4 ENVIRONMENTAL IMPACTS

DOE is evaluating potential impacts from the five alternatives discussed in Chapter 2 for the management of the ULP. The affected environments in the ROI for each of the 13 resource areas are discussed in Chapter 3. Other site-specific information and assumptions or bases for the impact evaluation for each of the five alternatives are discussed in Chapter 2 (Sections 2.2.1.1, 2.2.2.1, 2.2.3.1, 2.2.4.1, and 2.2.5.1), with additional details presented in Appendix C. The methodology used to evaluate the potential impacts is summarized in Appendix D for each of the resource areas evaluated. Additional discussion on the determination of the ROIs can also be found in Appendix D. To minimize redundancy in the text presented, information that applies to all five alternatives is presented in the text for the first alternative where it is applicable and not repeated in subsequent sections for the remaining alternatives.

4.1 ALTERNATIVE 1

Under Alternative 1, existing disturbed areas at 10 lease tracts (5, 6, 7, 8, 9, 11, 13, 15, 18, and 26) totaling about 257 acres (100 ha) would be reclaimed. It is assumed that the reclamation would be completed within 1 year of field work, followed by an observation period of about 2 years to gauge revegetation performance and obtain state approval.

> Alternative 1: DOE would terminate all leases, and all operations would be reclaimed by lessees. DOE would continue to manage the withdrawn lands, without uranium leasing, in accordance with applicable requirements.

Reclamation activities would involve (1) removing most, if not all, of the surface-plant area improvements (e.g., equipment, buildings, utilities); (2) removing from the site all wastes, contaminated media, and contaminated structures that were not inherent to the site geology and managing them as waste under state or Federal regulations; (3) placing in the mine any residual ores and other radioactive materials inherent to the site; (4) closing open shafts, adits, and inclines; (5) implementing erosion-control measures; (6) grading the waste-rock pile to be consistent with surrounding slopes; (7) replacing surface soils; and (8) revegetating.

4.1.1 Air Quality

Under Alternative 1, during reclamation, primary emission sources would include engine exhaust from heavy equipment and trucks, fugitive dust from earth-moving activities, and exposed ground or stockpiles being eroded by the wind. Engine exhaust emissions from heavy equipment and trucks would include criteria pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2); VOCs; and greenhouse gases (GHGs) (e.g., the primary GHG, carbon dioxide [CO_2]). Soil disturbances and wind erosion would generate mostly PM emissions. Typically, the amount of fugitive dust emissions is larger than the amount of engine exhaust emissions during the reclamation phase.

Emissions during the reclamation year were estimated as shown in Table 4.1-1 (see Appendix C for details). PM_{10} emission estimates of about 142 tons/yr are highest, accounting for about 0.92% of emission totals for the three counties (Mesa, Montrose, and San Miguel) encompassing the DOE ULP lease tracts. Most of these PM_{10} emissions, which account for about 2.4% of total emissions in Montrose County, would come from a very large open-pit mine (JD-7). A potential for 24-hour PM_{10} NAAQS exceedances at the lease tract boundary is anticipated when heavy activities would occur near the boundary. Among non-PM emissions, NO_x emissions from diesel combustion of heavy equipment and trucks are highest, up to 0.09% of three-county total emissions. Measures (i.e., compliance measures, mitigation measures, and BMPs) provided in Table 4.6-1 (Section 4.6), would be implemented to ensure compliance with environmental requirements. Thus, it is anticipated that potential impacts on ambient air quality associated with reclamation activities under Alternative 1 would be minor and temporary in nature. These low-level emissions are not anticipated to cause measureable impacts on regional ozone (O_3) or AQRVs, such as visibility or acid deposition, at nearby Class I areas, as discussed in detail in Section 4.3.1. In addition, CO_2 emissions during reclamation are estimated to be about 0.001% of Colorado GHG emissions in 2010 at 140 million tons (130 million metric tons) of CO_2 equivalent (CO_2e) and 0.00002% of U.S. GHG emissions in 2009 at 7,300 million tons (6,600 million metric tons of CO_2e) (EPA 2011a; Strait et al. 2007). Thus, under Alternative 1, potential impacts from reclamation activities on climate change would be negligible.

Reclamation activities will include grading, contouring, topsoil replacement, and seeding and mulching, in such a manner that the approximate original topographic contours are reestablished. The reclaimed areas will be monitored on a regular basis to ensure the integrity is maintained. Accordingly, long-term effects on ambient air quality after the reclamation are anticipated to be negligible.

4.1.2 Acoustic Environment

Reclamation activities would be similar to conventional construction activities in terms of procedures and equipment; however, activities would generally proceed in reverse order and would also proceed more quickly; thus, the associated impacts would last for a shorter time and on a more limited scale. Potential noise impacts on nearby residences or communities would be correspondingly less than those from operational activities. During reclamation, heavy construction equipment that would be used would include a backhoe, bulldozers, a grader, loaders, a track hoe, trucks, and a scraper.

Heavy equipment used during reclamation is similar to that used during mine development and operations, so it is conservatively assumed that noise levels during reclamation would be the same as they were during the mine development and operations phase. A composite noise level of 95 dBA at a distance of 50 ft (15 m) is assumed, as discussed in detail in Section 4.3.2. When only geometric spreading and ground effects among several sound attenuation mechanisms are considered (Hanson et al. 2006), noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the reclamation site, which is the Colorado

TABLE 4.1-1 Peak-Year Air Emissions from Reclamation under Alternative 1[a]

	Annual Emissions (tons/yr)		
Pollutant[b]	Three-County Total[c]	Reclamation	
CO	65,769	5.8	(0.01%)[d]
NO_x	13,806	12.1	(0.09%)
VOCs	74,113	1.2	(0.002%)
$PM_{2.5}$	5,524	29.1	(0.53%)
PM_{10}	15,377	142.1	(0.92%)
SO_2	4,246	1.6	(0.04%)
CO_2	142.5×10^6 [e]	1,100	(0.001%)
	$7{,}311.8 \times 10^6$ [f]		(0.00002%)

[a] Under Alternative 1, it is assumed that 10 lease tracts (5–9,11,13,15,18, and 26) with a total area of 257 acres (100 ha) would be reclaimed within a year.

[b] Notation: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of ≤2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter of ≤10 µm; SO_2 = sulfur dioxide; and VOCs = volatile organic compounds.

[c] Total emissions in 2008 for all three counties encompassing the DOE ULP lease tracts (Mesa, Montrose, and San Miguel Counties), except for CO_2 (see footnotes e and f). See Table 3.1-2.

[d] Numbers in parentheses are percentages of three-county total emissions except for CO_2, which are percentages of total Colorado emissions (top line) and total U.S. emissions (bottom line).

[e] Annual emissions in 2010 for Colorado on a CO_2-equivalent basis.

[f] Annual emissions in 2009 for the United States on a CO_2-equivalent basis.

Source: CDPHE (2011a); EPA (2011a); Strait et al. (2007)

daytime maximum permissible limit of 55 dBA in a residential zone.[1] If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the site. In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours would reduce noise levels further. Most residences are located beyond these distances; however, if reclamation activities occurred near the boundary of Lease Tract 13, noise levels at nearby residences could exceed the Colorado limit.

It is assumed that most reclamation activities would occur during the day, when noise is better tolerated, because the masking effects from background noise are better at that time than at night. In addition, reclamation activities at the lease tracts would be temporary in nature (typically a few weeks to months depending on the size of the area to be reclaimed). Accordingly, reclamation within the lease tracts would cause some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities. The same measures (i.e., compliance measures, mitigation measures, and BMPs) adopted during the mine development and operations phase, identified in Table 4.6-1 (Section 4.6), could also be implemented during reclamation under Alternative 1.

4.1.3 Geology and Soil Resources

Section 4.1.3.1 provides an overview of various potential impacts on soil resources due to ground disturbance from mining activities at the DOE ULP lease tracts. Section 4.1.3.2 discusses the potential impacts on soil resources under Alternative 1. Section 4.1.3.1.7 provides an overview of various potential impacts on paleontological resources due to ground disturbance from mining activities at the ULP lease tracts. Section 4.1.3.3 discusses the potential impacts on paleontological resources under Alternative 1.

4.1.3.1 Potential Soil Impacts Common to All Alternatives

Table 4.1-2 provides a summary of the types of potential soil impacts common to all alternatives (in varying degrees) and the mining activities that could cause them. These impacts include soil compaction, soil horizon mixing, loss of soil organic matter, soil erosion and deposition by wind, soil erosion by water and surface runoff, and sedimentation, as described below. The implementation of mitigation measures and BMPs to preserve the health and functioning of soils within the lease tracts would reduce the likelihood of soil impacts becoming impacting factors on other resources, such as vegetation, air, water, and wildlife, and it would also contribute to the success of future reclamation efforts. Such measures (i.e., compliance and mitigation measures) and BMPs are detailed in Table 4.6-1 (Section 4.6).

[1] DOE ULP activities might be subject to the much higher levels that pertain to light industrial or industrial zones, as in Colorado Revised Statutes, Title 25, “Health,” Article 12, “Noise Abatement,” Section 103, “Maximum Permissible Noise Levels.”

TABLE 4.1-2 Potential Impacts from Mining Activities on Soil Resources

Soil Impact	Impacting Mining Activities	Resources Potentially Affected by Soil Impact
Soil compaction	▪ Clearing vegetation ▪ Grading soil surface ▪ Excavating and backfilling ▪ Constructing infrastructure (roads and pads, buildings, storage areas, and utilities) ▪ Stockpiling of soil, waste rock and ore ▪ Operating heavy trucks and equipment on unpaved roads and surfaces ▪ Increased foot traffic	▪ Vegetation (diminished productivity) ▪ Water resources (changes in natural flow systems due to increased surface runoff; degradation of surface water quality) ▪ Microbial community (sterilization)
Soil horizon mixing	▪ Clearing vegetation ▪ Grading soil surface ▪ Excavating and backfilling ▪ Stockpiling waste rock and ore	▪ Vegetation (diminished productivity; growth of invasive species) ▪ Cultural (disturbance of and/or damage to buried artifacts)
Soil contamination	▪ Releasing fluids related to truck and mechanical equipment use ▪ Applying chemical stabilizers for dust suppression	▪ Vegetation (diminished productivity) ▪ Wildlife (mortality, injury) ▪ Water resources (degradation of surface water quality)
Soil erosion and deposition by wind	▪ Clearing vegetation ▪ Excavating and backfilling ▪ Stockpiling excavated topsoils ▪ Operating heavy trucks and equipment on unpaved roads and surfaces	▪ Vegetation (diminished productivity) ▪ Wildlife (habitat degradation) ▪ Air quality (fugitive dust) ▪ Water resources (degradation of surface water quality) ▪ Cultural (exposure of artifacts from soil erosion)
Soil erosion by water and surface runoff	▪ Clearing vegetation ▪ Excavating and backfilling ▪ Stockpiling excavated topsoils ▪ Constructing road beds ▪ Crossing drainages or wetlands ▪ Operating heavy trucks and equipment on unpaved roads and surfaces	▪ Vegetation (diminished productivity) ▪ Wildlife (habitat degradation) ▪ Water resources (changes in natural flow systems and surface water quality) ▪ Cultural (exposure of artifacts from soil erosion)
Sedimentation (indirect impact)	▪ Clearing vegetation ▪ Excavating and backfilling ▪ Stockpiling excavated topsoils ▪ Constructing road beds ▪ Crossing drainages or wetlands ▪ Operating heavy trucks and equipment traffic on unpaved roads and surfaces	▪ Vegetation (diminished productivity) ▪ Wildlife (habitat degradation) ▪ Water resources (changes in natural flow systems and surface water quality) ▪ Commercial and recreational fisheries (degradation)

4.1.3.1.1 Soil Compaction. Soil compaction is a form of soil damage that occurs when soil particles are compressed, increasing their density by reducing the pore spaces between them (USDA 2004). It is both (1) an intentional engineering practice that uses mechanical methods to increase the load-bearing capacity of soils underlying roads and site structures, and (2) an unintentional consequence of activities occurring in all phases of mining. Unintentional soil compaction is usually caused by vehicular (wheel) traffic on unpaved surfaces, but can also result from animal and human foot traffic. Soils are more susceptible to compaction when they are moist or wet. Other soil factors, such as low organic content and poor aggregate stability, also increase the likelihood that compaction will occur. Soil compaction can directly affect vegetation by inhibiting plant growth, because reduced pore spaces restrict the movement of nutrients and plant roots through the soil. Reduced pore spaces can also alter the natural flow of hydrological systems by causing excessive surface runoff, which, in turn, might increase soil erosion and degrade the quality of nearby surface water. Because soil compaction is difficult to correct once it occurs (USDA 2004), the best mitigation is prevention to the extent possible.

4.1.3.1.2 Soil Horizon Mixing. Soil horizon mixing is another form of soil damage that occurs as a result of activities like excavation and backfilling that displace topsoil and disturb the existing soil profile. When topsoil is removed, stabilizing matrices, such as biological crusts, are destroyed, increasing the susceptibility of soils to erosion by both wind and water. Burying topsoil is also damaging. Such disturbances directly affect vegetation by disrupting indigenous plant communities and creating an opportunity for the growth of invasive plant species and noxious weeds. Mixing ore and waste rock into the topsoil can also adversely affect indigenous plant communities by changing the soil composition.

4.1.3.1.3 Soil Contamination. Soil contamination within the lease tracts could result from the use of trucks and mechanical equipment (fuels, oils, and the like) during all phases of mining. Fuel tanks and generators stored on site could result in accidental spills, leaks, and fires; however, secondary containment practices would reduce the potential for releases to soil. Maintenance-related activities could also contaminate soils in mining areas. These activities include the applications of herbicides (for weed control) and chemical stabilizers such as magnesium chloride (for dust control) to the soil surface. Releases to soil would likely be localized, but they could be problematic to other resources, including vegetation (through uptake), wildlife (through inhalation and ingestion), and water quality (to surface water, through deposition, and to groundwater, through leaching and infiltration).

4.1.3.1.4 Soil Erosion and Deposition by Wind. Exposed soils are susceptible to wind erosion. Wind erosion is a natural process in which the shear force of wind is the dominant eroding agent, resulting in significant soil loss across much of the exposed area. Mining-related activities such as vegetation clearing, excavating, stockpiling soils, and truck and equipment traffic (especially on unpaved roads and surfaces) can significantly increase the susceptibility of soils to wind erosion. In its soil surveys, the NRCS rates the susceptibility of soils to wind erosion by assigning them to wind erodibility groups based on soil texture, organic matter content, effervescence of carbonates, rock fragment content, and mineralogy (NRCS 2010). The rating also takes into account factors such as soil moisture, surface cover, soil surface roughness, wind direction and speed, and length of uncovered distance (USDA 2004). Because wind dispersion and the deposition of eroded soils can be geographically widespread, this process is an important impacting factor for air quality, water quality, vegetation, and all wildlife. State and local governments might also have specific air permitting requirements for the control of fugitive dust and windborne particulates. Wind erosion and wind erodibility group designations for soils in the lease tracts are identified in Section 3.3.2.

4.1.3.1.5 Soil Erosion by Water and Surface Runoff. Exposed soils are also susceptible to erosion by water. Water erosion is a natural process in which water (in the form of raindrops, ephemeral washes, sheets, and rills) is the dominant eroding agent. The degree of erosion by water is generally determined by the amount and intensity of rainfall, but it is also affected by the cohesiveness of the soil (which increases with organic content), its capacity for infiltration, vegetation cover, and slope gradient and length (USDA 2004). The ULP lease tracts are located in a semi-arid environment where rainfall is rare; however, occasional heavy rains can cause sudden runoff. Activities such as vegetation clearing, excavating, and stockpiling soils significantly increase the susceptibility of soils to runoff and erosion, especially during heavy rainfall. Surface runoff caused by soil compaction also increases the likelihood of erosion. Soil erosion by surface runoff is an important impacting factor for the natural flow of hydrological systems, surface water quality (due to increased sediment loads), vegetation (diminished productivity), and all wildlife (habitat degradation). State and local governments might also have specific requirements about how surface runoff should be controlled. Surface runoff potential and water erosion potential for the soils in the lease tracts are described in Section 3.3.2.

4.1.3.1.6 Sedimentation. Soil loss during construction by wind or water erosion is a major source of sediment that ultimately makes its way to surface water bodies such as stock ponds, reservoirs, rivers, streams, and wetlands. Sedimentation occurs when sediment settles out of water; this process can clog drainages and block navigation channels, increasing the need for dredging. By raising streambeds and filling in streamside wetlands, sedimentation increases the probability and severity of floods. Sediment that remains suspended in surface water can degrade water quality, damaging aquatic wildlife habitat and commercial and recreational fisheries. Sediment in water also increases the cost of water treatment for municipal and industrial users (USDA 2004).

4.1.3.1.7 Potential Impacts on Paleontological Resources Common to All Alternatives. Significant paleontological resources, if present, could be affected by mining on the ULP lease tracts as a result of ground-disturbing activities associated with mine site improvements, such as the construction of buildings (offices and maintenance), utilities, parking areas, roads, service areas (for vehicles and heavy equipment), storage areas (for fuel, chemicals, materials, solvents, oils, and degreasers), discharge/treatment ponds (for mine water discharge), and diversion channels and berms; the use of trucks, heavy earth-moving equipment, and mining equipment; and the construction of various stockpile and loading areas (for waste rock, ore, and topsoil). Off-lease land disturbances would occur on adjacent BLM land and would mainly involve obtaining or improving ROWs for haul roads and utilities and would be subject to BLM's NEPA process.

Potential direct adverse impacts on paleontological resources common to all alternatives (in varying degrees) could include the damage or destruction of near-surface fossils and loss of valuable scientific information from disturbing their stratigraphic context as a result of mining-related ground-disturbing activities or soil erosion within or near the lease tracts. Indirect impacts include looting or vandalism as a result of increased accessibility. The application of mitigation measures developed in consultation with BLM Field Offices (and detailed in the lessee's paleontological resources management plan) would reduce or eliminate the potential for such impacts.

4.1.3.2 Soil Impacts under Alternative 1

Reclamation activities at the 10 lease tracts under Alternative 1 could result in minor impacts on soil resources because they would involve ground disturbances that could increase the potential for soil compaction, soil horizon mixing, soil contamination, soil erosion and deposition by wind, soil erosion by water and surface runoff, and sedimentation of nearby surface water bodies. Ground-disturbing activities would involve removing most, if not all, equipment, buildings, structures, and portal foundations; backfilling portals; regrading waste-rock piles; spreading topsoil over the waste-rock pile storage area and other disturbed areas (using salvaged topsoil from the mining site, if available); and seeding. Direct adverse impacts would be smaller during reclamation than other mining phases (e.g., mine development and operations), because they would occur over a shorter duration (1 year of field activity) and because the use of existing access roads would reduce impacts such as compaction and erosion (e.g., fugitive dust generation). However, given the longer time frame (1 to 2 years following the field activities) needed to re-establish vegetation, soils would likely remain susceptible to erosion throughout the 2- to 3-year reclamation phase and beyond, especially if subjected to high winds or intense rainfall. Soil contamination is less likely during this phase but could result from fuel and oil releases related to the use of trucks and mechanical equipment and the removal of fuel tanks. An estimated 257 acres (100 ha) across 10 lease tracts would be disturbed temporarily during the reclamation phase under Alternative 1. Implementing measures (i.e., compliance measures and mitigation measures, and BMPs) such as those listed in Table 4.6-1 and in DOE (2011a) would reduce the potential for adverse impacts associated with these activities.

4.1.3.3 Impacts on Paleontological Resources under Alternative 1

Reclamation activities at the 10 lease tracts under Alternative 1 could result in adverse impacts on paleontological resources, if present, because they would involve ground disturbances that could expose fossils, making them vulnerable to damage or destruction and looting/vandalism. Field surveys, conducted by a qualified paleontologist early in the reclamation process, would identify areas of moderate to high fossil-yield potential or known significant localities so that these areas could be avoided. In addition, mine operators would notify the BLM of any fossil discoveries so appropriate measures could be taken to protect discoveries from adverse impacts (see also Table 4.6-1). For this reason, it is anticipated that impacts on paleontological resources would be minor.

4.1.4 Water Resources

Land disturbance activities associated with reclamation have the potential to affect water resources by eroding soil and by altering the topography and soil conditions that affect hydrologic processes. The short duration of reclamation (2 to 3 years) in comparison to mining operations (on the order of 10 years or more) would reduce direct impacts on water resources; however, given the potentially 2 to 3 years needed to re-establish vegetation and soil conditions after reclamation, indirect impacts of reclamation could be significant.

Surface runoff, infiltration, and groundwater flow are the key hydrologic processes that affect water quality in the vicinity of a mine site, by controlling the runoff of sediments and contaminants to nearby rivers and by controlling the transport and geochemical conditions in local and regional groundwater aquifers. Reclamation activities involving unconsolidated materials (e.g., waste-rock piles) in upland areas near canyon walls or mesa cliffs could increase the potential for erosion from flash flooding. Backfilling of mine portals could affect groundwater quality through leaching processes and by connecting aquifers if seepage areas were not properly sealed.

