alternative A

Land use changes associated with other current or reasonably foreseeable future actions, such as housing or commercial developments or new recreation facilities, would have the potential to contribute to cumulative effects on visual resources in the project area. While some growth is expected to occur in the future, there are no known large housing or commercial developments that would occur within the same timeframe as the Proposed Action.

Effects on visual resources from increased truck traffic along SR 46 near La Sal would be related to activities from adjacent mines such as the Energy Queen Uranium Mine,

located 3 miles southwest of La Sal. Haul trucks from this mine would access the Piñon Ridge Uranium Mill via eastbound Utah SR 46 to Colorado Hwy 90. The proposed activities at the Energy Queen Uranium Mine would result in an increase in haul truck traffic along SR 46; however, the small increase in truck traffic under Alternative A would not be expected to result in cumulative effects on visual resources since these areas are not designated scenic areas or highways. Based on the limited number of current or reasonably foreseeable future actions planned, cumulative effects on visual resources from Alternative A would be minor.

4.16.2.2 Alternative B

Since there would be no direct or indirect effects on visual resources from Alternative B, the No Action Alternative, there would be no cumulative effects.

4.16.2.3 Alternative C

As with Alternative A, there would be limited cumulative effects on visual resources from Alternative C. Only a small number of current or reasonable foreseeable future actions are planned, relating primarily to mining activities within the region. Cumulative effects on visual resources from surface disruption activities or increased truck traffic are not anticipated.

4.17 Wildlife

Key issues identified during scoping that are relevant to wildlife consist of:

- What are the effects to wildlife from uranium mining in La Sal area?
- What are the effects of ore transportation on wildlife mortality?
- Would bioaccumulation of radioactivity affect wildlife or livestock?
- Would fugitive dust or silica cause adverse effects to wildlife?
- Would release of radioactive and non-radioactive particulates from ventilation shafts cause adverse effects to wildlife?
- Would the noise of ventilation fans cause adverse effects to wildlife?
- Would the project affect migratory birds?
- Would the project result in habitat loss to general wildlife and winter range for deer and elk?

4.17.1 Direct and Indirect Impacts

4.17.1.1 Alternative A

Under Alternative A, three phases of mining activity would occur and the expansion of the development rock area (DRA) at the Pandora Mine as discussed in Section 2. All three phases of mining activity have the potential to cause the following impacts to wildlife.

Habitat Loss and Fragmentation due to Vegetation Removal

The removal of vegetation would decrease habitat quality and quantity for wildlife. Decreased vegetation causes decreased foraging potential for wildlife and their prey species. It also reduces cover items and ability to hide from predators, decreased nesting site potential, and decreased thermal cover. Overall, habitat is reduced as vegetation is removed. The DRA expansion at the Pandora Mine would impact 6.5 acres. There are approximately 485 acres of vegetation in the area identified for Phase 1. The exploration drilling and installation of vent holes would disturb approximately 75 acres, which is about 15.5% of the vegetated area. There are approximately 970 acres of vegetation in the area identified for Phase 2. The exploration drilling and installation of vent holes would disturb approximately 74 acres, which is about 7.6% of the vegetated area. There are approximately 738 acres of vegetation in the area identified for Phase 3. The exploration drilling and installation of vent holes would disturb approximately 63 acres, which is about 8.5% of the vegetated area.

Noise

Temporary habitat quality reduction would result from noise during active construction and drilling, including increased noise from ventilation fans, truck-mounted drilling rigs, bulldozers and other construction vehicles, transportation vehicles, and construction workers. Ventilation fans would remain a constant source of noise. Increased noise may have an impact on all wildlife within the project area. Wildlife may become habituated to noise over time. However, tolerance of noise is not equal to absence of impact. Disturbance from noise may result in behavioral or distributional changes; displacement of sensitive individuals; or declining foraging success and, therefore, poor body condition or nest abandonment (Romin and Muck 2002).

In a 1998 USDA-USFS study “Logging Truck Noise near Nesting Northern Goshawks” (September, 1998), noise levels from four logging trucks were measured as the trucks passed within approximately 500 meters of two active Northern Goshawk (Accipiter gentilis) nests. Neither a brooding female nor a lone juvenile exhibited any discernible behavioral response to the logging truck noise which peaked at 53.4 dBA and 50.3 dBA. The peak noise levels in the 1998 study are within the range of noise levels expected at 500 to 1200 feet from a ventilation fan.