Many direct and indirect impacts on water resources from reclamation activities could be minimized through the implementation of compliance measures, mitigation measures, and BMPs, such as those identified in Table 4.6-1 (Section 4.6). Many of these are based on the guidelines proposed by the Colorado Division of Minerals and Geology (CDMG 2002) and by DOE's standard reclamation procedures outlined in DOE (2011a). Reclamation of a mine site does not result in hydrologic conditions that are similar to predisturbance conditions. It is likely that surface runoff will be greater and groundwater recharge will be less because of soil compaction, and it will alter groundwater flow paths and lower groundwater surface elevations in shallow aquifers (National Research Council 2012). In addition, there is evidence from reclaimed coal mine sites in the eastern United States that reclamation alters the ecosystem structure (compared to predisturbance conditions), which can affect surface runoff and nutrient cycling within a watershed, thus affecting both surface water and groundwater quality (Simmons et al. 2008).

Of the 10 lease tracts that would be reclaimed, Lease Tract 13 has the greatest potential to affect water resources because of its proximity to the Dolores River. Lease Tract 13 in the Slick Rock region encompasses a 3-mi (5-km) reach of the Dolores River where the canyon slopes are between 20% and 90%. The erosion of soil by water could potentially cause an increased loading of sediments to reach the Dolores River. Its impact is considered moderate but temporary in this region, with the highest erosion potential occurring along the canyon slopes of the Dolores River. Implementing erosion management (such as restricted activities and routine inspections for erosion control) along the side slopes (Table 4.6-1) could mitigate the impact of soil erosion on water quality near the Dolores River.

The potential impacts of decreasing the water quantity by reduced groundwater recharge on the domestic water supply are localized and considered temporary and minor. As discussed in Section 3.4.2, two domestic wells are located within Lease Tract 13 and four are located near the edge of Lease Tracts 8 and 13 (less than 1000 ft [330 m] from the edge of the lease tracts). It is not anticipated that the reclamation activities themselves would have any impacts on these water users.

The potential for impacts on groundwater quality might result from the backfill materials, poor sealing of drill holes, and inadequate water reclamation. As discussed in Section 3.4, most underground mines in lease tracts are dry, and impacts on groundwater are minimal except at Lease Tracts 7, 9, and 13 with a very low rate of groundwater seepage. During reclamation, the appropriate backfilling of mine portal and vent holes and complete sealing of drill holes that intercept multiple aquifers, in accordance with state regulations and standards set by the CDWR, could prevent leaching via backfills and minimize the future potential of cross-contamination between aquifers. The quality of groundwater will be evaluated to ensure that water quality is not affected by uranium prospecting based on standards set by the Colorado Water Quality Control Commission. The appropriate actions would otherwise be taken to comply with reclamation performance standards set forth by the CDWR.

4.1.5 Human Health

Section 4.1.5.1 provides a discussion of the conceptual site exposure model and the potential pathways of exposure at the ULP lease tracts and the surrounding area resulting from the exploration, mine development and operations, and reclamation phases associated with the five alternatives discussed in the ULP PEIS. This discussion is intended to provide the basis for the human health evaluation discussed subsequently for each of the five alternatives in Chapter 4. Section 4.1.5.2 discusses the potential impacts on human health under Alternative 1.

4.1.5.1 Conceptual Site Exposure Model

Potential human health risks associated with uranium mining were analyzed based on the conceptual site exposure model shown in Figure 4.1-1 and the source-receptor-exposure pathway relationships presented in Table 4.1-3. Mining of uranium ores, which originally are located underground, would bring the ore materials and surrounding waste rocks to the ground surface, thereby providing additional sources for potential human exposure. The sources of potential exposure above ground would include the uranium ore piles, waste-rock piles, potentially contaminated ground surface, and the wastewater treatment ponds. Waste-rock piles would contain uranium isotopes and their decay products because of the possible intermixing of uranium ores with surrounding rocks during mining and the inclusion of the abandoned ore materials that did not meet the cut-off uranium content requirement to be included in the uranium ore piles.

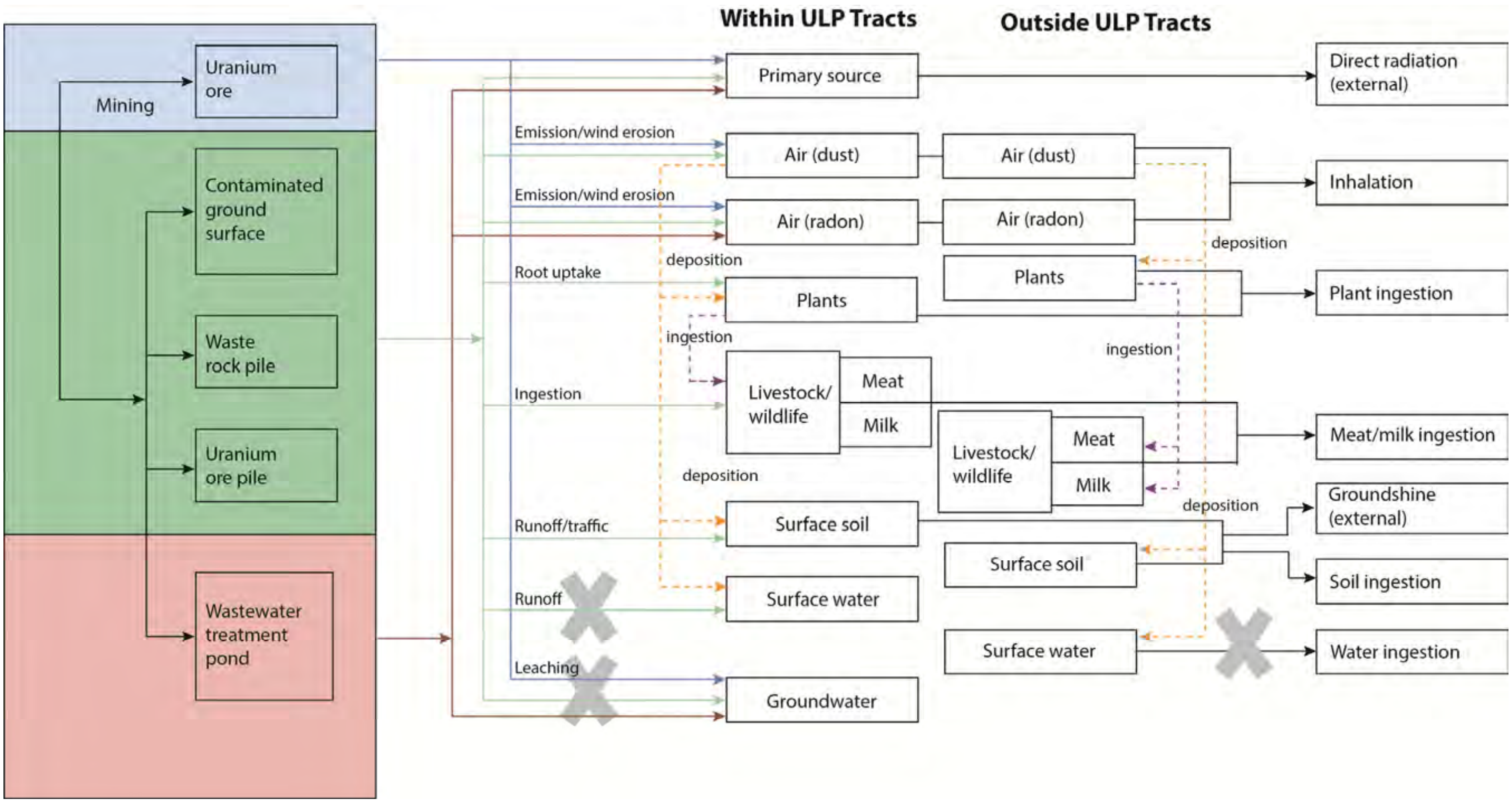


FIGURE 4.1-1 Conceptual Exposure Model for the Exploration, Mining Development and Operations, and Reclamation Phases at the ULP Lease Tracts

TABLE 4.1-3 Potential Human Receptors, Uranium Sources, and Exposure Pathways to Exploration, Mining Development and Operations, and Reclamation Phases at the ULP Lease Tracts[a]

		Exposure Pathway					
Receptor	Radiation Source	Direct Radiation	Inhalation	Plant/ Meat/Milk Ingestion	Ground-shine	Soil Ingestion	Surface Water/ Groundwater Use
Exploration phase							
Worker	Contaminated ground surface	A	A	–[b]	n	A	–
Off-site resident	Contaminated ground surface	–	n	n	n	n	–
Development/ operations phase							
Worker[c]	Uranium ores	A	A	–	a	a	–
	Contaminated ground surface	a	a	–	a	a	–
	Waste-rock piles	a	a	–	a	a	–
	Uranium ore piles	a	a	–	a	a	–
	Wastewater treatment pond	a	a	–			
Off-site resident	Uranium ores	–	A	n	n	n	–
	Contaminated ground surface	–	n	n	n	n	–
	Waste-rock piles	–	n	n	n	n	–
	Uranium ore piles	–	n	n	n	n	–
	Wastewater treatment pond	–	n	–			
Reclamation phase							
Worker (waste rocks)	Contaminated ground surface	n	n	–	n	n	–
	Waste-rock piles	A	a	–	n	a	–
Worker (mine workings)[d]	Contaminated ground surface	N	n	–	n	n	–
	Waste-rock piles	n	n	–	n	n	–
Off-site resident	Contaminated ground surface	–	n	n	n	n	–
	Waste-rock piles	–	A	n	n	n	–
Post reclamation phase							
Off-site resident	Contaminated ground surface	–	n	a	n	n	–
	Waste-rock piles	–	A	a	n	a	–
Recreationist (camper/hunter)	Contaminated ground surface	n	n	a	n	n	–
	Waste-rock piles	A	a	n	n	a	–
Mine inspector[e]	Uranium ores	N	A	–	–	n	–
	Contaminated ground surface	n	n	–	n	n	–
	Waste-rock piles	n	n	–	–	n	–

[a] Exposure pathways marked with an "A,, "a," "N," or "n" are considered completed pathways. Those marked with an uppercase "A" or "N" are major pathways, while those marked with a lowercase "a" or "n" are minor pathways. Exposure pathways that were quantified for potential exposures in the ULP PEIS are marked with an "A" or "a." The exposure pathways marked with an "N" or "n" were not quantified.

Footnotes continued on next page.

TABLE 4.1-3 (Cont.)

[b] A dash means item is not considered to be a completed exposure pathway.

[c] Potential exposures of uranium miners were analyzed with historical measurement data that included contributions from all major and minor pathways.

[d] The potential exposures incurred by workers working on reclaiming the aboveground mine workings are expected to be less than those incurred by workers working on waste-rock plies. Therefore, further analysis of potential exposures associated with reclaiming the mine workings was not conducted.

[e] Mine inspectors are expected to incur high radiation exposures from the direct radiation and radon inhalation pathways, with the radon dose being much larger than the direct radiation dose. Therefore, only the radon dose was analyzed and discussed in the ULP PEIS.

[f] Potential groundwater and surface water contamination from ULP mining activities was not considered to be a completed pathway because the transport of contaminants of concern to potential exposure points would be incomplete or would result in negligible exposures.

Ground surface on the mining site could potentially become contaminated from spills during ore handling and through runoff from uranium ore piles or waste-rock piles during rain events. Human activities and vehicular traffic could expand the surface contamination to a larger area. However, minimization of ground surface contamination can be achieved by implementing measures (i.e., compliance measures, mitigation measures, and BMPs), such as immediate cleanup after a spill, and by directing and collecting runoff from uranium ore piles through the use of diversion channels.

The wastewater treatment pond would be constructed to accept excess water pumped out from uranium mines during mining operations or water collected from uranium ore pads. Depending on the level of uranium concentration, the water in the wastewater treatment pond may need treatment before being discharged. The uranium ore piles and the wastewater in the treatment pond would be removed after the uranium mining operations ceased. Therefore, only waste-rock piles and residual ground surface contamination would remain after a reclamation.

Figure 4.1-1 shows the environmental transport and subsequent exposure pathways for the potential human receptors. Potential contamination of surface water and groundwater from the ULP lease tracts are not quantified here because the radioactive/chemical constituents of concern are not expected to reach a surface water body or an underlying groundwater aquifer near the mining site. The ULP lease tracts are very dry (i.e., with an annual average precipitation rate of about 1 ft/yr [0.3 m/yr]), and most of the precipitation is lost through runoff and evapotranspiration, so there is little water that would infiltrate the aboveground waste-rock pile or surface ground sources to leach out to groundwater. Furthermore, the depth to the groundwater aquifer would make it unlikely that any leached constituents would reach the groundwater table. Because of the poor quality of the on-site groundwater, groundwater use as a potential exposure pathway was not quantified. During mining operations, small amounts of water could be used; however, excess water that accumulates in the mine cavities would be pumped out, so that the potential for leaching of the radioactive/chemical constituents in uranium ores is minimized. In fact, because of the mining operations, the amount of uranium ores available for leaching would be greatly reduced from the initial amount before mining.

Most surface waters in the area of the ULP lease tracts are ephemeral and would appear only after a heavy rain event and then evaporate shortly thereafter. For ULP lease tracts near the Dolores River, a distance of 1,300 ft (0.25 mi) from the river would be required for new ULP mining activities. Therefore, surface runoff from aboveground sources to a surface water body is not considered a plausible pathway. Off-site surface water could be contaminated as a result of deposition of airborne particulates released from on-site uranium sources; however, the dilution in the surface water body would be so large that the potential exposure through the use of off-site surface water is considered to be negligible compared with the exposures through the inhalation pathway for off-site receptors.

Table 4.1-3 lists the receptors that could be exposed to the radioactive and chemical constituents of concern for the ULP activities. The radiation sources, potential exposure pathways, and exposure pathways that are quantified in the ULP PEIS are also indicated in the table. Among the various potential pathways, only a few are considered to be major contributors to the potential exposures. These major contributor pathways and the associated exposures are quantified in the ULP PEIS. Detailed discussions on the methodology used for the analyses are presented in Appendix D. The analyses were conducted with the use of three computer codes: RESRAD (Yu et al. 2001); CAP88-PC (Trinity Engineering Associates, Inc. 2007); and COMPLY-R (EPA 1989b). Detailed information on the input parameters used and the output results generated with these models is available in Argonne National Laboratory (Argonne) 2012.

4.1.5.2 Potential Human Health Impacts from Alternative 1

Under Alternative 1, potential human health impacts could result from implementation of reclamation activities including from the waste-rock piles that would be graded, provided with a top layer of soil material, and revegetated but would remain on site after reclamation.

Although the uranium and uranium decay products in the waste-rock piles would be at much lower concentrations than those in the uranium ores, they could still be higher than the concentrations in the undisturbed surface soils (i.e., higher than background levels), because some uranium ores could be intermixed with the waste rocks. Available measurement data for waste-rock samples indicated varied Ra-226 concentrations. Sampling data taken from the Whirlwind Mine indicated a range from 2.8 to 4.2 pCi/g (BLM 2008b), while those taken from the JD-6 and JD-8 lease tracts indicated a range from 30 to 70 pCi/g (corresponding to the measured total uranium concentration of 91 to 212 mg/kg, assuming the same activity ratio of 1:1:0.046 for U-234:U-238:U-235 as in natural uranium) (Whetstone Association 2011, 2012). The Ra-226 concentrations from sampling data from the JD-6 and JD-8 lease tracts were used in the analyses. However, because waste rock is typically considered to possibly contain less than 0.05% of uranium, there could be spots on the waste-rock piles that could contain concentrations closer to 0.05% (or higher). Therefore, in some hot spots within the waste-rock piles, the concentration of Ra-226 could be as high as 168 pCi/g (under the secular equilibrium assumption). For the human health risk assessment presented in this section, an average Ra-226 concentration of 70 pCi/g was used as the base value for obtaining estimates of radiation exposure associated with waste-rock piles. In addition to the base estimates, the potential ranges of exposures are also estimated by considering the potential for higher concentrations for the waste-rock piles. Assuming there is secular equilibrium between U-238 and its decay products, the base activity concentrations for U-238, U-234, Th-230, and Pb-210 would be the same as the Ra-226 concentration. A base concentration of 3.22 pCi/g was assumed for U-235, based on the natural radioactivity ratio of 1:1:0.046 among the uranium isotopes U-234, U-238, and U-235. The base concentrations for the U-235 decay products, Pa-231 and Ac-227, would be 3.22 pCi/g as well, if the secular equilibrium assumption is applied.

The dimension of the waste-rock pile accumulated over the lifetime of a uranium mine would depend on the cumulative amount of production of uranium ores. Based on available information, the mines in this area have typically averaged 2 to 3.5 tons of waste per ton of ore produced (BLM 2008b). For analysis in the ULP PEIS, the dimensions of four sizes of waste-rock piles were developed to correspond to the four mine sizes assumed for evaluation in the ULP PEIS. Other assumptions used to develop the dimensions of the waste-rock piles include the following:

1. The ratio of waste rock to uranium ore produced is 3 to 1.

2. The waste-rock pile occupies 40% of the total surface plant area, or 10% of the disturbed area for the very large open-pit mine.

3. The waste-rock pile is the accumulation resulting from mine development and mining operations for 10 years.

4. The average bulk density of the waste-rock pile is 2.8 g/cm^3 (EPA 2008).

5. For underground mining, 10% of the waste rock is placed back or “gobbed” into the mine cavities, and 90% is piled up on the ground surface.

6. For open-pit mining, 30% of the waste rock produced is used for backfilling, leaving 70% on the ground surface.

Table 4.1-4 lists the dimensions developed for the four waste-rock piles associated with the four mine sizes assumed. For evaluation purposes, it is assumed that all the waste rock is placed as one pile. This approach concentrates all the radionuclide inventory in the radiation source assumed for dose modeling; therefore, it will most likely result in overestimating the potential radiation exposures, especially when the exposures are dominated by direct external radiation.

4.1.5.3 Worker Exposure – Reclamation Workers

During the reclamation period, a worker could incur radiation exposures from working on or near a waste-rock pile. For the calculations here, it is assumed that the worker would work 8 hours a day on top of a waste-rock pile for 20 days. Potential radiation exposures could result

TABLE 4.1-4 Dimensions of the Waste-Rock Piles per Mine Size Assumed for Human Health Impact Analysis

Dimensions	Small[a]	Medium[a]	Large[a]	Very Large[b]
Base area (m^2)	16,180	24,280	32,370	80,920
Base area (acres)	4	6	8	20
Height (m)	6.4	8.6	12.9	6.0
Height (ft)	21	28	42	20

[a] Underground mines.

[b] Surface open-pit mine.

from the following pathways: (1) direct external radiation; (2) inhalation of particulates and radon; and (3) incidental ingestion of dust particles.

Based on RESRAD Version 6.7 (Yu et al. 2001) calculation results, the total radiation dose incurred by a reclamation worker from working on top of a waste-rock pile would be about 14.3 mrem or slightly lower from any of the four waste-rock pile sizes. This dose estimate corresponds to the base concentration of 70 pCi/g assumed for Ra-226. If the 168 pCi/g (in cases where hots spots could be present at a waste-rock pile) was used, the radiation dose estimated would be as high as 34.2 mrem. For comparison, the dose limit set in DOE Order 458.1 for protection of the general public from all exposure pathways is 100 mrem/yr. The radiation exposure would primarily be from the external radiation pathway, which would contribute about 94–96% of the total dose, followed by the incidental soil ingestion pathway, which would account for about 3% of the total dose. The remaining dose would be contributed by the exposures resulting from inhalation of particulate and radon pathways. The potential LCF risk associated with this radiation exposure is estimated to range from 1×10^{-5} to 3×10^{-5}; i.e., the probability that the receptor would develop a fatal cancer would be about 1 in 100,000 to 1 in 33,000. If the reclamation worker would work for more than 20 days to reclaim multiple waste-rock piles, the radiation dose and LCF risk he would incur would increase proportionally with the number of days of exposure.

In addition to the radiation emitted by the uranium isotopes and their decay products, the chemical toxicity of the uranium and vanadium minerals in the waste rocks could also affect the health of a reclamation worker. The potential chemical exposures could result from (1) inhalation of particulates suspended in the air that came from the waste-rock pile and (2) incidental ingestion of the particulates. On the basis of past uranium and vanadium production rates from the DOE lease tracts, the ratio of vanadium to uranium in the waste rock is assumed to be six to one or 6:1. The same exposure parameters as those used for estimating the radiation dose were used to evaluate the potential chemical hazard for the reclamation worker. The potential chemical risk from each exposure pathway is expressed in terms of hazard quotient, which is the ratio of the average daily intake rate from an exposure pathway to the threshold value for that pathway. The hazard quotients from each pathway are then added to get the hazard index for each chemical. Based on the evaluation results, the total hazard index ranges from about 0.13 to

0.31 (for 70 pCi/g to 168 pCi/g U-238). Vanadium contributes 95% and uranium contributes 5% of the estimated hazard index. Because the hazard index is below 1, the reclamation worker is not expected to experience adverse health effects resulting from exposure to vanadium and to the chemical effects of uranium.

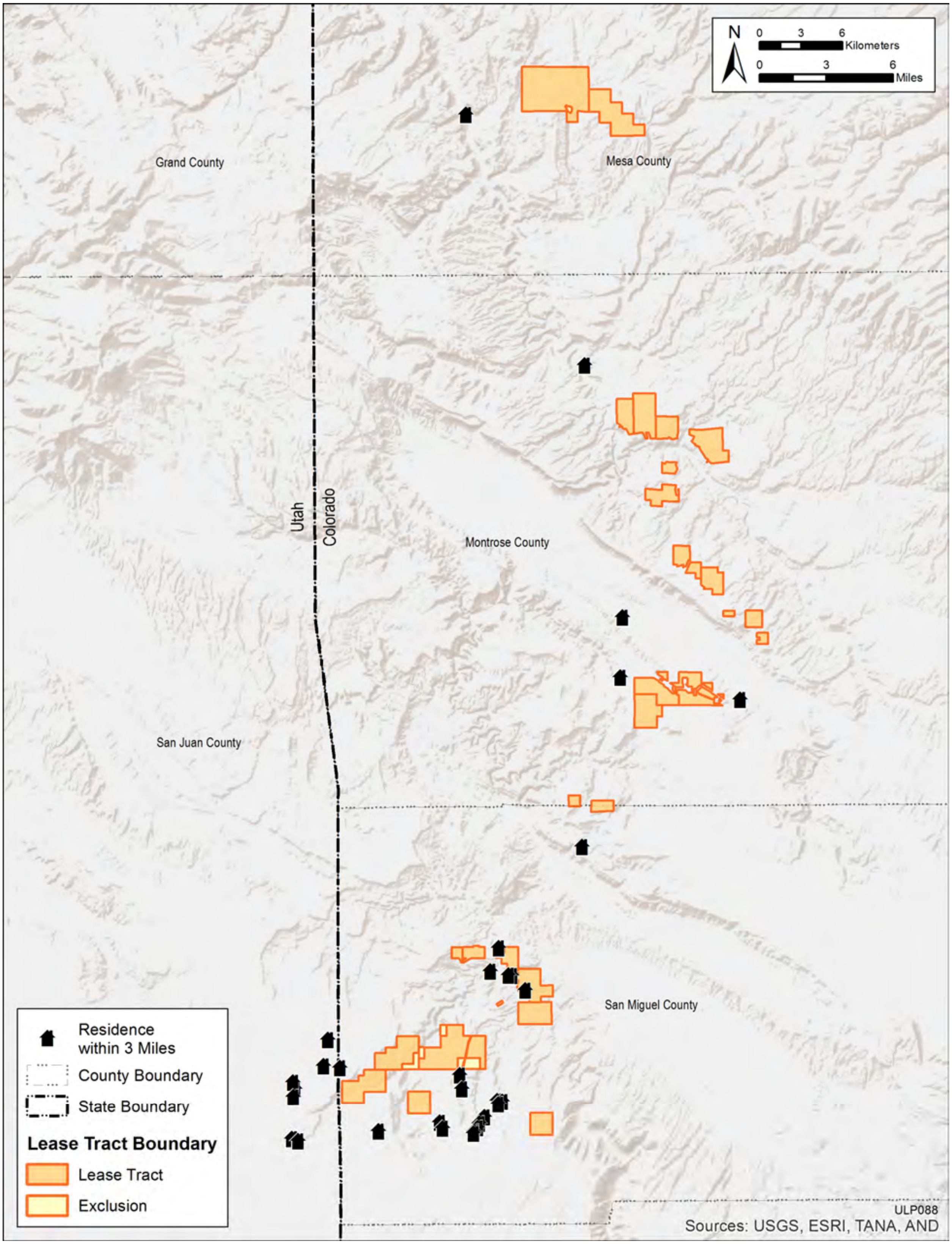
The above analyses consider potential exposures from working on a waste-rock pile, which is the largest aboveground radiation source in a lease tract during the reclamation phase. Therefore, the potential radiation dose associated with reclaiming other above ground mine working areas is expected to be less than those presented in this section.

In addition to conducting reclamation activities above the ground, a reclamation worker may be required to work underground to reclaim workings in the mine cavities; however, the time spent underground is expected to be much shorter than the time spent above the ground. The radiation exposure rate at underground workings would be higher than that on top of a waste-rock pile, due to the high level of radon in the mine cavities. The exposure rate that would be incurred by reclamation workers is expected to be similar to that incurred by uranium miners during mining operations (discussed in Section 4.3.5.1). On the basis of an average radiation dose of 433 mrem/yr for uranium miners (from monitoring data, see Section 4.3.5.1) and the assumption that the monitored miners worked 2,000 hours per year, a radiation dose rate of 0.29 mrem/h can be calculated. Therefore, a reclamation worker would need to spend 66–158 hours in underground mine workings to receive the same dose (14.3–34.2 mrem) as he would receive from working on top of a waste-rock pile for 160 hours (i.e., 20 workdays).

4.1.5.4 General Public Exposure – Residential Scenario

Residents who live close to uranium mines during or after the reclamation phase could be exposed to radiation as a result of radioactive particulates and radon gas being blown off from aboveground radiation sources located within ULP lease tracts, among which waste-rock piles are significantly larger sources than the others. Therefore, in the assessment of potential human health impacts, radiation exposures associated with the waste-rock piles are considered. Potential radiation exposure would depend on the direction and distance between the residence and the waste-rock piles and the emission rates of particulates and radon. Figure 4.1-2 shows the existing structures surrounding the uranium lease tracts as identified by Cotter (Cotter 2012) through the use of Google Earth satellite images. A total of 32 structures were identified.

The emission rate for Rn-222 as an input to CAP88-PC (Trinity Engineering Associates, Inc. 2007) was obtained from the RESRAD (Yu et al. 2001) analysis for the exposure of reclamation workers (see previous section). The RESRAD analysis generated the radon flux (~60–144 pCi/m^2/s, corresponding to a Ra-226 concentration of 70 -168 pCi/g) from the surfaces of the four assumed waste-rock piles. A radon emanation coefficient of 0.15 rather than the RESRAD default value of 0.25 was used in the calculation, based on measurement data taken from rock samples (Ferry et al. 2002; Sakoda et al. 2010). The emission rates for particulates were estimated following the guidance from Regulatory Guide 3.59 (NRC 1987) concerning emission of dust particles from exposed uranium mill tailings sands due to wind erosion. The frequencies of different wind speed groups that are required in the particulate emission

1


2 **FIGURE 4.1-2 Existing Structures in the ULP Lease Tract Surrounding Area**

calculation were calculated on the basis of meteorological data from the lease tracts (Rogers 2011). Table 4.1-5 lists the annual emission rates calculated for radon and radioactive particulates containing uranium isotopes and their decay products for the four assumed waste-rock pile sizes ranging from small to very large. The emission rates listed in the table correspond to a base concentration of 70 pCi/g for Ra-226 in waste rocks, as discussed in the previous section. If the value of 168 pCi/g is assumed, the estimated emission rates would increase by a factor of less than 3. The emission rates listed in Table 4.1-5 are expected to be greater than the actual values because wind erosion rates from waste rocks would be lower than those from uranium mill tailings sands; furthermore, no cover material on top of the waste rocks was considered. As a conservative approach, the entire surface of the waste-rock piles was assumed to be exposed for wind erosion.

Tables 4.1-6 through 4.1-8 list the estimated maximum radiation doses and corresponding LCF risks associated with the emissions of radon, particulates, and both radon and particulates, respectively, from the four assumed sizes of waste-rock piles that have an upper-end Ra-226 concentration of 70 pCi/g. The exposures are incurred mainly through the inhalation pathway, which accounts for more than 95% of the dose, and through the groundshine, incidental soil ingestion, and ingestion of plant foods, meat, and milk pathways, resulting from deposition of airborne particulates to ground surfaces. The radiation exposures associated with the emissions from a waste-rock pile would decrease with increasing distance because of greater dilution in the air concentrations of radon and radionuclides. The maximum exposure at a fixed distance from the center of a waste-rock pile would occur in the sector that coincides with one of the dominant wind directions for the DOE ULP lease tracts. In any of the other sectors, the potential exposure would be less than the maximum values. Because the emission rates of particulates and radon from a very large waste-rock pile are significantly higher than those from a small, medium, or large waste-rock pile, the corresponding dose and LCF risk are also significantly higher. This is because the surface area of a very large waste-rock pile is much larger than the surface area of a small, medium, or large waste-rock pile (see Table 4.1-4). At a distance of 1,600 ft (500 m), the dose/LCF risk associated with emissions from a small or a medium waste-rock pile are greater than the dose/LCF risk associated with a large waste rock pile; beyond 1,600 ft (500 m), the dose/LCF risk associated with a large waste-rock pile are greater than the dose/LCF risk associated with a small or a medium waste-rock pile. This shows the influence of release height on the downwind air concentrations. Emissions from a source of higher altitude would be dispersed over a larger area than emissions from a source of lower altitude, resulting in smaller air concentrations at short distances from the release point.

The results in Tables 4.1-6 and 4.1-7 indicate that the maximum radiation doses associated with radon emissions would be two times or more the doses associated with particulate emissions; the ratio would also increase as the distance increased. This increase in the ratio would occur because some airborne particulates would deposit to the ground surface during their transit to downwind locations, whereas radon gas would not be deposited (although its decay progenies, which are not gas, could attach to particulates and plate out from the air). Furthermore, the short-lived progeny of Rn-222 that are responsible for the radon dose would be generated along the transit to downwind locations. As a result, the radiation dose associated with a particulate emission would decrease faster with increasing distance than would the radiation dose associated with a radon emission. In terms of potential maximum LCF risks, the exposure

TABLE 4.1-5 Estimated Upper-Bound Emission Rates of Particulates, Radon, and Radionuclides for the Four Assumed Waste-Rock Pile Sizes

Parameters	Small[a]	Medium[a]	Large[a]	Very Large[b]
Base area (m^2)	1.62E+04	2.43E+04	3.24E+04	8.09E+04
Dust emission (g/yr)[c]	2.75E+06	4.12E+06	5.49E+06	1.37E+07
Emission rate of radionuclide (Ci/yr)				
U-238	1.92E-04	2.88E-04	3.85E-04	9.61E-04
U-234	1.92E-04	2.88E-04	3.85E-04	9.61E-04
Th-230	1.92E-04	2.88E-04	3.85E-04	9.61E-04
Ra-226	1.92E-04	2.88E-04	3.85E-04	9.61E-04
Pb-210	1.92E-04	2.88E-04	3.85E-04	9.61E-04
U-235	8.84E-06	1.33E-05	1.77E-05	4.42E-05
Pa-231	8.84E-06	1.33E-05	1.77E-05	4.42E-05
Ac-227	8.84E-06	1.33E-05	1.77E-05	4.42E-05
Emission rate of Rn-222 (Ci/yr)[d]	3.07E+01	4.61E+01	6.14E+01	1.54E+02

[a] Small, medium, and large represent the size of the hypothetical underground uranium mine with which the waste-rock pile is associated.

[b] Very large denotes the waste-rock pile that is associated with the surface open-pit uranium mine in Lease Tract 7.

[c] The dust emission rates were calculated with the Regulatory Guide 3.52 annual dust loss equation concerning wind erosion of exposed uranium tailings sands (NRC 1987).

[d] The emission rates of Rn-222 (corresponding to a Ra-226 concentration of 70 pCi/g) were calculated with the radon flux from the RESRAD code (Yu et al. 2001).

TABLE 4.1-6 Potential Maximum Radiation Doses and LCF Risks[a] to a Resident as a Result of the Emission of Radon from the Four Assumed Waste-Rock Pile Sizes

Distance (m)	Dose (mrem/yr) Associated with the Four Waste-Rock Pile Sizes				LCF Risk (1/yr) Associated with the Four Waste-Rock Pile Sizes			
	Small	Medium	Large	Very Large	Small	Medium	Large	Very Large
500	1.24	1.39	0.88	5.82	2E-06	2E-06	1E-06	9E-06
1,000	0.47	0.65	0.68	2.39	6E-07	8E-07	9E-07	3E-06
1,500	0.27	0.38	0.44	1.36	3E-07	5E-07	6E-07	2E-06
2,000	0.18	0.26	0.32	0.92	2E-07	3E-07	4E-07	1E-06
2,500	0.13	0.19	0.24	0.68	2E-07	3E-07	3E-07	9E-07
3,000	0.10	0.15	0.19	0.53	1E-07	2E-07	2E-07	6E-07
4,000	0.08	0.11	0.14	0.38	1E-07	1E-07	2E-07	6E-07
5,000	0.06	0.09	0.11	0.30	8E-08	1E-07	1E-07	3E-07

[a] Listed values correspond to a Ra-226 concentration of 70 pCi/g in waste rocks.

TABLE 4.1-7 Potential Maximum Radiation Doses and LCF Risks[a] to a Resident as a Result of the Emission of Particulates from the Four Assumed Waste-Rock Pile Sizes

Distance (m)	Dose (mrem/yr) Associated with the Four Waste-Rock Pile Sizes				LCF Risk (1/yr) Associated with the Four Waste-Rock Pile Sizes			
	Small	Medium	Large	Very Large	Small	Medium	Large	Very Large
500	0.65	0.74	0.48	2.95	2E-07	2E-07	1E-07	9E-07
1,000	0.22	0.31	0.33	1.09	5E-08	8E-08	8E-08	3E-07
1,500	0.11	0.16	0.20	0.56	3E-08	4E-08	5E-08	1E-07
2,000	0.07	0.10	0.13	0.35	2E-08	3E-08	3E-08	9E-08
2,500	0.05	0.07	0.09	0.23	1E-08	2E-08	2E-08	6E-08
3,000	0.03	0.05	0.07	0.17	9E-09	1E-08	2E-08	3E-08
4,000	0.02	0.03	0.04	0.11	5E-09	8E-09	1E-08	3E-08
5,000	0.02	0.02	0.03	0.08	4E-09	6E-09	8E-09	2E-08

[a] Listed values correspond to a Ra-226 concentration of 70 pCi/g in waste rocks.

TABLE 4.1-8 Potential Maximum Total Doses and LCF Risks[a] to a Resident as a Result of the Emission of Radon and Particulates from the Four Assumed Waste-Rock Pile Sizes

Distance (m)	Dose (mrem/yr) Associated with the Four Waste-Rock Pile Sizes				LCF Risk (1/yr) Associated with the Four Waste-Rock Pile Sizes			
	Small	Medium	Large	Very Large	Small	Medium	Large	Very Large
500	1.89	2.13	1.36	8.86	2E-06	2E-06	1E-06	9E-06
1,000	0.69	0.96	1.01	3.49	7E-07	9E-07	1E-06	3E-06
1,500	0.38	0.55	0.64	1.92	4E-07	5E-07	6E-07	2E-06
2,000	0.25	0.36	0.44	1.24	3E-07	4E-07	4E-07	1E-06
2,500	0.18	0.27	0.33	0.92	2E-07	3E-07	3E-07	9E-07
3,000	0.14	0.20	0.26	0.68	1E-07	2E-07	3E-07	6E-07
4,000	0.10	0.15	0.19	0.50	1E-07	2E-07	2E-07	6E-07
5,000	0.08	0.11	0.15	0.38	8E-08	1E-07	2E-07	3E-07

[a] Listed values correspond to a Ra-226 concentration of 70 pCi/p in waste rocks.

to radon would result in a risk 10 times higher or more than the exposure to radioactive particulates. Based on the CAP88-PC calculation results, the radon level at any downwind location 1,600 ft (500 m) or greater from the center of a small, medium, or large waste-rock pile would be less than 1.2×10^{-4} working level (WL). At a downwind location of 1,600 ft (500 m) or greater, the radon level from a very large waste-rock pile would be higher than that from a small, medium, or large waste-rock pile. According to the estimated results, at a distance of 1,600 ft (500 m) or beyond, the radon level would be less than 4.9×10^{-4} WL.

The total maximum doses listed in Table 4.1-8 provide some insight on the potential exposures of nearby residents. For example, if a resident lived a distance of 3,300 ft (1,000 m) from a small, medium, or large waste-rock pile, then the radiation dose he could receive would be less than 1.01 mrem/yr (LCF risk of 1×10^{-6}/yr; i.e., 1 in 1,000,000), and if the distance increased to 6,600 ft (2,000 m), then the exposure would be less than 0.44 mrem/yr (LCF risk of 4×10^{-7}/yr; i.e., 1 in 2,500,000). If a resident lived close to a very large waste-rock pile, then the radiation dose he could receive would decrease from 3.49 mrem/yr (LCF risk of 3×10^{-6}/yr; i.e., 1 in 330,000) at a distance of 3,300 ft (1,000 m) to 1.24 mrem/yr (LCF risk of 1×10^{-6}/yr; i.e., 1 in 1,000,000) at a distance of 6,600 ft (2,000 m). It should be noted that the maximum doses listed in Table 4.1-8 are estimated based on the assumed dimensions for waste-rock piles presented in Table 4.1-4. If the dimensions of a waste-rock pile were smaller than the assumed dimensions, the potential dose (LCF risk) to this resident would be less than the estimated values. On the other hand, if there were two waste-rock piles nearby, then the potential dose (LCF risk) that this resident would incur would be the sum of the doses (LCF risk) contributed by each waste-rock pile. For comparison, the general public living close to the lease tracts would receive a radiation dose of approximately 430 mrem/yr (LCF risk of 3×10^{-4}) from natural background radiation.

The presence of waste-rock piles in ULP lease tracts was assumed for the purposes of estimating potential human health impacts during or after the reclamation phase. Currently, the waste rock pile in Lease Tract 7 where an open-pit mine was located has been removed from above the ore horizon; therefore, there would not be a very large waste-rock pile under Alternative 1. The potential human health impact on residents living close to Lease Tract 7 is expected to be much lower than those presented in Table 4.1-6 for a very large waste-rock pile. On the basis of this reality and the maximum doses listed in Table 4.1-8, the potential dose incurred by any resident living close to the ULP lease tracts (at a distance of 1,600 ft [500 m] or greater) is expected to be much smaller (< 2.13 mrem/yr) than the National Emission Standards for Hazardous Air Pollutants (NESHAP) dose limit of 10 mrem/yr for airborne emissions (40 CFR Part 61). The potential LCF risk would be less than 2×10^{-6}/yr, which means the probability of developing a fatal cancer from living close to the ULP lease tracts for 1 year during or after reclamation is 1 in 500,000. If a resident lived in the same location for 30 years, then the cumulative LCF risk would be less than 6×10^{-5}.

During reclamation, it would be required that waste-rock piles be covered by a layer of soil material to facilitate vegetation growth (see measures [i.e., compliance measures, mitigation measures, and BMPs] identified in Table 4.6-1 in Section 4.6). If the thickness of this soil material is sufficient (the sufficient thickness would depend on the concentration of the radionuclide in the waste rocks), emissions of radioactive particulates would most likely be eliminated, and direct external radiation would be greatly reduced, if not eliminated completely. Emissions of radon from waste-rock piles could continue, although the emission rate would be also reduced. In fact, because the uranium isotopes and their decay products have long decay half-lives, the potential of radon emissions from waste-rock piles could persist for millions of years after reclamation was completed.

In addition to radiation exposure, the residents living close to the ULP lease tracts could incur chemical exposures due to the chemical toxicity of uranium and vanadium minerals contained in the waste rocks. Potential chemical exposures would be associated with the emissions of particulates and primarily through the inhalation pathway. The same exposure parameters as those used for radiation dose modeling were used to evaluate the potential chemical risks to nearby residents. Based on the estimates, the total HI would be less than 0.006 at a distance of 1,600 ft (500 m) from a large waste-rock pile (less than 0.03 at a distance of 1,600 ft [500 m] from a very large waste-rock pile, if it was not removed). Because the HI is much smaller than 1, potential adverse health effects are not expected for the residents.

The estimates of human health risks presented above were obtained by assuming the Ra-226 concentration in waste rocks was at the base concentration of 70 pCi/g. If the 168 pCi/g concentration of radionuclides were used in the analyses, the potential risks estimated for a resident living close to a ULP lease tract would increase by a factor of less than 3. Therefore, without the presence of a very large waste-rock pile, even if the Ra-226 concentration was increased to the higher 168 pCi/g value, the maximum radiation dose a nearby resident could receive would increase to 5.1 mrem/yr at a distance of 1,600 ft or 500 m (LCF risk of 5×10^{-6}/yr, i.e., 1 in 200,000 per year), and the maximum hazard index would increase to 0.01.