However, effects on nesting goshawks have been observed at Pine Ridge, where goshawks have been absent from nests and breeding territories since instillation of ventilation fans (B. Smith, USFS Biologist, personal communication May 4, 2012). In addition, other studies indicate that noise impacts forest songbirds by lowering habitat quality. In their study of noise from compressor stations in the boreal forest, Bayne et al (2008) found that the density of all passerines was lower near compressor stations than natural gas well pads which produce no noise but have similar forest edge characteristics as compressor stations. The researchers concluded that chronic noise affects the birds’ ability to communicate and thus find mates, and measures should be taken to reduce compressor noise to mitigate for these effects.

Based on this information, under Alternative A, ventilation fan noise would have a local impact on birds, including migratory songbirds and potentially northern goshawks. Depending on the noise sensitivity of the particular bird species, birds would likely avoid nesting near the fans, moving into adjacent habitat with lower noise levels. *Dust*

Material stockpiles and mine vents have potential to release airborne dust particles naturally enriched with uranium which ultimately deposits on the ground and on plant surfaces. Dust accumulation on the surface of vegetation immediately adjacent to roads or drilling sites may cause not only reduced vigor or death of vegetation on which wildlife rely, but also bio uptake of the contaminants by animals which graze on vegetation near the mine site. Most aspects of the proposed action such as exploration drilling, vent shaft construction, and associated road construction are unlikely to markedly affect the concentration of uranium within the soil. Exhaust of mine air containing trace concentrations of radon or uranium are unlikely to lead to measurable enrichment of uranium or other radionuclides in soils (SENES 2011). Biota may be exposed to ionizing radiation from the environment from both external and internal exposure from radionuclides taken into the organism. For example, terrestrial organisms are exposed externally to radiation from the nearby soil and through uptake from the soil and through food chains[1].

Various international and national authorities have developed approaches to assessing radiation doses to non-human biota and the potential effects of such exposures (including for example, UNSCEAR 2008, IAEA 1992 and the USDOE 2002 amongst others). The procedure for evaluating risks to non-human biota involves estimating dose rates and comparing the estimated dose rates to reference dose rates below which no effects are expected on populations of non-human biota. The recent evaluation by UNSCEAR (2008) concluded that chronic dose rates of 100 µGy/h (approximately 10,000 µR/h) to the most highly exposed biota are unlikely to have an effect on populations of terrestrial biota. Such levels are several orders of magnitude higher than dose rates around the La Sal complex as discussed in Section 4.9. No radiological effects would be expected on plants and animals as the result of activities at the La Sal mine.

Increased Vehicular Traffic

Vehicles used for mining activities would travel on ancillary access roads within the project area. The project area encompasses the seasonal movement corridors and winter and summer ranges of elk, deer, and other wildlife species. Wildlife may be injured or killed by collisions with vehicles traveling on the road system. Impacts from collisions typically affect individuals, though populations could be adversely affected if the species is rare or collisions are frequent. Birds, reptiles, and small mammals are among the species most commonly hit by vehicles but larger mammals such as elk and deer are also encountered along regional roads away from the mine sites. All ore trucks would travel to Blanding, Utah to process the ore. As discussed in the Transportation section of the EA, regional road capacity and level of service would not increase measurable from the proposed mining project. Because the level of service on regional roads would not change and because truck traffic would follow posted speed limits, any impacts to general wildlife are anticipated to be minor.

[1] Chambers *et al.* 2008 provides a societal discussion of the approach to environmental risk assessment.

Impacts to Bat and Bird Species

In addition, ventilation shafts may be used by bat species, including the big free-tailed bat, fringed myotis, spotted bat, and Townsend's big-eared bat. Bats may become exposed to radiation while using ventilation shafts for roosts. The Denison Mine Bat Policy (Denison 2009b) would be utilized for this project and coordinated with BLM and USFS biologists. This policy is attached as Appendix K of the proposed Plan of Operations.