The above discussions consider the exposures of nearby residents to the airborne emissions of radon and particulates from waste-rock piles. A less likely exposure scenario after the reclamation phase is for a nearby resident to raise livestock in the lease tract and consume the meat and milk produced. The RESRAD compute code (Yu et al. 2001), which models the ingrowth and decay of radionuclides, including radon, in contaminated porous media and the uptake of radionuclides by plant roots extending to the contaminated media, was used to analyze this scenario. To get a perspective on the potential dose, it was assumed that there were no soil covers and that grass would thrive on waste rocks for meat and milk cows to graze on. If it was further assumed that a nearby resident obtained 100% of the meat and milk he would consume from his livestock (139 lb/yr [63 kg/yr] for meat and 24 gal/yr [92 L/yr] for milk), then the potential radiation dose he would receive was estimated to be about 81 mrem/yr (48 mrem/yr from meat consumption, and 33 mrem/yr from milk consumption), with a corresponding LCF risk of 4×10^{-5}/yr (i.e., 1 in 25,000) for developing a fatal cancer. If the consumption would be less, the potential radiation dose would decrease proportionally. This estimate was obtained by using the upper-end concentrations assumed for uranium and its decay progenies (70 pCi/g for Ra-226). In reality, it would be quite unlikely that grass would thrive by growing into waste rocks. If waste rocks would be covered by a layer of surface soil materials to facilitate vegetation growth, the potential radiation dose associated with the meat and milk ingestion would be less, because the extent of roots to the contaminated zone would decrease. A more realistic consideration for radiation exposure through the meat and milk ingestion pathway would be for the cows to graze in an open area with residual surface contamination. Assuming a thickness of 0.4 in. (1 cm) in the RESRAD analysis, the potential radiation dose the resident would receive was estimated to be less than 5.5 mrem/yr, if the upper-end concentrations for waste rocks were assumed. The corresponding LCF risk would be less than 3×10^{-6}/yr; i.e., the probability of developing a latent fatal cancer would be less than 1 in 330,000 per year. In reality, the residual contamination would not be everywhere, and the average concentration would be lower;

therefore, a radiation dose of 5.5 mrem/yr (LCF risk of 3×10^{-6}/yr) is considered to be an overestimate for the resident.

4.1.5.5 General Public Exposure – Recreationist Scenario

In addition to the residents who might live near the ULP lease tracts and could thus be affected by the emissions from the waste-rock piles left after reclamation was completed, a recreationist who would unknowingly enter the lease tract could also be exposed to radiation. To model this potential radiation exposure, the recreationist is assumed to camp on top of a waste-rock pile for 2 weeks. A waste-rock pile is considered because it is the largest radiation source after reclamation. In addition to camping, the recreationist is assumed to collect and eat wild berries grown in the ULP lease tract and hunt wildlife animals for consumption. This recreationist could receive radiation exposure through the direct external radiation and radon inhalation pathways. Because the wild berries could grow in soil with residual contamination, and the meat of the wildlife animals could be contaminated due to consumption of contaminated plants by the animals, the recreationist could also incur radiation exposure through the food ingestion pathway. The inhalation of radioactive particulates and incidental soil ingestion pathways may be also viable depending on the thickness of soil materials placed on top of the waste-rock pile during reclamation. For radiation dose analysis, it is assumed that the thickness of soil materials on top of waste-rock piles would range from 0 to 1 ft (0 to 0.3 m) (see also Table 4.6-1 in Section 4.6).

The potential radiation doses that the recreationist could receive during the 2 weeks of camping were obtained with the RESRAD code (Yu et al. 2001). According to the calculation results, the direct external radiation dose could range from 0.75 mrem for a cover thickness of 1 ft (0.3 m) to 28.5 mrem with no cover. The radiation dose associated with inhalation of contaminated dust particles could range from 0 mrem with a cover thickness of at least 6 in. (0.15 m) to 0.26 mrem with no cover. The radiation dose associated with radon inhalation would range from 0.13 mrem with a cover thickness of 1 ft (0.3 m) to 0.17 mrem with no cover. The radiation dose that could be incurred through soil ingestion would be about 0.93 mrem if there was no cover. This ingestion dose could be reduced to zero with a cover thickness of just a few inches. In total, the radiation dose that could be incurred through the above four exposure pathways would range from 0.88 mrem with a cover thickness of 1 ft (0.3 m) to 30 mrem with no cover. The corresponding LCF risk would range from 1×10^{-6} to 2×10^{-5}; i.e., the probability of developing a latent fatal cancer would be about 1 in 1,000,000 to 1 in 50,000.

The above dose results were calculated with the base radionuclide concentrations in waste rocks (70 pCi/g for Ra-226). If the concentration of 168 pCi/g for Ra-226 was used for the calculations, the potential dose (LCF risk) would increase by a factor of less than 3, i.e., the radiation dose would range from 2.13 to 71.7 mrem (LCF risk of 3×10^{-6} to 6×10^{-5}/yr; i.e., 1 in 330,000 to 1 in 16,000) as the thickness of the cover materials on the waste-rock pile was decreased from 1 ft (0.3 m) to 0. For comparison, in DOE Order 458.1, the dose limit set to protect the general public from radiation exposure is 100 mrem/yr; the acceptable LCF risk usually ranges from 1×10^{-6}/yr to 1×10^{-4}/yr (DOE 2011e).

As discussed in the previous section (Section 4.1.5.2), it is quite difficult for plants to thrive on top of waste-rock piles unless they are covered by a layer of soil materials; also, if the plant roots are limited to the cover layer, then there would be essentially no uptake of radionuclides by roots, and the plants would not be contaminated. (The radon gas generated by Ra-226 in waste rocks could diffuse through the cover layer and leave behind its decay products; however, the amount of radioactivity in the cover layer would be negligible compared to that in waste rocks. Therefore, the amount of root uptake would be negligible, if the roots would not extend to waste rocks.) Therefore, the analyses of potential doses associated with eating wild berries and wildlife animals were made based on residual soil contamination that was assumed to have a thickness of 0.4 in. (1 cm) and the upper-end concentrations of waste rocks (i.e., 70 pCi/g for Ra-226). Furthermore, ingestion rates of 1 lb (0.45 kg) of wild berries and 100 lb (45.4 kg) of deer meat were assumed. The potential radiation exposure would depend on the depth of plant roots. When the RESRAD default value of 0.9 m was used, a radiation dose of 1.08 mrem was estimated (0.04 mrem from eating wild berries and 1.04 mrem from eating deer meat). If a depth of 1 ft (0.3 m) is assumed, the potential dose would increase to 1.66 mrem (0.12 mrem from eating wild berries and 1.54 mrem from eating deer meat). In either case, the potential dose would be less than 2 mrem. The corresponding LCF risk was estimated to be less 8×10^{-7} (i.e., 1 in 1,250,000).

No chemical risks would result from camping on a waste-rock pile if the waste-rock pile was covered by soil materials. In the worst situation (no soil cover), a hazard index of 0.039 was calculated considering both the inhalation of particulate and soil ingestion pathways. Potential chemical risk associated with ingesting contaminated wild berries would be negligible, with a hazard index of less than 0.003. However, because vanadium could accumulate in the tissues of animals if the animals ingested contaminated plants, potential chemical risks associated with the ingestion of deer meat pathway would be greater than those associated with the ingestion of wild berries pathway. Assuming an ingestion rate of 100 lb (45 kg) for deer meat, a hazard index of 0.39 was calculated. Overall, the sum of hazard indexes across all the exposure pathways is about 0.4, which is far below the threshold value of 1; therefore, the recreationist is not expected to experience any adverse health effect from these exposures.

In the above analyses, a recreationist was assumed to spend 14 days camping on top of a waste-rock pile in a ULP lease tract after the reclamation was completed. In reality, most of the encounter between a recreationist and a ULP lease tract would be much shorter; therefore, the potential radiation dose a recreationist would receive from the encounter would be much lower than the doses reported above. To get a perspective, the potential dose can be estimated by scaling the reported total dose with the duration of exposure. For example, the radiation dose associated with spending 1 hour on top of a waste-rock pile in a ULP lease tract after reclamation would be less than 0.09 mrem/h (LCF risk of 7×10^{-8}; i.e., 1 in 14,000,000), assuming Ra-226 concentration in the waste-rock pile is 70 pCi/g.

4.1.5.6 General Public Exposure – Individual Receptor Entering an Inactive Underground Mine Portal

During underground uranium mining operations, radon monitoring is required to ensure the safety of mine workers. Specifically, the radon concentration at the worker's breathing zone should be determined at least every 2 weeks and maintained at a level of less than 0.3 WL (30 CFR Part 57). To comply with this requirement, ventilation systems have to be operated efficiently. Without the ventilation systems, potential radon concentrations can accumulate to an unacceptable (high) level. Radon concentrations in bulk-headed areas (where mining is no longer active) have been reported to be from 30,000 to 300,000 pCi/L (EPA 1985). If an equilibrium factor of 0.2 is assumed for radon progenies, this would be equivalent to 60 to 600 WL (compared to the limit of 0.3 WL allowed for worker exposures).

The following information provides an additional perspective on potential radon exposures associated with entering an inactive underground mine after its closure. Denman et al. (2003) measured the radon levels in abandoned mines in the United Kingdom and reported the levels to range from 3 to 39 WL in three different mines at different locations within the mines. Using these measurement data, the corresponding radon dose rate was estimated to range from 6.85 to 89 mrem/h. The corresponding LCF risk would range from 9×10^{-6} to 1×10^{-4} (i.e., 1 in 110,000 to 1 in 10,000) per hour.

Based on the above two sources of data for radon, potential exposure to an individual who inadvertently enters an inactive underground mine could be high. It should be noted that most mines would be permanently closed after reclamation, so entry to a closed mine would be highly unlikely unless it was by an individual committing an illegal act of vandalism. However, entry to underground mines could be done by Federal or state employees and their contractors, and such entries would be conducted in compliance with appropriate requirements.

4.1.6 Ecological Resources

4.1.6.1 Vegetation

Under Alternative 1, lessees would complete reclamation on their respective leases. Exploration and mine development and operations would not occur on any of the lease tracts. Reclamation would occur on Lease Tracts 5, 6, 7, 8, 9, 11, 13, 15, 18, and 26. It is assumed that reclamation field activities would occur over a 1-year period and would include grading to create landforms conforming with the surrounding area, the application of surface soil materials, and seeding. The area of direct effects is considered to be the area that would be physically modified during reclamation (i.e., where ground-disturbing activities would occur).

Upland areas affected by grading would generally consist of previously disturbed areas, although higher-quality undisturbed plant communities near the margins of work areas could potentially be affected. Disturbed areas generally support commonly occurring non-native species, which in some areas include noxious weeds (see Table 3.6-4), or weedy native early successional species. Grading would be followed by the placement of a cover of surface soil materials designed to ensure an adequate thickness for protection of human health (see Section 4.1.5).

The disturbed surface area would be seeded following final surface preparation. BMPs that would improve the potential for successful vegetation establishment that have been proposed for use at several at mine sites (JD-6, JD-8, JD-9, CM-25, LP-21, SM-18, SR-11, SR-13A) include these: pocking south-facing slopes following placement of soil but before seeding, to enhance moisture retention; seeding immediately following topsoil placement before crust formation, preferably in the spring or fall; covering seeds by using a drag bar, chain link, or packer wheels (except pocked surfaces). The seed mix developed by DOE, in consultation with BLM, for use in reclamation of all lease tracts is given in Table 4.1-9. Weed-free seed mixes from local sources, where available, would be used. Higher short-term and long-term establishment and survival rates would likely result from the use of seeds of local native genotypes, adapted to local environmental conditions. Seeding may potentially introduce nonadapted genetic strains into local native populations of the species planted and could potentially lower the fitness of these populations (BLM 2008d). While effects would extend beyond the reclamation period, they would not threaten the local population of any affected species and would be considered minor. Following the second growing season, the establishment of desirable vegetation would be evaluated. The desired plant community at each mine site would depend on site-specific conditions and would be determined on a case-by-case basis. Most of the lease tracts are located in areas of piñon-juniper woodland and sagebrush shrubland (see Section 3.6.1). The reclaimed areas would be monitored until vegetation establishment was determined to be successful. The final determination of successful vegetation establishment would be made by DOE with input from BLM and the CDRMS. Satisfactory reclamation would require the successful establishment of at least six of the species shown in Table 4.1-9, the stabilization of soil erosion resulting from the project, plant cover at least equal to what existed prior to disturbance, and species composition at least as desirable as what existed prior to disturbance. Follow-up activities might be required to correct deficiencies in community composition or cover. While reclamation would be expected to establish native plant communities over the long term, it might result in the establishment of plant communities that would be considerably different from those of adjacent areas (Newman and Redente 2001). Colonization of reclaimed areas by species from nearby plant communities might be slow (Paschke et al. 2005; Newman and Redente 2001; Sydnor and Redente 2000). The successful reestablishment of some plant communities, such as sagebrush shrubland or piñon-juniper woodland, would likely require decades.

Reclamation activities could result in indirect impacts on habitats in adjacent areas. Indirect impacts associated with reclamation activities could include the deposition of fugitive dust, erosion, sedimentation, and the introduction of non-native species, including noxious weeds. Measures, such as applying dust suppressants, creating gentle slopes, controlling runoff and sediment, and eradicating invasive species, which are listed in Table 4.6-1, would mitigate these potential impacts. The area of indirect effects includes the lease tracts and the area within 5 mi [8 km] of the lease tracts, where ground-disturbing activities would not occur but that could be indirectly affected by activities in the area of direct effects. The potential degree of indirect effects would decrease with increasing distance from the lease tracts. This area of indirect effects

TABLE 4.1-9 Seed Mixture Developed for Reseeding on the DOE ULP Lease Tracts

Species		Broadcast Application Rate (lb PLS/acre)[a]
Scientific Name	Common Name	
Achnatherum hymenoides	Paloma Indian ricegrass	4.0
Atriplex canescens	Rincon fourwing saltbush	3.0
Bouteloua gracilis	Hachita blue grama	2.0
Elymus trachycaulus ssp. *trachycaulus*	Slender wheatgrass	2.0
Hesperostipa comata	Needleandthread grass	1.0
Krascheninnikovia lanata	Winterfat	1.0
Linum lewisii	Maple Grove Lewis flax	1.0
Nassella viridula	Lodorm green needlegrass	2.0
Pascopyrum smithii	Arriba western wheatgrass	4.0
Penstemon cyanocaulis[b]	Bluestem beardtongue	0.5
Pleuraphis jamesii (florets)	Galleta grass	2.0
Sphaeralcea coccinea or *Sphaeralcea parvifolia*	Scarlet or parvifolia globemallow	0.3

[a] PLS = pure live seed.

[b] Rocky Mountain penstemon (Bandera) should be used if *Penstemon cyanocaulis* is not available.

was identified on the basis of professional judgment and was considered sufficiently large to bound the area that would potentially be subject to indirect effects.

Because most impacts could be avoided and plant communities would be expected to fully recover from remaining impacts, the impacts of reclamation activities would be minor.

Deposition of fugitive dust generated during grading and the use of access roads could reduce photosynthesis and productivity in plant communities near project areas. Prolonged exposure to fugitive dust could alter a plant community's composition, reducing the occurrence of species less tolerant of disturbance and resulting in habitat degradation. However, because of the short duration of reclamation activities, the deposition of fugitive dust would constitute a short-term minor impact.

Soils disturbed by equipment or used for waste-rock reclamation could be subject to erosion. Soil erosion might also occur in areas where biological soil crusts had been disturbed by equipment or foot traffic. Soil compaction from the operation of heavy equipment could reduce the infiltration of precipitation or snowmelt and result in increased runoff and subsequent erosion. Erosion could result in the localized loss of plant communities in areas where surface soil materials were lost, and it could include areas outside the mine site. Effects might include mortality or reduced growth of plants, changes in species composition, or reduced biodiversity. Species more tolerant of disturbance, including invasive species, might become dominant in affected plant communities. Reclamation of mine sites would generally include a working area of approximately 1 to 8 acres (0.4 to 3.2 ha) per mine. However, the reclamation of the open-pit mine on JD-7 would involve approximately 210 acres (85 ha). A greater working area would be expected to increase the potential for erosion and sedimentation impacts. However, measures such as directing runoff to settling or rapid infiltration basins and quickly stabilizing slopes, which are listed in Table 4.6-1, would mitigate these potential impacts.

As noted above, areas on the lease tracts that have been previously disturbed by mining activities generally support commonly occurring non-native species, which in some areas include noxious weeds or weedy native early successional species. Eight species of noxious weeds are known to occur on the lease tracts included in Alternative 1 (Table 3.6-5), while many others occur in the area. Soils disturbed by reclamation activities might provide an additional opportunity for the introduction and spread of invasive species or noxious weeds. Seeds of these species could be inadvertently brought to a project site from infested areas by vehicles or equipment used at the site. Invasive species or noxious weeds might also colonize disturbed soils from established populations in nearby areas. DOE and the state of Colorado require lessees to control noxious weed infestations. The establishment of invasive species or noxious weeds might slow or prevent the establishment of desired plant communities, but would be minimized by on-going weed control measures. Invasive species or noxious weeds might also alter fire regimes, including increasing the frequency and intensity of wildfires, particularly as a result of the establishment of annual grasses such as cheatgrass. Habitats that were not adapted to frequent or intense fires could experience long-term effects, requiring decades to recover, or replacement by non-native species. As just noted, reclaimed areas would be monitored until vegetation establishment was successful, and invasive species would be eradicated immediately. Therefore, the spread of these species would be minimized. In addition, any noxious weeds or invasive species currently present on areas to reclaimed would be replaced by native plant communities, reducing seed sources for those species.

4.1.6.1.1 Wetlands and Floodplains

Grading operations would include the filling or removal of containment ponds, sedimentation ponds, or other retention basins that can occur on mine sites. Some of these areas might include wetland habitats, requiring compliance with E.O. 11990, *Protection of Wetlands*, and the DOE implementation in 10 CFR Part 1022, as well as with Section 404 of the CWA for jurisdictional wetlands. Compliance may include mitigation requirements.

Erosion might result in sedimentation in downgradient wetland habitats and increased sediment deposition in ephemeral or intermittent drainages or riparian habitats of receiving streams such as the Calamity Creek drainage in Lease Tract 26, the Dolores River drainage in Lease Tract 13, or the Atkinson Creek drainage in Lease Tract 18. Effects might include mortality or reduced growth of plants, changes in species composition, or reduced biodiversity. Species more tolerant of disturbance, including invasive species, might become dominant in affected plant communities.

4.1.6.2 Wildlife

Under Alternative 1, reclamation would occur on 10 lease tracts. Altogether, 267 acres (108 ha) would be reclaimed, with most of it (210 acres or 85 ha) involving the surface open-pit mine on Lease Tract 7. As discussed in Section 4.1.6.1, areas affected by reclamation would generally consist of previously disturbed areas, although some undisturbed habitats could be affected near the outer margins of the areas being reclaimed. As mentioned in mine permit amendment applications, mines will be reclaimed for range and wildlife habitat to meet DOE's directive to return land as closely as possible to pre-mine land use (Cotter Corp. 2011, 2012a–g). Post-mine conditions should improve forage and habitat for both wildlife and grazing stock.

Reclamation activities could affect wildlife by altering existing habitat characteristics and the species supported by those habitats. These activities would vary among locations, depending on the extent of infrastructure (if any) that would need to be removed, projected future land use, and the amount of site restoration (e.g., amount of recontouring) required. Reclamation activities that could affect wildlife include (1) dismantling of structures, (2) generation of waste materials, (3) recontouring of project areas, (4) revegetation activities, and (5) accidental releases (spills) of potentially hazardous materials. Where mine portals exist, reclamation activities would involve either filling the portals or adding bat gates to the openings. Mine closure would be achieved with boulders and rocks and/or by backfilling the portals with available mine-waste rock and other surface soil materials, covering those materials with surface soil materials, and reseeding.

During reclamation activities, localized obstructions of wildlife movement could occur. There would also be an increase in noise and visual disturbance associated with removal of project facilities and site restoration. Traffic and equipment operations during reclamation could result in low levels of wildlife mortality. Most wildlife would avoid areas where reclamation activities were taking place. Avoidance would be a short-term impact.

Other potential environmental concerns resulting from reclamation would include the disposal of solid wastes and hazardous materials and the remediation of any contaminated soils and water treatment pond sediments. Some fuel and chemical spills could also occur, but they would be generally confined to access roads and project site areas. The probability of wildlife exposure to such spills would be small and limited to a few individuals. After reclamation activities were complete, there would be no fuel or chemical spills associated with the reclaimed mine areas.

Permanent underground mine closure could destroy potential habitat for bats and other wildlife. To mitigate this impact, mines to be closed should be surveyed for the presence of bats, if feasible (Brown et al. 2000) (see Table 4.6-1 in Section 4.6). The use of bat gates in the mine openings would maintain the mines utilized by bats as potential roost-site habitats. However, the use of underground habitats in uranium-rich areas or reclaimed uranium mines could expose wildlife species to uranium or other radionuclides through inhalation, ingestion, or direct exposure (BLM 2011n). The potential exists for radium-226 concentrations to exceed DOE's biota concentration guideline of 50.6 pCi/g (i.e., the assumed concentration could be 168 pCi/g or more in hot spots); although the overall radium-226 concentration is expected to be below the guideline (i.e., 23.7 pCi/g or less, which would be similar to the waste-rock pile). Exposure to continuous low doses of radiation has been shown to adversely affect bats (e.g., cause genetic damage) (Meehan 2001). Thus, unless the mine sites slated for reclamation have exceptional qualities as hibernacula or roost sites, consideration should be given to evicting bats (e.g., determining when fewest bats would be present in the mine and then adding exclusion barriers to allow bats to exit, but not reenter the mine) and permanently sealing the mines in order to remove the threat of their exposure to radionuclides. The Colorado Bat Working Group (2005) discussed the pros and cons of gating uranium mines. Evidence of adverse radiation impacts on bats was inconclusive. The risks of exposure to radionuclides may be outweighed by the use of caves as alternatives to diminishing natural habitats. In particular, the majority of Colorado's Townsend's big-eared bats (*Corynorhinus townsendii*) maternity roosts are in uranium mines, and displacing them could impact the population (Colorado Bat Working Group 2005). The closure of abandoned mines is considered a substantial imminent threat to the Townsend's big-eared bat; a substantial non-imminent threat to the fringed myotis (*Myotis thysanodes*); and a widespread, low-severity threat, slightly threatened, or unthreatened for other bats species in Colorado (Colorado Bat Working Group 2010b). Decisions on whether to use bat gates or permanently close underground mines should be made among DOE, BLM, CPW, and other interested stakeholders such as the Colorado Bat Working Group.

Indirect impacts on wildlife could occur from dust deposition, erosion, sedimentation, and introduction of non-native plant species. Non-native plant species can increase the frequency and intensity of wildfires (Section 4.1.6.1). Measures (i.e., compliance measures, mitigation measures, and BMPs; see Table 4.6-1 in Section 4.6.4) would minimize these impacts. The seed mixture approved for reseeding mine sites during reclamation (Section 4.1.6.1) would reduce the potential for invasive plant species to become established.

Overall, impacts on wildlife would be minor during reclamation activities. The potential to minimize or avoid impacts on migration, breeding, and other seasonal wildlife activities could be accomplished by timing reclamation work so as not to occur during these periods. Reclamation would restore habitat and establish ecological conditions suitable for wildlife species. However, except for species whose range includes the 210 acres (85 ha) to be reclaimed within Lease Tract 7, the amount of habitat reclaimed would be limited. For example, only a maximum of 27 acres (11 ha) of overall desert bighorn sheep (*Ovis canadensis nelsoni*) habitat would be restored or improved. Reclamation would restore or improve up to 267 acres (108 ha) of habitat for many of the representative wildlife species listed in Section 3.6.2 (except amphibians). Removal of water treatment ponds on Lease Tracts 7 and 9 would eliminate potential drinking water sources and habitats for wildlife (particularly amphibian species). However, water treatment pond removal would also eliminate potential sources of contaminant exposure for wildlife. There is no evidence that these ponds are extensively used by water fowl or other migratory birds. The removal of these ponds would not result in a valuable resource loss for birds or other wildlife.

The effectiveness of any reclamation activities would depend on the specific actions taken; the best results, however, would occur where original site topography, hydrology, surface soil materials, and vegetation patterns were reestablished. This could most likely be attained at underground mine sites. However, this might not be possible under all situations. Following reclamation, negligible impacts on wildlife would occur during DOE's long-term management of the withdrawn lands.

4.1.6.3 Aquatic Biota

During reclamation, erosion could result in sediment deposition in intermittent and ephemeral drainages, and, during storm events, the sediments could potentially reach perennial streams and rivers. The potential for this is most likely at Lease Tract 13, through which the Dolores River flows. A total of only 8 acres (3.2 ha) at three mine sites is being reclaimed in Lease Tract 13. Thus, the potential for sediments (including those that could contain radioactive or chemical contaminants) to enter either the Dolores River due to reclamation activities is unlikely, particularly with the appropriate use of mitigative and compliance measures and BMPs to control erosion (see Table 4.6-1 in Section 4.6).

Areas being reclaimed would become less prone to erosion over time because site grading would be completed and vegetative cover would be established in accordance with the mitigative and compliance measures and BMPs identified in Table 4.6-1. Assuming that reclamation activities were successful, restored areas should eventually become similar to natural areas in terms of erosion potential. Following reclamation, the potential for erosion from the reclaimed mine sites would be less than what currently exists for the unreclaimed mine site areas.

Overall, impacts on aquatic biota from Alternative 1 would be negligible.

4.1.6.4 Threatened, Endangered, and Sensitive Species

Impacts on threatened, endangered, and sensitive species from uranium mining activities are fundamentally similar to, or the same as, those described for impacts on more common and widespread plant communities and habitats, wildlife, and aquatic resources (see Sections 4.1.6.1, 4.1.6.2, and 4.1.6.3). However, because of their low populations, listed species are far more sensitive to impacts than more common and widespread species. Low population size makes these species more vulnerable to the effects of habitat fragmentation, habitat alteration, habitat degradation, human disturbance and harassment, mortality of individuals, and the loss of genetic diversity. Although listed species often reside in unique and potentially avoidable habitats, the loss of even a single individual of a listed species could result in a much greater impact on the population of the affected species than would the loss of an individual of a more common species.

Under Alternative 1, potential impacts could result from reclamation activities at Lease Tracts 5, 6, 7, 8, 9, 11, 13, 15, 18, and 26. Table 4.1-10 presents the potential for impacts on threatened, endangered, and sensitive species under Alternative 1. Of the 52 species listed in Table 4.1-10, 45 might be affected by program activities under Alternative 1. Among these species that might be affected are 17 plants, 7 fish, 2 amphibians, 1 reptile, 9 birds, and 7 mammals.

TABLE 4.1-10 Potential Effects of the Uranium Leasing Program under Alternative 1 on Threatened, Endangered, and Sensitive Species

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
***Plants*[d]**				
Canyonlands biscuitroot	*Aletes latilobus*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Dolores River skeletonplant	*Lygodesmia doloresensis*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Eastwood's monkeyflower	*Mimulus eastwoodiae*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Fisher milkvetch	*Astragalus piscator*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
Grand Junction milkvetch	*Astragalus linifolius*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, 18, and 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Grand Junction suncup	*Camissonia eastwoodiae*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Gypsum Valley cateye	*Cryptantha gypsophila*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Helleborine	*Epipactis gigantean*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Horseshoe milkvetch	*Astragalus equisolensis*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect impacts such as runoff, sedimentation, and the dispersion of fugitive dust.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
Kachina daisy	*Erigeron kachinensis*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, and 18 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Naturita milkvetch	*Astragalus naturitensis*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Osterhout's cryptantha	*Cryptantha osterhoutii*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 26 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Paradox breadroot	*Pediomelum aromaticum*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as runoff, sedimentation, and the dispersion of fugitive dust.
Paradox lupine	*Lupinus crassus*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, and 18 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
San Rafael milkvetch	*Astragalus rafaelensis*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, 18, and 26 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.
Sandstone milkvetch	*Astragalus sesquiflorus*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, and 18 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.
Wetherill's milkvetch	*Astragalus wetherillii*	FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance resulting from reclamation activities, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.
Invertebrates[e]				
Great Basin silverspot butterfly	*Speyeria nokomis nokomis*	BLM-S	All	No impact. Direct or indirect impacts on the species or its habitat (riparian areas) from reclamation activities are unlikely to occur.
Fish				
Bluehead sucker	*Catostomus discobolus*	BLM-S; FS-S	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Bonytail	*Gila elegans*	ESA-E; CO-E	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the bonytail or its critical habitat.
Colorado pikeminnow	*Ptychocheilus lucius*	ESA-E; CO-T	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Colorado pikeminnow or its critical habitat..
Flannelmouth sucker	*Catostomus latipinnis*	BLM-S; FS-S	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A.
Humpback chub	*Gila cypha*	ESA-E; CO-T	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the humpback chub or its critical habitat..

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Razorback sucker	*Xyrauchen texanus*	ESA-E; CO-E	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the razorback sucker or its critical habitat..
Roundtail chub	*Gila robusta*	BLM-S; FS-S	All	Potential for negative impact. Reclamation activities could cause short-term soil erosion and sediment in ephemeral drainages, streams, and rivers. Greatest potential for impact occurs at Lease Tracts 13 and 13A.
Amphibians				
Boreal toad	*Bufo boreas*	CO-E	18, 19, 19A, 26, 27	No impact. Direct or indirect impacts on the species or its habitat (riparian areas) from reclamation activities are unlikely to occur.
Canyon treefrog	*Hyla arenicolor*	BLM-S	All	Potential for negative impact—indirect effects only. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Direct impacts on the species or its habitat (canyonlands and riparian areas) are unlikely to occur. However, indirect effects from runoff, sedimentation, or fugitive dust deposition might be possible.
Great Basin spadefoot	*Spea intermontana*	BLM-S	11, 11A	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tract 11 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.
Northern leopard frog	*Rana pipiens*	BLM-S; FS-S	13, 13A, 14, 15, 18, 19, 19A, 24, 25	No impact. Direct or indirect impacts on the species or its habitat (riparian areas) from reclamation activities are unlikely to occur.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Reptiles				
Longnose leopard lizard	*Gambelina wislizenii*	BLM-S	18, 19, 19A, 20, 24, 26, 27	No impact. Direct or indirect impacts on the species or its habitat (riparian areas) from reclamation activities are unlikely to occur.
Midget-faded rattlesnake	*Crotalus oreganus concolor*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance, as well as indirect effects such as those resulting from runoff, sedimentation, and the dispersion of fugitive dust.
Birds				
Bald eagle	*Haliaeetus leucocephalus*	BLM-S; FS-S	5, 5A, 6, 7, 8, 8A, 9, 13, 13A, 14, 18, 19, 19A, 20, 21, 22, 22A, 23, 26, 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 5, 6, 7, 8, 9, 13, 13A, 18, and 26 could affect this species. Direct effects include disturbance of foraging habitat within the lease tracts. Wintering habitat along the Dolores River and Dry Creek Basin is not expected to be directly affected. However, indirect effects on these wintering habitats from noise, runoff, sedimentation, or fugitive dust deposition might be possible.
Brewer's sparrow	*Spizella breweri*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of sagebrush habitats, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Burrowing owl	*Athene cunicularia*	BLM-S; CO-T	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust.
Ferruginous hawk	*Buteo regalis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust.
Gunnison sage-grouse	*Centrocercus minimus*	ESA-P; BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Gunnison sage-grouse.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Mexican spotted owl	*Strix occidentalis lucida*	ESA-T; CO-T	All	Potential for negative impact—indirect effects only. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Direct impacts on the species or its habitat (canyonlands and coniferous forests) are unlikely to occur. However, indirect effects on suitable habitat from noise, runoff, sedimentation, or fugitive dust deposition might be possible. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the Mexican spotted owl or its critical habitat.
Northern goshawk	*Accipiter gentilis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from disturbance of foraging habitats (sagebrush, shrublands, and grasslands), as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust.
Peregrine falcon	*Falco peregrinus*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of foraging or nesting habitats, as well as indirect effects such as those resulting from noise runoff, sedimentation, and the dispersion of fugitive dust. Nests near Paradox Valley lease tracts might be indirectly affected by reclamation activities.
Sage sparrow	*Amphispiza belli*	FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of sagebrush habitats, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; CO-E	All	No impact. Direct or indirect impacts on the species or its habitat (riparian thickets and woodlands) from reclamation activities are unlikely to occur. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the southwestern willow flycatcher or its critical habitat.
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	ESA-C; BLM-S; FS-S	All	No impact. Direct or indirect impacts on the species or its habitat (riparian woodlands) from reclamation activities are unlikely to occur. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the western yellow-billed cuckoo.
White-faced ibis	*Plegadis chihi*	BLM-S; FS-S	13, 13A, 14, 15, and 15A.	No impact. Direct or indirect impacts on the species or its habitat (wetlands and water bodies) from reclamation activities are unlikely to occur.
Mammals[f]				
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to roosting or foraging habitats.
Black-footed ferret	*Mustela nigripes*	ESA-E; ESA-XN; CO-E	All	No impact. This species is considered extirpated from the ULP project counties. Prairie dog colonies in the vicinity of the ULP lease tracts are not at suitable densities for supporting ferret populations. ULP activities under Alternative 1 will have no effect on the black-footed ferret.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Mammals (Cont.)				
Fringed myotis	*Myotis thysanodes*	BLM-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to roosting or foraging habitats.
Gunnison's prairie dog	*Cynomys gunnisoni*	ESA-C; BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to suitable habitats. With the implementation of minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Gunnison's prairie dog.
Nelson's bighorn sheep	*Ovis canadensis nelsoni*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from disturbance of habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to suitable habitat.
Northern river otter	*Lutra canadensis*	CO-T	All	No impact. Direct or indirect impacts on the species or its habitat (river systems) from reclamation activities are unlikely to occur.

TABLE 4.1-10 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Mammals (Cont.)				
Spotted bat	*Euderma maculatum*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to roosting or foraging habitats.
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Reclamation activities on all lease tracts under Alternative 1 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to roosting or foraging habitats.
White-tailed prairie dog	*Cynomys leucurus*	BLM-S; FS-S	18, 19, 19A, 24, 25, 26, and 27	Potential for negative impact—direct and indirect effects. Reclamation activities on Lease Tracts 18 and 26 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitat, as well as indirect effects such as those resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust to suitable habitats.

[a] BLM-S = BLM-designated sensitive species; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; ESA-P = proposed for listing under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population as defined by Section 10 of the ESA; FS-S = USFS-designated sensitive species.

[b] Refer to Table 3.6.4-1 (Section 3.6.4) for a description of species' habitat requirements and potential to occur on or near lease tracts. Recorded occurrences were obtained as U.S. Geological Survey (USGS) quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011b). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the vicinity of the lease tracts.

Footnotes continued on next page.

TABLE 4.1-10 (Cont.)

[c] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 1 lease tracts. Impacts on species might occur as either direct or indirect effects. Direct effects are considered to be physical impacts resulting from ground-disturbing activities; these include impacts such as direct mortality and habitat disturbance. The impact zone for direct effects does not extend beyond the lease tract boundaries. Indirect effects result from factors including, but not limited to, noise, runoff, dust, accidental spills, and potential radiation exposure. The impact zone for indirect effects might extend beyond the lease tract boundaries, but the potential degree of indirect effects would decrease with increasing distance from the lease tracts. Impacts on species listed under the ESA are discussed using impact levels consistent with determinations made in the ESA Section 7 consultation with the USFWS.

[d] One plant species, the Colorado hookless cactus (ESA-T), might occur in one or more project county. However, suitable habitat for this species does not occur in the vicinity of any of the ULP lease tracts; ULP activities are not likely to affect this species or its habitat.

[e] One invertebrate species, the Uncompahgre fritillary butterfly (ESA-E), might occur in one or more project county. However, suitable habitat for this species does not occur in the vicinity of any of the ULP lease tracts; ULP activities are not likely to affect this species or its habitat.

[f] Two mammal species, the Canada lynx (ESA-T) and North American wolverine (ESA-C), might occur in one or more project counties. However, suitable habitat for these species does not occur in the vicinity of any of the ULP lease tracts; ULP activities are not likely to affect these species or their habitats.

4.1.6.4.1 Impacts on Species Listed under the Endangered Species Act. Ten of the species listed in Table 4.1-10 are listed as threatened or endangered under the ESA or are proposed or candidates for listing under the ESA: four fish—the bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker; four birds—the Gunnison sage-grouse, Mexican spotted owl, southwestern willow flycatcher, and western yellow-billed cuckoo; and two mammals—the black-footed ferret and Gunnison's prairie dog. Impacts of the preferred alternative (Alternative 4) on ESA-listed species were also evaluated through programmatic consultation with the U.S. Fish and Wildlife Service (USFWS) as required under Section 7(c)(1) of the ESA. Impacts on these species are discussed using the impact determinations consistent with terminology used in the ESA Section 7 consultation with the USFWS. The BA and BO prepared as part of the ESA Section 7 consultation are presented in Appendix E. Although the BA and BO discuss impacts related to the preferred alternative (Alternative 4), the programmatic consultation considered reclamation activities under Alternative 4, which could inform impact determinations under Alternative 1. As discussed in Section 3.6.4.1, there are no plants or invertebrates listed under the ESA that could occur in the vicinity of the ULP lease tracts. Impacts on these ESA-listed species are discussed below.

Colorado River Endangered Fishes. There are four listed species of fish that might be affected by ULP activities under Alternative 1: the bonytail chub; Colorado pikeminnow; humpback chub; and razorback sucker. Each of these fish species historically inhabited tributaries of the Colorado River system, including portions of the Dolores and San Miguel Rivers in the ULP project counties. Current populations of the Colorado River endangered fishes no longer inhabit these rivers in the vicinity of the lease tracts. However, suitable habitat and populations occur in the Colorado River downstream from the Dolores River, which is in the vicinity of and downgradient from several lease tracts and flows through Lease Tracts 13 and 13A. Designated critical habitat for the Colorado River endangered fishes also occurs in the Colorado River, downstream from the Dolores River. Direct impacts on these species or their habitat are unlikely to occur. However, indirect impacts on the Dolores or San Miguel Rivers from erosion, runoff, and sedimentation might be possible, which might affect the species and their habitat (including designated critical habitat) in the Colorado River (Table 4.1-10).

Water consumption from the Dolores River and Upper Colorado River Basin has the potential to affect downstream aquatic habitat for the Colorado River endangered fish. However, water consumption to support ULP reclamation activities under Alternative 1 will be low and is not likely to affect aquatic habitats. As discussed in Section 4.1.6.3, the potential for reclamation activities under Alternative 1 to affect biota such as the Colorado River endangered fishes is considered to be small. Any disturbance to surface features that would result in erosion and sedimentation would be short term; areas being reclaimed would become less prone to erosion over time because of the completion of site grading and establishment of vegetated cover. Actions to reduce impacts on the Colorado River endangered fishes are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Consultation with the CPW should also occur to determine any state mitigation requirements. Given the implementation of these minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Colorado River endangered fishes or their critical habitats.

Gunnison Sage-Grouse. The Gunnison sage-grouse is a species proposed for listing as endangered under the ESA. It was proposed for listing as an endangered species on January 11, 2013 (USFWS 2013a). Critical habitat for the species was also proposed at that time (USFWS 2013b). This species occurs in sagebrush-dominated habitats in western and southwestern Colorado. Although the species is not known to occur on any of the ULP lease tracts, a portion of the potential proposed critical habitat intersects several lease tracts in the Slick Rock area (Lease Tracts 10, 11, 11A, 12, 15A, 16, and 16A). No occupied or vacant/unknown proposed critical habitat intersects any of the ULP lease tracts. Occupied proposed critical habitat occurs within 1 mi (1.6 km) south of lease tracts in the Paradox area (Lease Tracts 6, 8, and 9) (Figure 3.6-15). Reclamation activities in the above-mentioned lease tracts under Alternative 1 could affect this species through direct effects associated with habitat disturbance, as well as indirect effects resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust (Table 4.2-1).

Surveys would be needed to determine the presence of the Gunnison sage-grouse and its habitat (e.g., sagebrush) on the ULP lease tracts and develop the appropriate avoidance, minimization, and mitigation measures, if necessary. Program activities would also comply with guidelines set forth in the BLM's *Greater Sage-Grouse Interim Management Policies and Procedures* (BLM 2011e) and *BLM National Greater Sage-Grouse Land Use Planning Strategy* (BLM 2011f). Measures to reduce impacts on this species (including survey protocol development, avoidance measures, minimization measures, and, potentially, translocation actions and compensatory mitigation if necessary) should be determined following coordination with the USFWS and the CPW. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these minimization and mitigation measures, ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Gunnison sage-grouse.

Mexican Spotted Owl. The Mexican spotted owl is listed as threatened under the ESA. This species is considered to be a rare migrant in Montrose and San Miguel Counties, Colorado. It inhabits steep canyons with dense old-growth coniferous forests. This habitat does not occur on the ULP lease tracts, but suitable habitat might occur in the vicinity of the ULP lease tracts. Reclamation activities in all lease tracts under Alternative 1 would not be likely to directly affect this species. However, indirect impacts on suitable habitat resulting from noise, runoff, sedimentation, or fugitive dust deposition might be possible (Table 4.1-10). The implementation of best reclamation practices should be sufficient to reduce or minimize indirect impacts on this species. Designated critical habitat for this species does not occur in the vicinity of the ULP lease tracts and is not expected to be affected by program activities. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the Mexican spotted owl or its critical habitat.

Southwestern Willow Flycatcher. The southwestern willow flycatcher is listed as endangered under the ESA. This species is considered to be an uncommon breeding resident in San Miguel County, Colorado. It inhabits riparian thickets and riparian woodlands. This species is not known to occur on any of the ULP lease tracts. However, according to the SWReGAP habitat suitability model for this species, potentially suitable summer nesting habitat might occur along the Dolores and San Miguel Rivers as well as their tributaries in Mesa, Montrose, and San Miguel Counties. These potentially suitable habitat areas occur in Lease Tracts 13 and 13A, which are being evaluated under Alternative 1. Program activities under Alternative 1 would not be expected to directly affect the southwestern willow flycatcher because direct impacts on this species and its habitat (riparian habitats) would probably be avoided. However, program activities in all lease tracts under Alternative 1 have the potential to indirectly affect the southwestern willow flycatcher through impacts resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to radiation exposure (Table 4.1-10). Critical habitat for the southwestern willow flycatcher does not occur in the vicinity of the lease tracts and is not likely to be affected.