The special status bird species that may occur in the project area include bald eagle, ferruginous hawk, flammulated owl, golden eagle, Lewis' woodpecker, northern goshawk, and peregrine falcon. Construction activities that cause noise and removal of vegetation occurring during the breeding season may cause disturbance that may result in nest abandonment.

Impacts to Management Indicator Species

Management indicator species for the Manti-La Sal National Forest with the potential to occur in the project area include: golden eagle, northern goshawk, rocky mountain elk, mule deer, and Abert's squirrel. Direct impacts may include, but are not limited to: loss of foraging habitat from the project footprint, direct mortality of raptors (e.g., due to collisions with vehicles), and loss of nest sites or winter roost sites. Indirect impacts may include, but are not limited to: noise disturbance, degradation of habitat adjacent to the project area, habitat fragmentation, contamination of food sources, and reduction or changes in available prey species.

4.17.1.2 Alternative B

Under Alternative B, no additional mining activities would take place, and mining would continue as allowed by current permits. The La Sal Mines Complex would not be expanded. The impacts to wildlife under the current conditions and mining operations would not change. Therefore, no additional impacts to wildlife would occur.

4.17.1.3 Alternative C

Alternative C would be identical to Alternative A with the exception of specific modifications.

Conduct Pre-construction Wildlife and Vegetation Surveys

Alternative C would require pre-construction wildlife and vegetation surveys prior to exploration drilling or ventilation shaft construction. The specific location for exploration drill holes and ventilation shafts would be provided to BLM or USFS for approval prior to Phase 1, 2 or 3 activities. Alternative C would require that these areas be surveyed for the presence of sensitive wildlife or vegetation prior to construction, and that potential effects to these species be addressed as set forth in terms and conditions of approval for the POA, which are attached as Appendix B.

Under Alternative C, Raptor management would be guided by Best Management Practices for Raptors and Their Associated Habitats in Utah (BLM 2008b:Appendix M) and Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances (Romin and Muck 2002). If construction is scheduled between the dates of

January 1 and September 31, raptor surveys would be required prior to construction. Field surveys would be conducted as determined by the authorized officer of BLM or the USFS as applicable. Based on the result of the field survey, the authorized officer would determine if appropriate buffers and timing limitations are necessary. The BLM (2008b) recommendation for the northern goshawk is a 0.5 mile spatial buffer a seasonal buffer from March 1 to August 15. In addition, the Manti-La Sal Forest Plan (USFS 1986) requires a seasonal buffer for northern goshawk from March 1 to September 15. The BLM recommendation for the golden eagle is a 0.5 mile spatial buffer and a seasonal buffer from January 1 to September 30 (BLM 2008b; Romin and Muck 2002).

Impacts to migratory birds

In order to avoid impacts to potential nesting birds within the project area, vegetation removal should not occur during the breeding season (most migratory birds nest between May 15 to July 15) or nest surveys should be conducted within a five-day window of vegetation removal to aid in nest avoidance. Under this alternative all vegetation removal would occur in one scheduled time frame before exploration drilling, road construction, and ventilation shaft construction commences. This would ensure that the bird surveys could be done five days prior to vegetation removal, and no nest building would occur after the survey has been completed.

Modifications to Pandora DRA

Alternative C also includes modifications to the Pandora DRA, which would be expanded to the north and south for a total of 20.32 acres. This is approximately 5 acres larger than the area defined for the Pandora DRA in Alternative A. The area within the expanded boundary for the Pandora DRA would require pre-construction wildlife and vegetation surveys prior to construction activities in the same manner as the locations identified for Phase 1,2, and 3 for exploration drill holes and ventilation shafts.

Management of Noise

Alternative C would require installation of ventilation fans underground in all new ventilation shafts, unless installation underground is not feasible because of health and safety concerns. This would place the ventilation fans approximately 800 to 1,000 ft. below the surface to mitigate noise concerns with surface ventilation fans. In addition, where existing fans present a localized noise concern, Denison would utilize available engineered methods to reduce noise including: installation of sound barriers to direct noise away from receptors, installation of extended risers on fans to dissipate noise, and installation of baffles in cases where such modifications to existing fans are available.

As discussed in Section 4.8, noise levels from new underground fans would be more than 10 dBA lower at a given distance to nearby receptors as compared to surface ventilation fans. This reduction in average noise levels would be recognized by humans as a noise level that is about half as loud as the surface fans. Therefore, average noise levels affecting wildlife would be lower under Alternative C as compared to Alternative A.

4.17.2 Cumulative Effects

4.17.2.1 Alternative A

Various management activities, extractive industries, and recreation take place on the lands in and surrounding the project area.

Mining, Oil, and Gas

There are several permitted mines and exploration areas in the general vicinity of the La Sal Mines Complex that may become active in the reasonable foreseeable future. Additional road building, maintenance, and construction activities would cause increased disturbance to wildlife. Increased vegetation loss and habitat fragmentation would further decrease habitat for wildlife.

Recreation

Improved access into the study area associated with new mine roads could result in an increase in human activity prompting additional disturbances of animal behavior. Though not designed for recreational purposes, the new roads would have the potential to facilitate recreational activities and could lead to displacement of wildlife or decreased use of wildlife corridors related to increased human disturbances. Foot and off-road vehicle traffic through sensitive areas could disturb wildlife and/or prevent successful feeding or breeding activities.

Grazing

Grazing occurs on BLM, USFS, state, and private land within and surrounding the project area. The Manti-La Sal National Forest Land and Resource Management Plan (USDA Forest Service 1986, as amended) states the forest has permits for 20,730 cattle and 84,913 head of sheep, and there are 1,212,846 acres of range suitable for grazing and browsing. The BLM Moab Field Office Approved Resource Management Plan (2008a) states there are 106,479 animal unit months (AUMs) allotted to livestock and 1,690,481 acres of range available for grazing, which is in accordance with the Standards for Rangeland Health and Guidelines for Grazing Management. Grazing pressure can reduce habitat value for wildlife species.

When combined with the impacts of these other activities, Alternative A could contribute to additional wildlife habitat impacts, a decrease in habitat productivity, an increase in collisions, disturbance-related displacement, poaching of wildlife, and/or fragmentation of wildlife movement corridors.

4.17.2.2 Alternative B

Under Alternative B, the cumulative effects to wildlife under the current conditions and mining operations would not change. Therefore, no additional cumulative effects to wildlife would occur.

4.17.2.3 Alternative C

The modifications defined by Alternative C would reduce the effect to wildlife. Pre-construction surveys for wildlife would provide for avoidance of breeding migratory birds and raptors. Seasonal restrictions of construction activities and spatial buffers for

nesting raptors, as determined by the USFS and BLM Moab Field Office, would prevent nest abandonment due to noise or other disturbance caused by construction activies. Underground ventilation fans would reduce the overall ambient noise from mining operations, which would otherwise disturb wildlife. The additional 5-acre expansion of the Pandora DRA would not greatly reduce available habitat for wildlife because it is in an area that has already been developed for mining operations. Alternative C would reduce the overall impact to wildlife.

4.18 Worker Health and Safety

Key issues that relate to worker health and safety are:

- Will mining at the La Sal Mines Complex increase cancer risk for workers?
- Will the proposed POA cause workers at the La Sal Mines Complex to work in an environment that will have adverse health effects?
- Will workers at the La Sal Mines Complex spread radioactive contamination into the La Sal community?

4.18.1 Direct and Indirect Effects

4.18.1.1 Alternatives A and C

Work conducted at the La Sal Mines Complex would be subject to state and federal worker health and safety requirements. Implementation of Alternatives A and C would provide for additional vent holes spaced appropriately to continue to provide adequate ventilation in the mine workings to allow for safe working conditions and compliance with federal and state regulations. Therefore, workers at the La Sal Mines Complex are not expected to be exposed to an unsafe working environment and should not experience direct health effects, as long as proper health and safety protocol is followed. The following sections further address issues associated with worker health and safety.

<u>Will mining at the La Sal Mines Complex increase cancer risk for workers?</u>

The La Sal Mine complex would be operated in compliance with the requirements established by the Mine Safety and Health Administration ("MSHA"), which establishes standards and inspects operational practices to ensure mine worker safety. There are no operational practices proposed in the Plan of Operations Amendment that would impact the compliance of the La Sal Mine Complex with applicable MSHA requirements.