The implementation of stormwater controls, mine water treatment systems, and other discharge mitigation methods would reduce impacts of ULP activities on this species under Alternative 1. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the southwestern willow flycatcher or its critical habitat.

Western Yellow-Billed Cuckoo. The western yellow-billed cuckoo is a candidate species for listing under the ESA. It inhabits deciduous riparian woodlands, particularly cottonwood and willow. The western yellow-billed cuckoo is known to occur in Mesa and Montrose Counties as an uncommon summer breeding resident. This species is not known to occur in the vicinity of any of the lease tracts; however, according to the SWReGAP habitat suitability model for the species, potentially suitable summer nesting habitat might occur along the Dolores River in southern Mesa and northern Montrose Counties. These potentially suitable habitat areas do not intersect any of the lease tracts, but they are downslope from Calamity Mesa, Outlaw Mesa, and Uravan lease tracts in Sinbad Valley. Program activities under Alternative 1 are not expected to directly affect the western yellow-billed cuckoo because direct impacts on this species and its habitat (riparian habitats) would probably be avoided. However, program activities in all lease tracts under Alternative 1 have the potential to indirectly affect the southwestern willow flycatcher through impacts resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to radiation exposure (Table 4.1-10).

The implementation of stormwater controls, mine water treatment systems, and other discharge mitigation methods would reduce impacts of ULP activities on the western yellow-billed cuckoo. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these minimization and mitigation measures, ULP activities under Alternative 1 will have no effect on the western yellow-billed cuckoo.

Black-Footed Ferret. The black-footed ferret is listed as endangered under the ESA. There are several introduced populations that are listed as experimental and nonessential; however, these populations do not occur in the vicinity of the ULP lease tracts. This species inhabits prairies and shrublands in association with prairie dogs. According to the SWReGAP model, suitable habitat for this species does not occur on or in the vicinity of the ULP lease tracts. The black-footed ferret is presumably extirpated from west central Colorado in the region of the ULP lease tracts even though block clearance surveys for this species have not been conducted in western Colorado (USFWS 2009a). Prairie dog densities in the region surrounding the ULP lease tracts are not at sufficient densities for supporting the black-footed ferret. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these minimization and mitigation measures, ULP activities associated with Alternative 1 will have no effect on the black-footed ferret.

Gunnison's Prairie Dog. The Gunnison's prairie dog is a candidate species for listing under the ESA. This species is known to occur in the ULP counties in shrubland habitats at elevations between 6,000 and 12,000 ft (1,800 and 3,700 m). According to CPW, this species is known to occur in at least one lease tract, and suitable habitat may occur in several other lease tracts in Montrose and San Miguel Counties. The overall range for this species intersects several Paradox and Uravan lease tracts. Furthermore, information provided by CNHP (2011b) indicated recorded quad-level occurrences of this species near Wild Steer Mesa, which is near the lease tracts in Paradox Valley and Dry Creek Basin. Reclamation activities in all lease tracts under Alternative 1 could affect this species through direct effects associated with habitat disturbance, as well as indirect effects resulting from noise, runoff, sedimentation, and the dispersion of fugitive dust (Table 4.1-10). Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Predisturbance surveys would be needed to determine the presence of this species and its habitat on the ULP lease tracts and develop the appropriate project-specific avoidance, minimization, and mitigation measures, if necessary. With the implementation of minimization and mitigation measures (Table 4.6-1), ULP activities under Alternative 1 may affect, but are not likely to adversely affect, the Gunnison's prairie dog.

4.1.6.4.2 Impacts on Sensitive and State-Listed Species. In addition to species listed under the ESA, there are several other sensitive species that could be affected by ULP activities under Alternative 1. These species include species designated as sensitive by the BLM and USFS, as well as those listed as threatened or endangered by the State of Colorado.

Of the species listed in Table 4.1-10, there are 41 species that are designated as sensitive by the BLM. Of these BLM-designated sensitive species, there are 16 plants, 1 invertebrate, 2 fish, 3 amphibians, 2 reptiles, 9 birds, and 7 mammals. Several of these BLM-designated sensitive species are candidates for listing under the ESA. Impacts to BLM-designated sensitive species are presented in Table 4.1-10.

Of the species listed in Table 4.1-10, there are 20 species that are designated as sensitive by the USFS. Of these USFS-designated sensitive species, there are 2 plants, 3 fish, 1 amphibian, 8 birds, and 6 mammals. Several of these USFS-designated sensitive species are candidates for listing under the ESA or are also designated as BLM-sensitive. Impacts to USFS-designated sensitive species are presented in Table 4.1-10.

Of the species listed in Table 4.1-10, there are 10 species that are listed as threatened or endangered by the State of Colorado. Of these state-listed species, there are 4 fish, 1 amphibian, 3 birds, and 2 mammals. Several of these state-listed species are listed under ESA (or proposed or candidates for listing under the ESA) or are also designated by the BLM or USFS as sensitive. Impacts on state-listed species are presented in Table 4.1-10.

4.1.7 Land Use

Under Alternative 1, the existing 29 leases would be terminated, and DOE would continue to manage the withdrawn lands, without leasing. The lands would continue to be closed to mineral entry; however, all other activities (e.g., recreation) within the lease tracts would continue. As a result, impacts due to land use conflicts are expected to be minor.

4.1.8 Socioeconomics

The socioeconomic impacts of uranium mining reclamation were assessed for an ROI that comprises three counties in Colorado (Mesa, Montrose, and San Miguel Counties). The ROI corresponds to the area in which workers at the site would reside and spend their wages and salaries.

The economic impacts of uranium mining reclamation activities were measured in terms of employment and income. Direct impacts would include wages and salaries as well as the purchase of goods and services required for uranium mining reclamation. Indirect and induced impacts would include project wages and salaries as well as the purchase of goods and services required for reclamation that would subsequently circulate through the economy, creating additional employment and income. Sales of goods and services by retailers in the ROI, together with the purchase of equipment and materials required for reclamation, would provide new sources of indirect employment and income to ROI residents.

The potential socioeconomic impacts from reclamation activities are expected to be minor. Reclamation would require 29 direct jobs during the reclamation year for field work and revegetation. It is assumed that the jobs required for reclamation would include laborers, supervisors, equipment operators, truck drivers, and electricians. The entire reclamation period would likely span 2 to 3 years, although only 1 year of reclamation activities would require a workforce. Reclamation would generate 16 indirect jobs (see Table 4.1-11). In total, reclamation activities would constitute 0.1% of total ROI employment and would increase the annual average employment growth rate by less than 0.1% in the ROI. Reclamation under Alternative 1 would also produce $1.7 million in income.

TABLE 4.1-11 Socioeconomic Impacts of Uranium Mining Reclamation in the Region of Influence under Alternative 1

Parameter	Reclamation
Employment (no.)	
Direct	29
Indirect	16
Total	45
Income[a]	
Total	1.7
In-migrants (no.)[b]	0
Vacant housing[c] (no.)	0
Local community service employment[d]	
Teachers (no.)	0
Physicians (no.)	0
Public safety (no.)	0

[a] Unless indicated otherwise, values are reported in $ million 2009.

[b] Reclamation would not result in in-migrants.

[c] Reclamation would not affect vacant rental housing or vacant owner-occupied housing.

[d] Reclamation would not require additional local community employment.

As discussed in Section 3.8, the average unemployment rate in the ROI was 9.6% in 2010; approximately 10,600 people were unemployed. Based on the number of people that could be available from the unemployed workforce and the ROI's distribution of employment by sector, there could be approximately 2,100 people available for reclamation activities in the ROI. On the basis of the available labor supply in the ROI as a whole, the current workforce could meet the demand for labor necessary for reclamation of the existing leases; therefore, in-migration of workers or families may not be required.

4.1.8.1 Recreation and Tourism

As described in Section 3.8.3, the three counties that make up the ROI (Mesa, Montrose, and San Miguel) contain large acreages of public land, both state and Federally managed. These public lands include designated wilderness, National Conservation Areas (NCAs), the Colorado National Monument, SRMAs including the Dolores River SRMA, Black Canyon of the Gunnison National Park, State Parks, WSAs, and other areas used for recreation. Recreation and tourism together are an economic driver in the area, with significant indirect impacts on the local economy. The diverse types of recreation that occur in the area include hunting, fishing, hiking, camping, horseback riding, mountain bike riding, OHV use, rafting, and cross-country and downhill skiing (BLM 2009e). According to the BLM, nearly all public land visitors use vehicles for recreation. For some visitors, their vehicle is just the mode of transportation used to access their recreational activity. For others, vehicle use itself is the activity. For example, the Unaweep/Tabeguache Scenic and Historic Byway passes through many towns in the ROI, including Nucla, Naturita, Redvale, Norwood, Sawpit, and Telluride.

If recreation and outdoor areas are the drivers of an area's tourism industry, then the condition of the environment is vital to the success of the industry. It is difficult to estimate the impact of any activity on recreation because it is not always clear how it could affect recreational visitation and nonmarket values (i.e., the value of recreational resources for potential or future visits).

Impacts on recreation in the area that would result from reclamation activities are likely to be minor. There might be a negative perception of uranium mining and its potential impacts on air quality, wildlife habitat, water quality, scenic viewsheds, and local roads from increased truck traffic. Therefore, the cessation of all uranium mining activities and initiation of reclamation on existing leases could have a positive effect on the local recreation economy if more people visited the area after reclamation. Increased mining activity in the area could put a strain on local governments from increased road use and traffic safety issues; the absence of mining activities would eliminate this pressure on local governments. Because reclamation would require such a small workforce, it is unlikely that traffic would affect recreational activities in the area. Reclamation does not require tall structures; therefore, the visual impacts would be limited. Unlike uranium mining development, which would continue 10 years past each mine's development phase, reclamation ground-disturbing activities would last only 1 year, and the expectation is that full reclamation would be completed within 2 to 3 years. The shortened time line, small workforce, and absence of uranium mining would likely result in a minor positive impact on recreation and tourism in the ROI.

4.1.9 Environmental Justice

Although there are unique radiological exposure pathways (such as subsistence fish, vegetation, wildlife consumption, or well water use) that could potentially produce adverse health and environmental impacts on low-income and minority populations, no radiological impacts are expected during the reclamation of uranium mining facilities. Reclamation would produce only minor radiological risks to workers or radiological or adverse health impacts to the general public (see Section 4.1.5) and thus would not disproportionately affect low-income and minority populations. Air emissions from fugitive dust and from the operation of equipment are expected to be minor (see Section 4.1.1), and chemical exposure during reclamation would be limited to airborne toxic air pollutants, would be at less than standard levels, and would not result in any adverse health impacts. No disproportionate impacts on low-income and minority populations would therefore be expected.

Because water would be trucked in from outside the local area during reclamation, there would be no diversion of water from domestic, cultural, religious, or agricultural uses that might disproportionately affect low-income and minority populations. Potential impacts of mining operations on surface water through runoff could occur in some lease tracts, and it has the potential to affect local rivers and aquifers (see Section 4.1.3.1). Short-term soil erosion impacts could occur during reclamation (see Section 4.1.3), with longer-term erosion impacts associated with runoff before revegetation would occur. Longer-term surface water runoff and soil erosion impacts could affect wildlife, water quality, and, if there was sedimentation, recreational fishing, and they could increase the potential for flooding. Both short-term and long-term surface water runoff and soil erosion impacts could affect subsistence activities, which could produce disproportionate impacts on low-income and minority populations.

Reclamation would introduce contrasts in form, line, color, and texture, as well as an increasing degree of human activity into landscapes where activity levels are generally low (see Section 4.1.12). However, dust mitigation would reduce the visual impact of reclamation, while revegetation programs would reduce the longer-term visual impact of mining sites on local communities and religious and cultural sites and, consequently, any disproportionate impacts on low-income and minority populations. Adverse impacts of uranium mining on property values would likely be minor, and the proximity to reclamation employment, higher tax revenues, and improved local public service provisions in local communities where there are low-income and minority populations would likely have positive impacts on these populations.

Although potential impacts on the general population could result from the reclamation of uranium mining facilities, for the majority of resources evaluated, impacts would likely be minor, and they would be unlikely to disproportionately affect low-income and minority populations. Specific disproportionate impacts on low-income and minority populations as a result of participation in subsistence or certain cultural and religious activities would also be minor.

4.1.10 Transportation

No transport of uranium ore would occur under Alternative 1. There would be no radiological transportation impacts. No changes in current traffic trends near the uranium lease tracts are anticipated because no significant supporting truck traffic or equipment moves would occur, and only about five reclamation workers would be commuting to each site on a regular basis during reclamation activities.

4.1.11 Cultural Resources

Under Alternative 1, reclamation activities would be conducted within Lease Tracts 5, 6, 7, 8, 9, 11, 13, 15, 18, and 26 where there are existing and permitted mines. A total of 111 cultural resource sites have been inventoried in these lease tracts. Adverse impacts are expected to be limited. No undeveloped land surfaces are expected to be directly affected. Any borrow material needed to cap old mines would come from existing stockpile locations. Direct impacts on cultural resources are not expected under this alternative. Indirect adverse impacts from vandalism could still occur in the lease tracts where reclamation is proposed, depending on the number and activities of workers engaged in reclamation.

Mining features themselves can be historically significant. Mining has had a significant influence on the development of the economic base of the Uravan Mineral Belt. Mining features and artifacts are at risk in reclamation activities. The BLM is responsible for surface management of the lease tracts. DOE procedures require ULP personnel to oversee the lessees' reclamation activities and, prior to reclamation, to consult with the BLM and adhere to Section 106 of the National Historic Preservation Act and consult with the Colorado SHPO to determine whether historic (eligible for inclusion on the NRHP) mine structures or features (trash piles, collapsed buildings, old mining equipment) are present on the site, and, if so, how they are to be managed (DOE 2011a).

All but one of the currently permitted mines are underground, and surface disturbance is restricted to portal and shaft openings and associated facilities. This area would already have been disturbed. Direct disturbance would occur if the already-stockpiled surface soil was not sufficient to complete surface reclamation.

The presence of reclamation work crews could put cultural resources at risk. The added presence of work crews would increase the risk of cultural resources being trampled, illegally collected, and/or vandalized. This risk could be reduced by the training of work crews and through the on-site oversight of reclamation activities by DOE and BLM personnel.

There is also the potential for positive consequences on cultural resources to occur under this alternative. Reclamation would take only about a year, whereas mine development and production could take 10 or more years. The termination of uranium mining would likely result in less heavy equipment, which would result in ground vibration, which can also have negative impacts on structural remains. It would also likely reduce regular human presence in the area the attendant potential adverse effects.

4.1.12 Visual Resources

As indicated in Section 3.12, the BLM's VRM procedures provide a means of systematically describing visual impacts, as well as a method for evaluating potential impacts on the scenic qualities of affected landscapes (BLM 1984). In essence, the BLM is responsible for ensuring that the scenic values of BLM-administered public lands are considered before allowing uses that might have negative visual impacts, such as uranium mining operations.

The BLM's VRM system defines a visual impact as the contrast that observers perceive between an existing landscape and a proposed project or activity. The BLM's contrast rating system (BLM 1986b) specifies a systematic approach for determining the nature and extent of visual contrasts that might result from a proposed activity and for determining whether those levels of contrast are consistent with the VRM class designation for the area. Contrasts between an existing landscape and a proposed project or activity are expressed in terms of form, line, color, and texture.[2] These basic design elements are routinely used by landscape designers to describe and evaluate landscape aesthetics; these elements have been incorporated into the BLM's VRM system to lend objectivity, integrity, and consistency to the process of assessing visual impacts of proposed projects and activities on BLM-administered lands.

Visual impacts can depend on the type and degree of visual contrasts introduced into an existing landscape. Where modifications repeat the general form, line, color, and texture of the existing landscape, the degree of visual contrast is generally lower and the perceived impacts are lower. Where modifications introduce pronounced changes in form, line, color, and texture, the degree of contrast is often greater, and perceived impacts are greater too.

Visual changes associated with Alternative 1 are associated with the reclamation activities that would be conducted at Lease Tracts 5, 6, 7, 8, 9, 11, 13, 15, 18, and 26.

Impacts resulting from reclamation can be produced through a range of direct and indirect actions or activities occurring on the lands contained within the lease areas. These types of impacts include the following:

- Vegetation and landform alterations,

- Removal of structures and materials,

- Changes to existing roadways, and

- Vehicular and worker activity.

Each of these impacts is discussed in further detail in Sections 4.1.12.1 through 4.1.12.5. These sections largely refer to impacts that are associated with the actual mining sites within the individual lease tracts. For this reason, an additional analysis was conducted to determine the impacts on lands surrounding the lease tracts. This discussion is provided in Section 4.1.12.6. Potential mitigation and compliance measures and BMPs to minimize lighting to off-site areas and to minimize contrast with surrounding areas are summarized in Table 4.6-1 (Section 4.6).

4.1.12.1 Vegetation and Landform Alterations

The reclamation of mining sites might require minimal clearing of vegetation, large rocks, and other objects in order to accommodate large equipment. The nature and extent of clearing are affected by the requirements of the individual mines, the types of vegetation, and the need for other objects to be cleared. The removal of vegetation would result in contrasts in color and texture because the varied colors and textures of vegetation would be replaced by the more uniform color and texture of bare soil. Depending on the type of vegetation cleared and the nature of the cleared surface, vegetation removal could also introduce additional contrasts in

2 See BLM (1986b) for definitions of form, line, color, and texture, and see BLM (1986a) for the applicability of these terms to the contrast rating.

form and line. Vegetation removal may also cause contrasts in texture during the short term (1 to 3 years). This might occur in areas where stockpiled soil was not sufficient to provide material for reclamation activities (DOE 1995). Over the long term (2 to 5 years), contrasts in line, color, and texture would begin to decrease as vegetation became established in reclaimed areas.

Recontouring of the land surface; potential grading, scarifying, seeding, and planting; and, at times, stabilizing disturbed surfaces would also be conducted (DOE 1995). The contours of reclaimed areas might not replicate pre-mining conditions. In the conditions generally found in the lease tracts, newly disturbed soils resulting from these activities might create visual contrasts that could persist for many seasons before revegetation would begin to disguise past activity.

In addition, invasive species also might colonize reclaimed areas; this occurrence likely would produce contrasts of color and texture over the short term, until infestations were controlled. Lessees are required to control invasive species and repeat reclamation if it is not successful after 3 years; however, if a lack of proper management led to the growth of invasive species in the reseeded areas, noticeable color and texture contrasts might remain indefinitely. The unsuccessful reclamation of cleared areas also could result in soil erosion, ruts, gullies, or blowouts, which could cause negative visual impacts until the erosional features were mitigated and adequate vegetation was established. Proper weed management would minimize these effects.

4.1.12.2 Removal of Structures and On-Site Materials

During many reclamation activities, structures associated with mining activities would probably be removed; pond liners would be removed from discharge and treatment ponds; debris and waste would be managed and transported off site; and adits and mine shaft openings would be closed. In some cases, mine waste-rock piles, residual ores, and other radioactive materials would be placed in the mine (DOE 1995).

These activities might result in some physical ground disturbance, which could produce contrasts of form, line, color, and texture. These impacts would be short term (1 to 3 years) and would decrease as vegetation became established.

Permanent structures might be needed to block off areas where mine shafts were opened. In the case of underground mines, this effort might include the addition of bat gates or other means of closure for open shafts. These types of structures might be visible from outside the lease tracts after reclamation activities were completed.

4.1.12.3 Roads

In general, no new roads would be needed for the reclamation of the mining areas. However, if additional upgrades to roads were needed, their development might introduce minor visual contrasts to the landscape, depending on the routes selected relative to surface contours and on the widths, lengths, and surface treatments of the roads.

Likewise, the closure of previously used access roads would have some associated residual impacts (e.g., vegetation disturbance, traffic patterns, and ground disturbance) that could be evident for some years afterward, with a gradual diminishing of impacts over time.

4.1.12.4 Workers, Vehicles, and Equipment

The various reclamation activities needed to restore the mine sites to their predevelopment conditions would require work crews, vehicles, and equipment. Each of these components might produce visual impacts. For instance, traffic involving small vehicles to allow worker access and traffic involving large equipment used for reclamation activities would occur.

The movement of workers and heavy machinery would produce visible activity and dust in dry soils. The suspension and visibility of dust would be influenced by the frequency and density of traffic, vehicle speeds and weights, road surface materials, and weather conditions. Visual impacts from truck-created dust typically would be localized to the unpaved roads (BLM 2011g). Temporary parking for vehicles would be needed at or near work locations. If there was unplanned and unmonitored parking, it could expand these areas, producing visual contrast from suspended dust and loss of vegetation. Some of the reclamation equipment could also produce emissions while it operated and thereby create visible exhaust.