MSHA has determined (30 CFR 57.5037 through 57.5047) that, for underground mine workers, the primary potential health risks result from inhalation of radon gas and gamma radiation exposure from uranium decay. In order to comply with these regulations, Denison is required to ensure that La Sal Mine workers do not incur exposures, measured in working levels months (WLM), that exceed prescribed doses for radon. Denison must maintain an annual cumulative radon exposure to within 4 WLM (30 CFR 57.5038). The prescribed exposure limits have been established to be protective for health effects, including cancer. MSHA requires that Denison measure and record radon levels underground, calculate doses to workers, and modify working conditions as required to meet the prescribed exposure limits.

In mines like the La Sal Mine Complex, which recover relatively low-grade uranium ores, gamma radiation is far less of a concern than in mines which recover higher grade ores. MSHA has established that annual individual exposure shall not exceed 5 rems for underground mine worker exposure to gamma radiation. As prescribed in 30 CFR 57.5047, annual gamma surveys are required to be conducted to determine the gamma radiation dose in all areas of the underground and surface workings where radioactive ores are present.

MSHA establishes maximum acceptable levels for diesel particulates and silica dust in underground mines. Similar to radon, the prescribed maximum levels of particulates were determined to be protective for health effects (such as black lung and silicosis) and cancer. MSHA considers that the maximum allowable levels and the controls for diesel particulates and silica are sufficient to also be protective from potential effects of radioactive particulates.

Will the proposed POA cause workers at the La Sal Mines complex to work in a health and safety environment that will have significant health effects?

The La Sal Mine Complex would be operated in compliance with the requirements established by MSHA, which establishes standards and inspections of operational practices to ensure mine worker safety. The proposed POA would not impact the La Sal Mine Complex's ability to comply with applicable MSHA requirements.

MSHA inspects the La Sal mines at a minimum of once per quarter; however, occasionally MSHA will perform random inspections to ensure the Health and Safety of the Miners. The La Sal Mine Complex is currently in compliance with applicable MSHA requirements.

Will workers at the La Sal Mines Complex spread radioactive contamination into the La Sal community?

The primary mechanism for workers to spread radioactive contamination into the community would be by bearing uranium ore dust on their persons from mining activities and then leaving the mine site. Workers at the La Sal Mine Complex are provided with work clothes, either coveralls or over-shirts and pants, to be worn over their personal clothing during their work shift, and work boots to be worn in place of personal shoes during their work shift. They are also provided with other safety equipment such as hardhats, safety glasses, and gloves. Workers are assigned a locker in the mine's change house/locker room to store over-clothing, work boots, and other safety equipment after their work shift.

Workers are provided with showers in the locker rooms to remove any ore and dust particles before dressing in their personal clothes to leave the mine site after each shift.

Tools and equipment which have been used in the workings remain in the workings or are brought to the surface for repair and/or storage in the mine's maintenance or storage shops. Tools and equipment which have been used in the workings are not permitted to leave the site.

As a result of these measures, and the low grades of the uranium ores mined at the La Sal Mine Complex, the risk from any incidental radioactive contamination is considered to be negligible.

4.18.1.2 Alternative B

Alternative B would not lead to direct or indirect effects to worker health and safety, because it would not approve the POA.

4.18.2 Cumulative Effects

4.18.2.1 Alternative A

Cumulative effects from the Alternative A would be negligible since worker health and safety programs are currently in place to prevent any compounding of health and safety issues.

4.18.2.2 Alternative B

Alternative B would not lead to direct or indirect effects to worker health or safety, therefore, it would also not lead to cumulative effects.

4.18.2.3 Alternative C

Cumulative effects of Alternative C would be the same as Alternative A.

5.0 CONSULTATION AND COORDINATION

5.1 Introduction

The issue identification section of Chapter 1 identifies those issues analyzed in detail in Chapter 4. The ID Team Checklist provides the rationale for issues that were considered but not analyzed further. The issues were identified through the public and agency involvement process described in sections 5.2 and 5.3 below.