Reclamation activities could also proceed in phases, with several crews moving through a given area in succession, giving rise to brief periods of intense activity (and associated visual impacts) followed by periods of inactivity.

4.1.12.5 Lighting

During reclamation, lighting might be needed around temporary buildings, parking areas, and work areas. Security and other lighting around and on support structures (e.g., temporary trailers) could contribute to light pollution. Section 4.3.12.2 provides an additional discussion on the potential visual impacts that might be created by the use of exterior lighting on mine sites.

4.1.12.6 Impacts on Lands Surrounding the Lease Tracts

Lands outside the lease areas might be subject to visual impacts related to the reclamation activities conducted at the mining sites. The affected areas and the extent of impacts would depend mostly on topography, vegetation, the types of activities conducted, length of exposure, and viewer distance.

Preliminary viewshed analyses were conducted to identify which lands surrounding the four lease groups, as identified in Section 3.12, are visible from within the various lease tracts.

An additional viewshed analysis was conducted for a subset of these groups that would include all of the lease tracts in which reclamation activities would be conducted under Alternative 1. This analysis was based upon a reverse viewshed analysis, (for which the methodology is provided in Appendix D); it considered Federal, state, and BLM-designated sensitive visual resources. The intent of the analysis was to determine the potential levels of contrasts (i.e., changes in form, line, color, and texture from the existing condition to that under Alternative 1) that would be present from within a surrounding land.

Under Alternative 1, reclamation activities would take place at 10 lease tracts. This analysis provides an overview of the potential visual impacts to those SVRAs surrounding the lease tracts. Due to the number of leases and the potential for increased activity, lands outside the lease tracts that have views of the lease tracts would be subject to visual impacts. For this analysis and subsequent analyses under other alternatives, SVRAs are defined as surrounding lands with a Federal, state, or BLM designation that have scenic and visual values and are thereby visually sensitive. SVRAs that surround the lease tracts and have open lines of sight to the mining facilities could be subject to impacts from the visual contrasts that would result, particularly if the distances to the facilities were short or the viewpoints in the SVRAs were elevated with respect to the individual lease tracts. In general, since the public is not allowed access to the mine sites, and since the sizes of the disturbed lease tracts that need to be reclaimed are relatively small, the viewing duration would be short, especially if the viewer was traveling along local roads near the lease tracts.

In some locations, views could include multiple mining sites that varied in size, layout, and type of activity being conducted (e.g., underground or open-pit mining). The variety of project sizes, layouts, and associated visual impacts could exceed the visual absorption capability of the landscape, resulting in “visual clutter” that would detract from the experience or enjoyment of scenic or visual qualities for visitors to the SVRAs.

For the purposes of this analysis, the lease tracts were analyzed in four groups: North; North Central; South Central; and South Groups (as described in Section 3.12). Ten lease tracts were evaluated under this alternative: Lease Tracts 5; 6; 7; 8; 9; 11; 13; 15; 16; and 18. This analysis accounts only for these tracts within each group.

4.1.12.6.1 North Group. Under Alternative 1, the following SVRAs potentially would have views of activities in the North Group (i.e., Lease Tract 26):[3]

- Sewemup WSA;

- The Palisade ONA (an ACEC); and

- The Palisade WSA.

[3] For the four groups of lease tracts, the SVRAs are presented in descending order, based on the percentage of the total acreage or mileage visible.

Figure 4.1-3 shows the results of the viewshed analysis for the lease tract within the North Group. The colored segments indicate areas in the SVRAs with clear lines of sight to one or more areas within the lease tract and from which reclamation activities conducted within the lease group could be visible, assuming the absence of screening vegetation or structures and the presence of adequate lighting and other favorable atmospheric conditions.

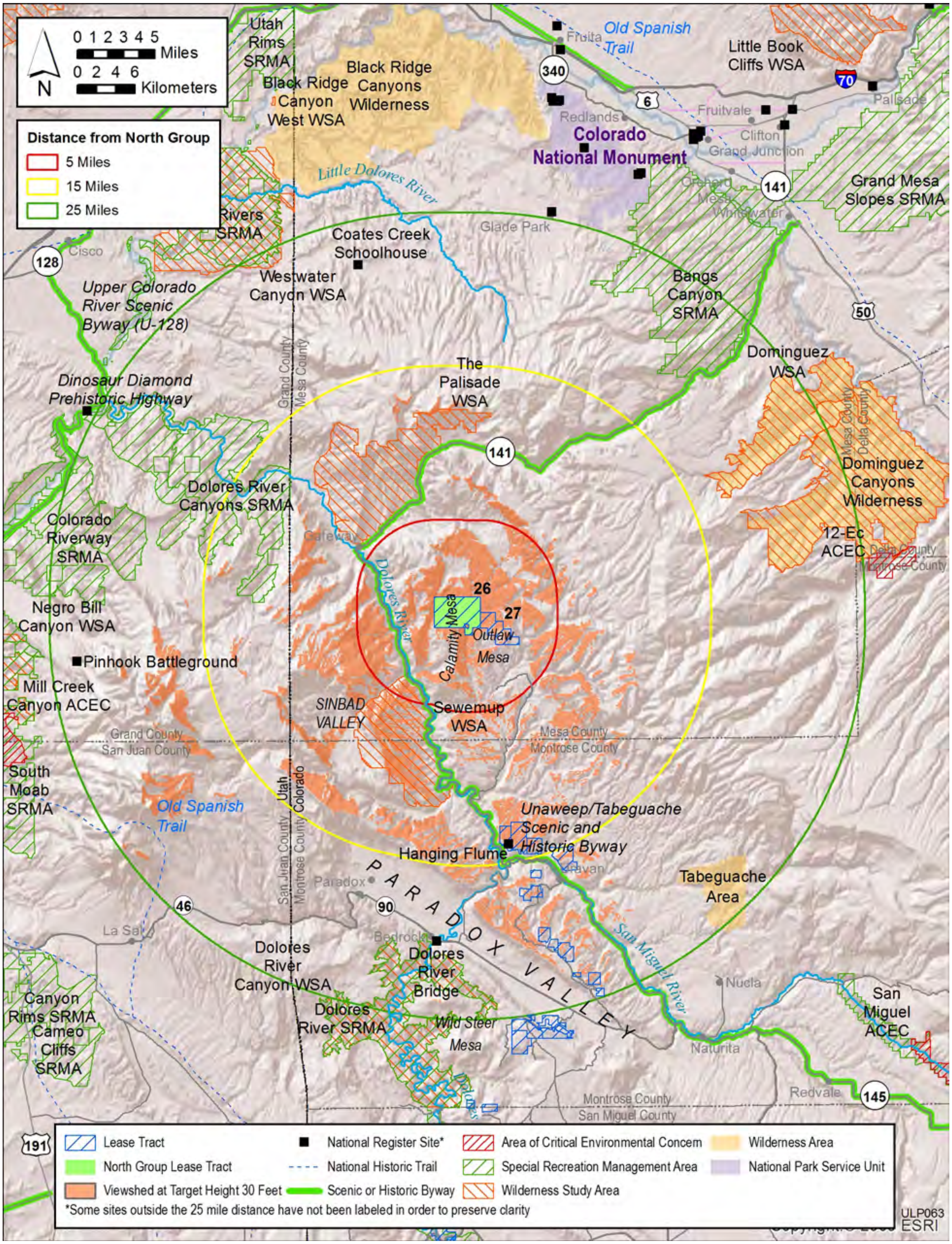
The North Group lease tract would potentially be visible from approximately 3.2% (620 acres or 250 ha) of the Sewemup WSA; these viewing areas are located within 5 mi (8 km) of this portion of the North Group. The lease tracts also would be visible from approximately 34% (6,600 acres or 2,700 ha) of the WSA that is within 15 mi (24 km) or less of the North Group lands. Views of the North Group from the WSA are generally partially or fully screened by the intervening mountains. Visibility of this portion of the North Group is most likely from the locations within the WSA that are higher in elevation than the lease tract. Views of the reclamation activities would likely be limited and could include existing structures and possibly equipment used for the reclamation activities. Reclamation activities under Alternative 1 would be expected to cause minimal (barely discernible) to weak (not likely to be noticed by a casual viewer) visual contrast for views from the Sewemup WSA.

Portions of the North Group would be visible from the Palisade ONA ACEC in areas of the ACEC between 5 and 15 mi (8 and 24 km) from the North Group. The North Group would be visible from approximately 390 acres (160 ha) (1.6%) of the total ACEC. Views of the lease tract within the North Group from the ACEC are generally partially or fully screened by the intervening mountains. Only views from the northernmost portions of the ACEC would include this lease tract. Views of the reclamation activities and site would likely be limited and could include existing structures and possibly equipment used for the reclamation activities. As such, reclamation activities under this alternative would be expected to cause minimal to zero contrast levels for views from this ACEC.

Approximately 290 acres (120 ha) (1.1%) of the Palisade WSA would potentially have views of the lease tract, in portions of the WSA that are between 5 and 15 mi (8 and 24 km) from the North Group. The Palisade WSA is contained almost entirely within the Palisade ONA ACEC. As a result, levels of contrast in this area would be similar to those described for the ACEC.

4.1.12.6.2 North Central Group. Figure 4.1-4 shows the results of the viewshed analysis for Lease Tract 18 within the North Central Group. The following SVRAs could have views of this lease tract:

- Tabeguache Area;
- Sewemup WSA; and
- Unaweep/Tabeguache Scenic and Historic Byway.

1 

2 **FIGURE 4.1-3 Viewshed Analysis for Portions of the North Lease Group under Alternative 1**

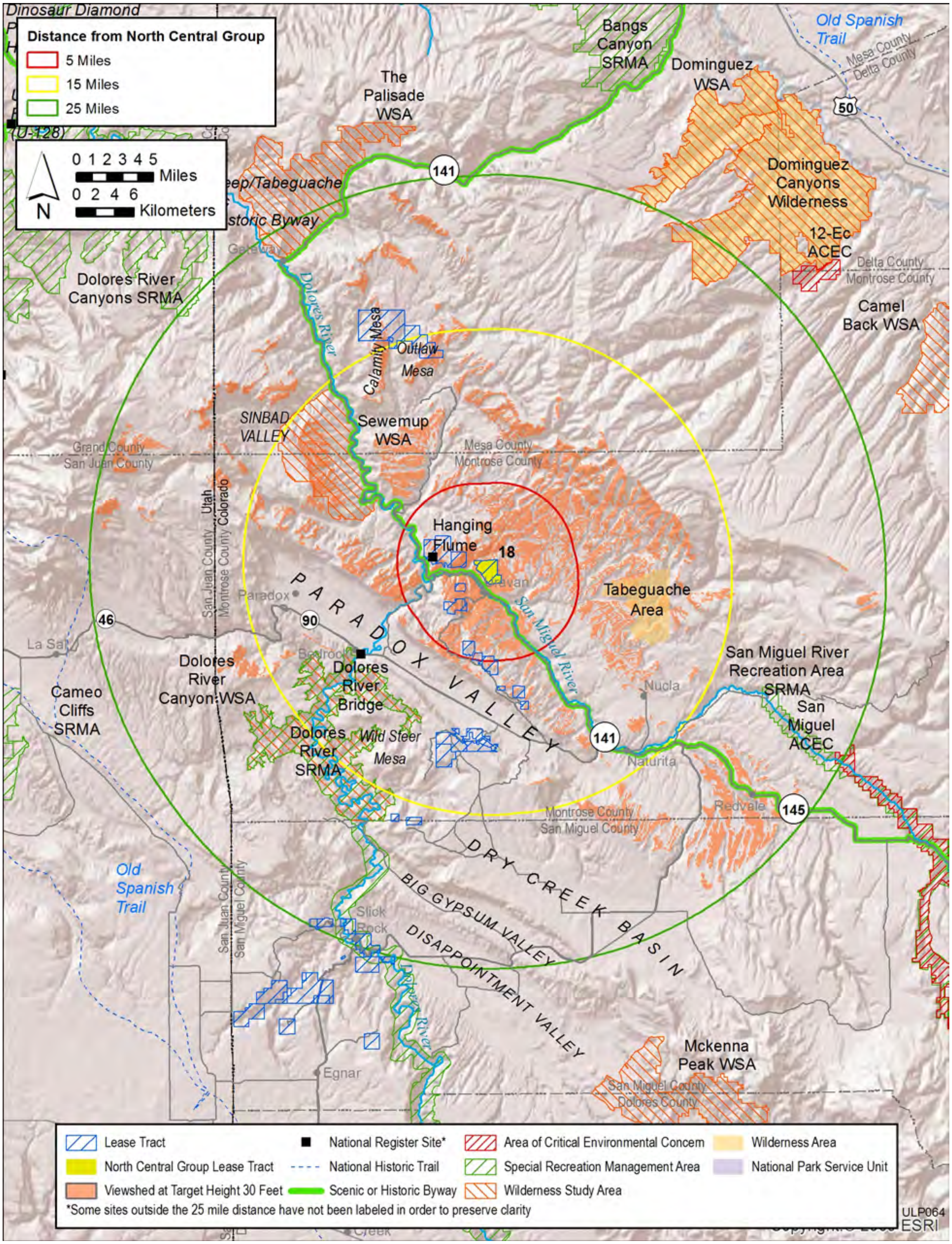


FIGURE 4.1-4 Viewshed Analysis for the North Central Lease Group under Alternative 1

The North Central Group activities could be visible from portions of the Tabeguache Area located between 0 and 25 mi (0 and 40 km) from the lease tract. Views of Lease Tract 18 are partially or fully screened by the intervening mountains and vegetation. This lease tract would be visible from approximately 20% (1,600 acres or 670 ha) of the Tabeguache Area. Views of the lease tract would be possible from elevated viewpoints within the Tabeguache Area. Views of the reclamation activities and site might be limited and include existing structures and possibly equipment used for the reclamation activities. Reclamation activities under Alternative 1 would be expected to cause minimal to weak levels of contrast for views from within this area.

The North Central Group activities could be visible from approximately 19% (3,700 acres or 1,500 ha) of the Sewemup WSA. It would be visible from portions of the WSA that are located between 5 and 15 mi (8 and 24 km) of the North Central Group. Views of this lease tract from the WSA are generally partially or fully screened by the intervening mountains. Visibility of this portion of the North Central Group is likely from the locations within the WSA that are higher in elevation than the lease tract. Views of the reclamation activities and site might be limited and include existing structures and possibly equipment used for the reclamation activities. Reclamation activities under this alternative would be expected to cause minimal to weak levels of contrast for views from this WSA.

The viewshed analysis indicates that activities within the North Central Group lease tracts could be visible from approximately 23 mi (37 km) of the Unaweep/Tabeguache Scenic and Historic Byway, 6 mi (10 km) of which is within 1 mi (1.6 km) of Lease Tract 18. However, because of minor mapping inaccuracies that place portions of the roadway outside the narrow canyon it occupies, thereby locating them at higher elevations than they actually are, and because of vegetative screening, the actual mileage of the byway with views of the lease tracts is likely smaller. Actual visibility would be determined as part of a site- and project-specific environmental assessment. Views of the reclamation activities and existing infrastructure might be visible to visitors driving along the byway. Activities conducted under this alternative would be expected to cause minimal to no contrast levels for views from the byway, because of the small size of the individual lease tract and the location of the byway within the San Miguel River Canyon below the lease tract.

4.1.12.6.3 South Central Group. Figure 4.1-5 shows the results of the viewshed analysis for lease tracts within the South Central Group in which reclamation activities would take place; these are Lease Tracts 5, 6, 7, 8, and 9. The following SVRAs might have views of the South Central Group:

- Tabeguache Area;
- Unaweep/Tabeguache Scenic and Historic Byway;
- Dolores River Canyon WSA;
- Sewemup WSA;

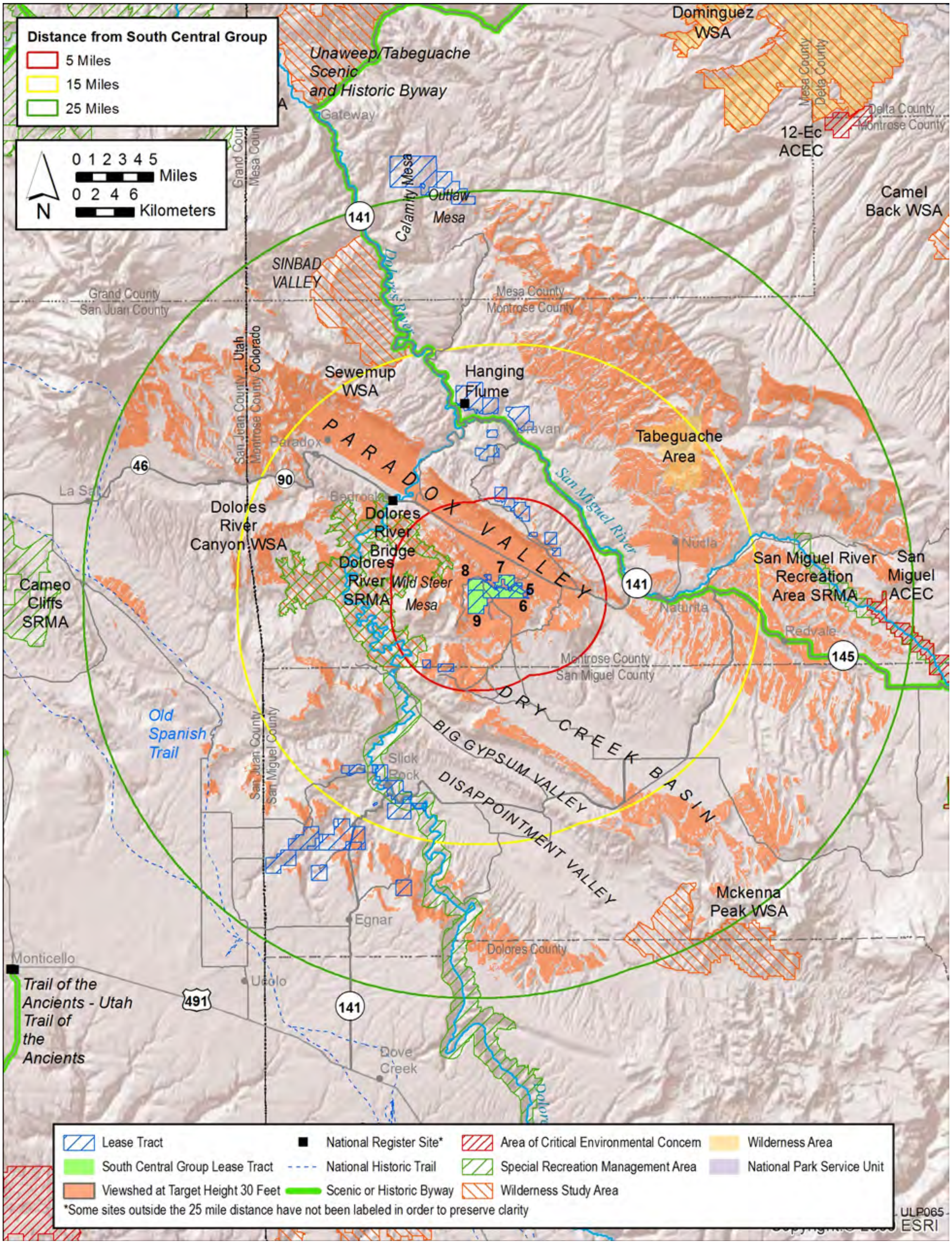


FIGURE 4.1-5 Viewshed Analysis for the South Central Lease Group under Alternative 1

- Dolores River SRMA;
- McKenna Peak WSA;
- San Miguel ACEC; and
- San Miguel River SRMA.

The South Central Group lease tracts would potentially be visible from approximately 47% (3,800 acres or 1,600 ha) of the Tabeguache Area; areas in Tabeguache Area with potential visibility of the lease tracts are located between 5 and 25 mi (8 and 24 km) of the South Central Group. Views of the lease tracts within the South Central Group are partially or fully screened by the intervening topography and vegetation. Views of the reclamation activities might be limited and likely would include any existing infrastructure, if present within the mine sites. The reclamation activities under this alternative would be expected to cause minimal to weak levels of contrast for views from the Tabeguache Area.

The viewshed analysis indicates that drivers on the Unaweep/Tabeguache Scenic and Historic Byway would potentially have views of the South Central Group in locations within the background and “seldom seen” distances, along approximately 16 miles (25 km) of the Byway. However, because of minor mapping inaccuracies that place portions of the roadway outside the narrow canyon it occupies, thereby locating them at higher elevations than they actually are, and because of vegetative screening, the actual mileage of the byway with views of the lease tracts is likely much smaller. Actual visibility would be determined as part of a site- and project-specific environmental assessment. Views of the reclamation activities likely would be limited and could include any existing infrastructure, if present within the mine sites.

Activities conducted under this alternative would be expected to cause minimal to zero contrast levels for views from the byway.