5.2 Persons, Groups, and Agencies Consulted:

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Lori Hunsaker	State Historic Preservation Office	Based on the findings of the survey, no cultural properties eligible for the National Register for Historic Places or other significant cultural sites occur in the proposed disturbances Because this undertaking does not exceed any of the review thresholds listed in Part VII (A) of the State Protocol Agreement between the Utah State Director of the Bureau of Land Management and the Utah State Historic Preservation Officer an informational letter was sent on March 19, 200 per the review thresholds listed in Part VII (C) of the Protocol.
Ernest House, Sr.	Chairman Ute Mountain Ute Tribe	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Leigh Kuwanwisisma	Director, Hopi Tribe	Consultation letter mailed on March 10, 2011. The Hopi Tribe responded with a letter dated March 28, 2012. The letter stated their opposition to uranium mining and support for the "No Action Alternative".
Terry Mogart	Hopi Tribe	Consultation letter mailed on March 10, 2011. No response was received.
Joe Shirley	President, Navajo Nation	Consultation letter mailed on March 10, 2011 The BLM did not receive a response.
Kelly Francis	Cultural Specialist, Navajo Nation	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Jeanie Borchardt	Chairwoman, Paiute Tribe	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Dorena Martineau	Cultural Resource Director, Paiute	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Matthew Box	Chairman, Southern Ute Tribe	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Neil Cloud	NAGPRA Coordinator, Southern Ute Tribe	Consultation letter mailed on March 10, 2011. The Tribe asked the BLM to meet with the tribal council to explain the project. BLM representatives met with the Tribal Council for the Southern Ute and Mr. Cloud on April 8, 2011. The Southern Ute Tribe did not express any concerns, but did ask to receive a copy of the EA when it became available.
Curtis Cheespooch	Chairman, Ute Indian Tribe	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Betsy Chapoose	Director, Ute Indian Tribe	Consultation letter mailed on March 10, 2011 The BLM did not receive a response.
Kurt Dongoske	Director, Zuni Pueblo	Consultation letter mailed on March 10, 2011. No response was received.
Norman Cooeyate	Governor, Zuni Pueblo	Consultation letter mailed on March 10, 2011. No response was received.
Terry Knight	Tribal Historic Preservation Officer, Ute Mountain Ute Tribe	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.
Leona Eyetoo	Council Member, White Mesa Ute	Consultation letter mailed on March 10, 2011. The BLM did not receive a response.

5.3 Summary of Public Participation

Public involvement is critical to the National Environmental Policy Act (NEPA) process. This section describes how public involvement was solicited, and how public comments were used during preparation of the EA.

The public involvement process included the following:

- Public Scoping
    - Listing of the proposed action on BLM and FS internet sites
    - Publication of legal notice that the Plan of Operations was available for public review
    - Solicitation of public involvement through an information mailer, which was mailed to any individuals or organizations who requested it, to those who have participated in project planning, to other government agencies, and to affected tribes
    - Completion of an open house meeting in La Sal, Utah
    - Completion of an open house meeting in Moab, Utah
    - Compilation of comments and identification of key issues for analysis in the EA
- Publication of USFS Notice of Proposed Action

- Solicitation of public comment on the EA
    - Mailing of EA to parties who participated in public scoping
    - Analysis of comments

Additional information regarding these activities is provided in the following sections.

5.3.1 Public Scoping

5.3.1.1 Listing of Proposed Action on Internet Sites

The initial step in the public participation process was to list the proposed action on internet sites managed by BLM and FS for the purpose of informing the public about planned and on-going NEPA projects. The BLM listed the project on their Environmental Notification Bulletin Board (ENBB) on December 20, 2010, and the Forest Service listed the project on their forest web site February 17, 2011. The BLM maintained a digital copy of the POA on the Moab Field Office webpage and listed the EA scoping information on the on their web page and on the BLM ENBB. The USFS maintained digital copies of the POA on the Manti-La Sal National Forest webpage and listed the EA scoping information on the USFS SOPA.

5.3.1.2 Public Notice

BLM regulations for locatable mining activities at 43 Code of Federal Regulations (CFR) 3809 require that public notice be published in a newspaper of local distribution. This public notice advertised the availability of the Plan of Operations Amendment for public review at the BLM Moab Field Office and Grand County Public Library in Moab, Utah; the Monticello Ranger District Office, BLM Monticello Field Office, and San Juan County Public Library in Monticello, UT; and the La Sal Store, La Sal, Utah. Copies of the Plan of Operations were placed at these locations prior to publication of the public notice. The public notice was published in the San Juan Record on December 22, 2010, the Moab Times Independent on December 23, 2010, and the Price Sun Advocate on December 21, 2010.

5.3.1.3 Solicitation of Public Involvement

Public involvement was solicited through an information mailer, which requested public involvement and provided a general description of the proposed action, the purpose and need for the action, and the planned NEPA process. The information mailer was mailed to any individual or organization who requested it, those who participated in previous project planning, persons living in close proximity to the La Sal Mines Complex, and other government agencies. Existing NEPA mailing lists were compiled from the local BLM and FS offices, and the combined mailing list was supplemented with persons living in close proximity to the La Sal Mines Complex. This compiled mailing list contained 418 people and/or organizations. The information mailer also advertised a public meeting, which was held in La Sal, Utah, on January 13, 2011.The information mailer was sent out during the business week starting Monday, December 20, 2010.

5.3.1.4 Open House Meeting in La Sal, Utah

An open house meeting was held in La Sal, Utah to provide further opportunity for public comment. The meeting occurred on Thursday, January 13, 2011. BLM and FS staff with project

expertise, BLM's NEPA contractor, and the proponent was present at the meeting to answer questions about the proposed action and the NEPA process. A series of wall-size maps and other information regarding the project were available for public review. Comments received during the public meeting were recorded and incorporated into the project record. The open house meeting was advertised in the San Juan Record (December 29, 2010), the Moab Times Independent (December 30, 2010), and the Price Sun Advocate (December 28, 2010). The meeting was also advertised in the information mailer described previously.

5.3.1.5 Open House Meeting in Moab, Utah

At the request of representatives from Living Waters and Uranium Watch, a second open house meeting was held at the BLM Field Office in Moab, Utah on January 20, 2011. No comments were received during the public meeting.

5.3.2 Forest Service Notice of Proposed Action

A separate information mailer was sent out by the USFS as part of their NOPA to 53 interested parties on February 17, 2011. In addition, a legal notice of proposed action was published in the Sun Advocate newspaper on February 22, 2011. The public comment period for the NOPA closed on March 23, 2011, 30 days after publication of the NOPA in the Sun Advocate newspaper. The USFS response to comments is provided in Appendix E.

5.3.3 Public Comment

This section will be completed after the public comment period ends.

5.4 List of Preparers

Table 5-1 lists the preparers of this EA report and their contributions to this EA.

5.4.1 BLM Preparers

BLM preparers are listed in Table 5.1.

Table 5-1. BLM Preparers

Name	Title	Responsible for the Following Section(s) of this Document
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Katie Stevens	Recreation Planner	Areas of critical environmental concern, recreation, wild and scenic rivers, visual resources
Bill Stevens	Recreation Planner	BLM natural areas, socioeconomics, wilderness
Don Montoya	Archaeologist	Cultural resources, Native

Name	Title	Responsible for the Following Section(s) of this Document
		American religious concerns
Ben Kniola	Natural Resource Specialist	Environmental justice, wastes
Pamela Riddle	Rangeland Management Specialist	Threatened, endangered or candidate animal species, migratory birds, sensitive species, fish and wildlife
Kim Allison	Rangeland Management Specialist	Threatened, endangered or candidate plant species, livestock grazing, rangeland health
Jordan Davis	Rangeland Management Specialist	Invasive species/noxious weeds, woodland/forestry
Dave Williams	Rangeland Management Specialist	Vegetation excluding USFW designated species
Brian Keating	Fuels Program Manager	Fuels, fire management
Rebecca Doolittle	Geologist	Geology, mineral resources, energy production, paleontology
Jan Denney	Lands and Realty Specialist	Lands, access

5.4.2 Forest Service Preparers

USFS preparers are listed in Table 5.2.

Table 5-2. USFS Preparers

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Jan Curtis-Tollestrup	Hydrologist	Hydrology
Don Wilcox	Civil Engineer	Roads
Greg Montgomery	Forester	Timber
Tina Martin	Rangeland Management Specialist	Range
Brian Murdock	Recreation Program Manager	Recreation, visuals
Tom Lloyd	Minerals/Engineering/Lands Staff	General Review
Michael Davis	NEPA Coordinator	NEPA

5.4.3 Non-BLM and non-USFS Preparers

Consulting specialists who participated in preparation of this document are listed in Table 5.3.

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Douglass Chambers, Ph.D.	Radiological Specialist	Radiological Issues
Kathryn Dumm	Cultural Resource Specialist	Cultural Resources
Moosub Eom, Ph.D., P.E.	Civil Engineer	Stormwater Management
Eric Farstad	Air Quality Specialist	Air Quality
Michael Fischer	Geological Engineering Technician	Hazardous Waste, EA Administrative Record Management
Arnon Howe	Radiological Specialist	Radiological Issues
Jennifer Jones	Environmental Scientist	Reclamation, Socioeconomics, Visual Resources
Amanda Kuenzi	Wildlife Biologist	BA/E, Wildlife, and Vegetation
Leo Love, Ph.D.	Radiological Specialist	Radiological Issues
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Mark Nelson, P.G.	Project Geologist	Groundwater, Rock Characterization, Surface Water, Writer/Editor
Zivorad Radonjic	Meteorologist	Radiological Issues
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Mark Turner	Wildlife Biologist	BA/E, Wildlife, and Vegetation
Alex Wesson	Cultural Resource Specialist	Cultural Resources
Derek Wintle, P.E.	Civil/Environmental Engineer	Slope Stability, Soils, Stormwater Management, Transportation, Worker Health and Safety

6.0 REFERENCES, GLOSSARY

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6.2 List of Acronyms Used in this EA

AADT	average annual daily traffic
amsl	above mean sea level
AO	Approval Order

APE	area of potential effects
ATV	all-terrain vehicle
BAE	biological assessment and evaluation
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
CDM	Camp, Dresser & McKee Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cy	cubic yards
dB	decibels
dBA	A-weighted sound levels in decibels
Denison	Denison Mines (USA) Corp.
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DR	Decision Record
DRA	Development Rock Area
DRC	Division of Radiation Control
EA	environmental assessment
EIS	environmental impact statement
FES	final environmental statement
FHWA	Federal Highway Administration
FLPMA	Federal Land Policy and Management Act
FONSI	finding of no significant impact
ft	feet
ft^2	square feet
GHG	greenhouse gas
H	horizontal
HUD	U.S. Department of Housing and Urban Development
Hwy	highway
IDT	interdisciplinary team
Leq	equivalent noise level
Ldn	day-night average noise level
lbs	pounds
m	meter
MBTA	Migratory Bird Treatment Act
MFO	Moab Field Office
MIS	management indicator species
mrem/hr	millirem per hour
mrem/yr	millirem per year
MSHA	U.S. Mine Safety and Health Administration
mSv	millisieverts
MWMP	Meteoric Water Mobility Procedure
NAAQA	National Ambient Air Quality Standards
NAC	noise abatement criteria
NRC	U.S. Nuclear Regulatory Commission

NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NGO	non-governmental organization
NOI	Notice of Intent
NOPA	notice of proposed action
NP	National Park
NPS	National Park Service
NRHP	National Register of Historic Places
PM2.5	particulate matters less than 2.5 microns in diameter
PM10	particulate matters less than 10 microns in diameter
POA	plan of operations amendment
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
R	range
RCRA	Resource Conservation and Recovery Act
RMC	risk management criteria
RMP	resource management plan
ROD	record of decision
RSL	regional screening level
SITLA	Utah State Institutional Trust Lands Administration
SPCC	spill prevention, control, and countermeasure plan
SR	State Route
SWCA	SWCA Environmental Consultants
SWPPP	stormwater pollution prevention plan
T	Township
TI	transport index
UAC	Utah Administrative Code
UCDC	Utah Conservation Data Center
UDAQ	Utah Department of Air Quality
UDEQ	Utah Department of Environmental Quality
UDOGM	Utah Division of Oil, Gas, and Minerals
UDOT	Utah Department of Transportation
UDSH	Utah Division of State History
UDWR	Utah Division of Water Rights
UPIF	Utah Partners in Flight
U.S.C.	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
EPA	U.S. Environmental Protection Agency
$\mu g/m^3$	micrograms per cubic meter
µGy/h	Microgray per hour
µR/h	Microrad per hour
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Services

USGS	U.S. Geological Survey
V	vertical
VQO	visual quality objective
VRI	Visual Resource Inventory
VRM	Visual Resource Management