The South Central Group lease tracts would potentially be visible from approximately 3.6% (1,000 acres or 420 ha) of the Dolores River Canyon WSA; these viewing locations are within 0 to 25 mi (0 to 40 km) from the South Central Group. If present, existing infrastructure might be visible from within the WSA. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Reclamation activities under this alternative would be expected to cause minimal to weak contrast levels for views from the WSA.

The South Central Group would potentially be visible from approximately 2.1% (410 acres or 170 km) of the Sewemup WSA. Views of the South Central Group from the WSA are generally partially or fully screened by the intervening mountains. Visibility of this group of lease tracts is likely from the locations along the western edge of the Sewemup Mesa within the WSA that are higher in elevation than the lease tracts. Views of the reclamation activities likely would be limited and would include any existing infrastructure present within the mine sites. Activities conducted under this alternative would be expected to cause minimal to zero levels of contrast at all for views from within this area.

In addition, the South Central Group lease tracts would potentially be visible from approximately 2.0% (1,300 acres or 530 ha) of the Dolores River Canyon SRMA. The group would be visible from approximately 0.7% (489 acres or 200 ha) of the SRMA in viewing locations within 0 to 5 mi (0 to 8 km) from the lease tracts. Views of the reclamation activities from the SRMA might be limited and likely would include existing infrastructure, if present. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Similar to the Dolores River Canyon WSA, reclamation activities under this alternative would be expected to cause minimal to weak levels of contrast for views from this SRMA.

The South Central Group lease tracts would be potentially visible from approximately 1.1% (220 acres or 88 ha) of the McKenna Peak WSA. These viewing locations are between 15 and 25 mi (24 and 40 km) from the South Central Group; these areas are primarily located within San Miguel County. Views of the reclamation activities might be limited and likely would include any existing infrastructure, if present within the mine sites. Reclamation activities under this alternative would be expected to cause minimal to zero levels of contrast for views from this SVRA.

The South Central Group lease tracts would be potentially visible from less than 1% (3 acres or 1.2 ha) of the San Miguel ACEC. Under this alternative, activities would be expected to cause minimal to zero levels of contrast for views from this SVRA due to the limited amount of acreage that would have views of the lease tracts.

The South Central Group lease tracts would be potentially visible from less than 1% (105 acres or 43 ha) of the San Miguel River SRMA, at distances of 18–22 mi (29–35 km) from the SRMA. There could potentially be views of the lease tracts from elevated viewpoints within the SRMA outside the river canyon. Activities conducted within the South Central Group lease tracts would be expected to cause minimal to no contrasts at all as seen from the SRMA, primarily due to the relatively long distance between the SRMA and the lease tracts, and the very limited amount of acreage within the SRMA that would potentially have views of the lease tracts.

4.1.12.6.4 South Group. Figure 4.1-6 shows the results of the viewshed analysis for lease tracts within the South Group in which reclamation activities would occur; these include Lease Tracts 11, 13, and 15. Views from the following SVRAs could potentially include the South Group:

- McKenna Peak WSA;
- Dolores River SRMA; and
- Trail of the Ancients Byway.

The three lease tracts within the South Group would potentially be visible from approximately 16% (3,300 acres or 1,300 ha) of the McKenna Peak WSA, at distances up to 15 mi (24 km) from the lease tracts. Views of the reclamation activities might be limited and

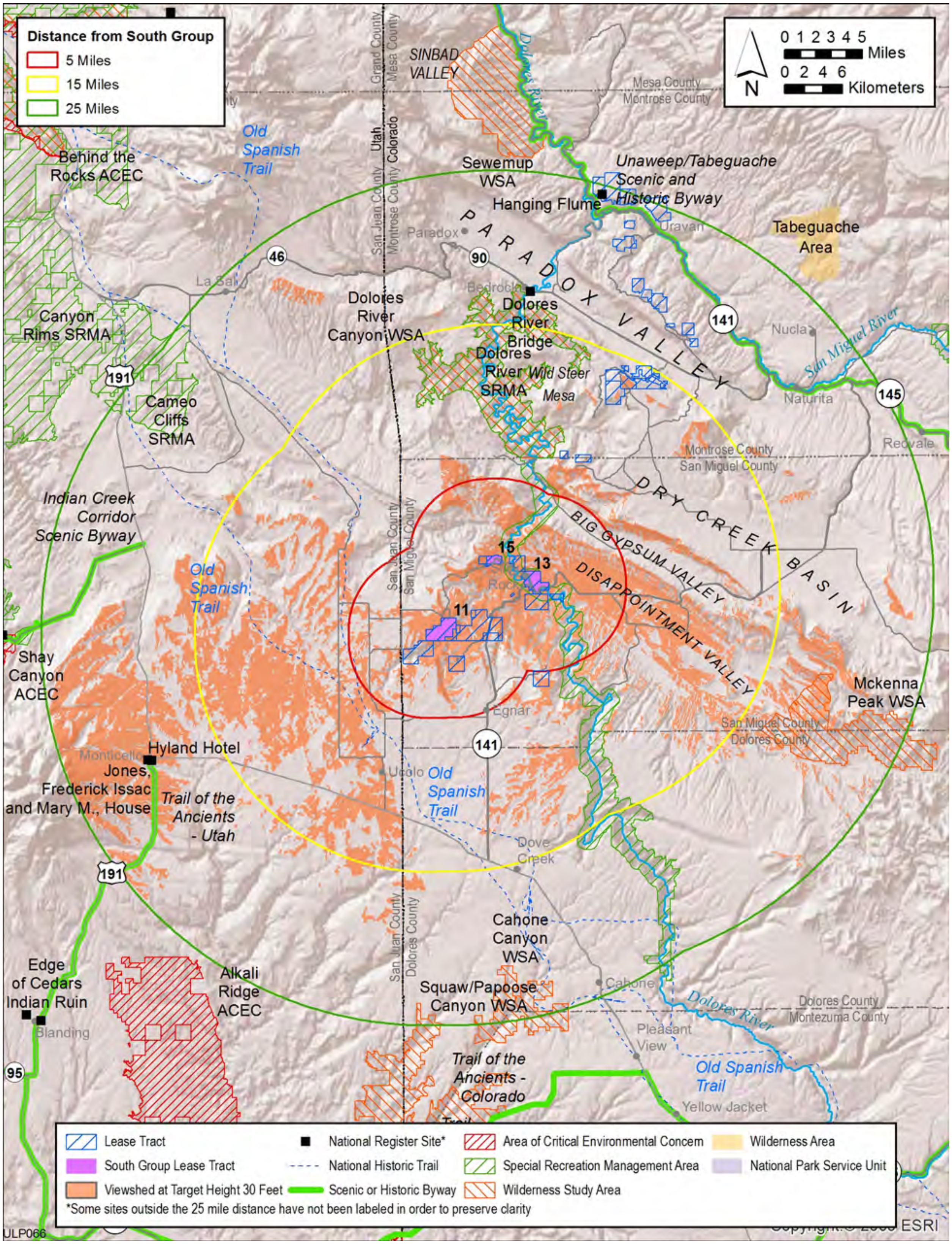


FIGURE 4.1-6 Viewshed Analysis for the South Lease Group under Alternative 1

likely would include any existing infrastructure, if present within the mine sites. Under Alternative 1, reclamation activities would be expected to cause minimal to weak levels of contrast for views from this SVRA.

Within 5 mi (8 km) of the lease tracts within the South Group, the lease tracts could potentially be visible from approximately 8.7% (5,700 acres or 2,300 ha) of the Dolores River Canyon SRMA; in fact, portions of the SRMA are located within the actual lease tracts, including Lease Tract 13. Between 0 and 25 mi (0 and 40 km), portions of the South Group lease tracts could be visible from approximately 9.0% (5,900 acres or 2,400 ha) of the SRMA. Views of the reclamation activities might be limited and likely would include any existing infrastructure, if present within the mine sites. For this alternative, mining-related activities would be expected to cause weak to strong contrast levels (i.e., not likely to be noticed by casual observers, attracting and holding their visual attention and potentially dominating the view) for views from this SRMA; stronger contrast levels would be expected for views from portions of the SRMA that are located within the South Group; lower contrast levels would be expected for views from areas farther from the lease tracts.

The South Group lease tracts could potentially be visible from approximately 7.4 mi (3 km) of the Trail of the Ancients Byway in Utah. This portion of the byway is located within the "seldom seen" distance zone (i.e., between 15 and 25 mi or 24 and 40 km) and is primarily west of the lease tracts. Views of the lease tracts would be limited, and they would be of brief duration for byway drivers. The byway generally follows US 191. Reclamation under Alternative 1 would be expected to cause minimal to zero levels of contrast for views from along the byway.

4.1.13 Waste Management

Potential impacts on waste management practices (described in Section 3.13) from waste generated during reclamation activities under Alternative 1 are expected to be small. Waste that could remain on the mine sites would be managed accordingly, and disposal capacity at the permitted landfills or licensed facilities would be adequate to accommodate the waste that would need to be transported off site for disposal.

4.2 ALTERNATIVE 2

> Alternative 2: Same as Alternative 1, except once reclamation was completed by lessees, DOE would relinquish the lands in accordance with 43 CFR Part 2370. If DOI/BLM determines, in accordance with that same Part of the CFR, the lands were suitable to be managed as public domain lands, they would be managed by BLM under its multiple use policies. DOE's uranium leasing program would end.

As would occur under Alternative 1, a total of about 257 acres (100 ha) would be reclaimed at 10 lease tracts (5, 6, 7, 8, 9, 11, 13, 15, 18, and 26). Also similar to what would happen under Alternative 1, the only mining activity to be implemented as part of this alternative would be reclamation.

4.2.1 Air Quality

The types of impacts and resulting emissions would be the same as those described for Alternative 1 (Section 4.1.1). Thus, potential impacts on ambient air quality associated with reclamation activities under Alternative 2 would be minor and temporary in nature. In addition, these activities are not anticipated to cause any measurable impacts on regional ozone or AQRVs at nearby Class I areas. Potential impacts from these activities on climate change would be negligible.

As discussed in Section 4.1.1, long-term impacts on ambient air quality after the reclamation are anticipated to be negligible.

4.2.2 Acoustic Environment

The type of impacts and resulting noise levels would be the same as those described for Alternative 1 (Section 4.1.2). Most residences are located beyond the distances where the Colorado noise limit is reached, but, if reclamation activities occurred near the boundary of Lease Tract 13, noise levels at nearby residences could exceed the Colorado limit.

It is assumed that most reclamation activities would occur during the day, when noise is better tolerated because of the masking effects of background noise that occurs during daytime. In addition, reclamation activities for ULP lease tracts would be temporary in nature (typically a few weeks to months, depending on the size of disturbed area to be reclaimed). Accordingly, reclamation within the DOE ULP lease tracts would cause some unavoidable but localized short-term noise impacts on neighboring residences or communities. Mitigation measures would be implemented to minimize these potential impacts.

4.2.3 Geology and Soil Resources

Soil impacts from ground-disturbing activities at the 10 lease tracts requiring reclamation would be the same as those described for Alternative 1 (Section 4.1.3.1).

4.2.3.1 Paleontological Resources

Impacts on paleontological resources from ground-disturbing activities at the 10 lease tracts requiring reclamation would be the same as those described for Alternative 1 (Section 4.1.3.3).

4.2.4 Water Resources

Under Alternative 2, impacts on water resources associated with the reclamation activities would be the same as those described for Alternative 1 (Section 4.1.4). The potential impact of soil erosion by water is moderate but temporary in lease tracts along the Dolores River. It is not anticipated that the reclamation activities would injure any existing water rights in the region. Potential impacts on groundwater quality are minor and could be avoided if water reclamation is performed in accordance with reclamation performance measures set by the CDWR. Subsequent impacts on water quality during BLM's administrative control would depend on the use of the reclaimed areas and could range from negligible (e.g., if no development or other use, other than as a natural land, occurred) to minor (e.g., if mining occurred once again on the reclaimed areas).

4.2.5 Human Health

Potential human health impacts to individual receptors under Alternative 2 would be the same as those under Alternative 1 (see Section 4.1.5) because people would conduct the same types of activities and work the same amount of hours regardless of the alternative under consideration. The dimensions of and radioactivity levels in the major radiation sources to which these receptors would be exposed would also be the same.

4.2.6 Ecological Resources

4.2.6.1 Vegetation

Impacts on vegetation under this alternative would be similar to those described for Alternative 1.

4.2.6.2 Wildlife

There would be no difference in reclamation activities under Alternative 2 than those under Alternative 1 (Section 4.1.6.2). Therefore, the potential impacts on wildlife from reclamation activities would be minor. Subsequent impacts on wildlife during BLM's administrative control would depend on the use of the reclaimed areas and could range from negligible (e.g., if no development or other use, other than use as a natural habitat, occurred) to moderate (e.g., if mining occurred once again on the reclaimed areas).

4.2.6.3 Aquatic Biota

There would be no difference in reclamation impacts under Alternative 2 than those under Alternative 1 (Section 4.1.6.2). Therefore, the potential impacts on aquatic biota from reclamation activities would be negligible. Subsequent impacts on aquatic biota during BLM's administrative control would depend on the use made of the reclaimed areas and their proximity to aquatic habitats (particularly perennial water bodies) and could range from negligible (e.g., if no development or other use, other than use as a natural habitat, occurred) or minor to moderate (e.g., if mining occurred on the reclaimed areas, particularly on the reclaimed areas on Lease Tracts 13 or 18, through which the Dolores River and Atkinson Creek, respectively, flow).

4.2.6.4 Threatened, Endangered, and Sensitive Species

There would be no difference between Alternative 1 and 2 impacts on threatened, endangered, and sensitive species (Section 4.1.6.4). The potential for impacts on threatened, endangered, and sensitive species from Alternative 2 would be identical to those from Alternative 1 (Table 4.1-10).

4.2.7 Land Use

Under Alternative 2, all the ULP lease tracts would be terminated, and DOE would restore the lands to the public domain under BLM's administrative control once reclamation activities were completed. The lands would no longer be closed to mineral entry, and all other activities within the lease tracts would continue. As a result, impacts due to land use conflicts are expected to be minor. Impacts related to future activities, such as ROW authorizations, mining (including uranium mining), or drilling oil and gas wells, would be evaluated under a separate NEPA review.

4.2.8 Socioeconomics

Potential impacts on socioeconomics (including recreation and tourism) for Alternative 2 would be the same as those described for Alternative 1 in Section 4.1.8.

4.2.9 Environmental Justice

Each of the health and environmental impacts that would occur under Alternative 1 would not change by adding mining land to the public domain after reclamation. Potential impacts occurring at each mine site during mining operations and reclamation would be minor, with the majority of potential impacts occurring off site. Once reclamation has been completed, there would be no additional impacts to the general public on reclaimed mining land, meaning that impacts on environmental justice associated with reclamation activities under Alternative 2 would be the same as those under Alternative 1, as described in Section 4.1.9.

4.2.10 Transportation

No transport of uranium ore would occur under Alternative 2. There would be no radiological transportation impacts. No changes in current traffic trends near the uranium lease tracts are anticipated because no significant supporting truck traffic or equipment moves would occur, and only about five reclamation workers would be commuting to each site on a regular basis during reclamation activities.

4.2.11 Cultural Resources

Impacts on cultural resources would be similar to those described for Alternative 1 in Section 4.1.11. Under Alternative 2, the reclamation activities would take place as they would under Alternative 1; however, after reclamation, all lands would be returned to the public domain and managed by the BLM rather than DOE. DOE's ULP would end, but uranium mining could continue under BLM regulations and procedures. Under the current ULP, the BLM functions as land manager, with responsibility for the surface estate, including cultural resources. Cultural resources would continue to be managed in accordance with Section 106 of the NHPA. As they would be under Alternative 1, impacts from ULP activity under Alternative 2 would be associated primarily with reclamation activities, and adverse impacts are expected to be limited. Adverse impacts would be possible at the 10 lease tracts where reclamation would need to be conducted; the impacts would depend on the amount of land that was disturbed, the number of historically significant mining features that were demolished, and the number of workers engaged in the reclamation activities. The potential impacts from any future potential uranium mining under BLM management would likely be similar to those discussed for Alternatives 3 through 5 in the ULP PEIS.

4.2.12 Visual Resources

Because the primary difference between Alternative 1 and 2 is in the administrative control of the lease tracts, the resulting visual impacts would be similar to those presented in Section 4.1.12.

4.2.13 Waste Management

The potential impact on the ability to manage the waste generated from reclamation activities under Alternative 2 would be the same as that described for Alternative 1 in Section 4.1.13.

4.3 ALTERNATIVE 3

> Alternative 3: DOE would continue the ULP as it existed before July 2007, with the 13 active leases, for the next 10-year period or for another reasonable period, and DOE would terminate the remaining leases.

Under Alternative 3, eight mines (two small, four medium, one large, and one very large) with a total surface area of 310 acres (130 ha) are assumed to be in operation during the peak year. The three phases involved in uranium mining (exploration, mine development and operations, and reclamation) are evaluated for this alternative. The exploration phase is assumed to require a relatively short duration of time, from 2 weeks to a month for each mine; however, it can occur annually over the course of several years. Mine development and operations would be conducted for about 10 years. Reclamation would be conducted within a time frame of 2 to 3 years after operations ceased.

4.3.1 Air Quality

4.3.1.1 Exploration

The degree of potential impacts on ambient air quality would vary depending on a number of factors, such as existing road conditions, topography, soil properties, vegetation cover, and meteorological conditions (e.g., wind speed, precipitation). Exploration activities would involve little ground disturbance. The exploration phase is assumed to require a relatively short duration, and a small fleet of heavy equipment along with a small crew would be used. In addition, measures (i.e., compliance measures, mitigation measures, and BMPs) would be implemented to ensure compliance with environmental requirements and to mitigate potential impacts, if any (see Table 4.6-1, Section 4.6).

During this phase, exploration activities would occur on all 12 lease tracts, with multiple drill holes on each lease tract. For the analysis, air emissions from engine exhaust and soil disturbances are estimated, assuming that two, four, and six borehole drillings up to a depth of 600 ft (180 m) would occur at two small mines, four medium mines, and one large mine, respectively, on any peak year. Emission sources would include drilling rigs, front-end loaders/bulldozers/skid-steer loaders, and support vehicles (water truck, flatbed truck for extra drill pipe, pickups, and probe truck). Types of air pollutants being emitted are discussed in Section 4.3.1.2, and estimated emissions are presented in Table 4.3-1. Among criteria pollutants and VOCs, NO_x emissions would be the highest, which account for about 0.06% of three-county total emissions. Annual total CO_2 emissions account for about 0.001% of Colorado GHG emissions in 2010 at 140 million tons (130 million metric tons) of CO_2e and account for 0.00001% of U.S. GHG emissions in 2009 at 7,300 million tons (6,600 million metric tons) of CO_2e (EPA 2011a; Strait et al. 2007).

Air emissions during the exploration phase would be negligible, and thus potential impacts on ambient air quality would be negligible and temporary. These activities are not anticipated to cause measureable impacts on regional ozone or AQRVs. Potential impacts from these activities on climate change would be negligible.

4.3.1.2 Mine Development and Operations

During mine development and operations, primary emission sources would include engine exhaust from heavy equipment and trucks, fugitive dust from earth-moving activities, erosion of exposed ground or stockpiles caused by wind, and explosives use (e.g., ammonium nitrate–fuel oil). Engine exhaust emissions from heavy equipment and trucks would include

TABLE 4.3-1 Peak-Year Air Emissions from Mine Development, Operations, and Reclamation under Alternative 3[a]

	Annual Emissions (tons/yr)								
Pollutant[b]	Three-County Total[c]	Exploration		Mine Development		Mine Operations		Reclamation	
CO	65,769	3.3	(0.01%)[d]	74.0	(0.11%)	64.2	(0.10%)	7.2	(0.01%)
NO_x	13,806	8.0	(0.06%)	26.0	(0.19%)	138	(1.0%)	14.9	(0.11%)
VOCs	74,113	1.0	(0.001%)	0.8	(0.001%)	13.4	(0.02%)	1.5	(0.002%)
$PM_{2.5}$	5,524	0.7	(0.01%)	36.4	(0.66%)	11.8	(0.21%)	30.6	(0.55%)
PM_{10}	15,377	1.1	(0.01%)	225	(1.5%)	22.5	(0.15%)	150.3	(0.98%)
SO_2	4,246	0.9	(0.02%)	3.1	(0.07%)	17.7	(0.42%)	2.0	(0.05%)
CO_2	142.5×10^{6} [e]	890	(0.001%)	750	(0.001%)	13,000	(0.009%)	1,400	(0.001%)
	$7{,}311.8\times10^{6}$ [f]		(0.00001%)		(0.00001%)		(0.00018%)		(0.00002%)

[a] Under Alternative 3, it is assumed that 8 mines (2 small, 4 medium, 1 large, and 1 very large) would be in operation, and a total surface (disturbed area of about 310 acres [130 ha]) would be reclaimed in any peak year.

[b] Notation: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of ≤2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter of ≤10 µm; SO_2 = sulfur dioxide; and VOCs = volatile organic compounds.

[c] Total emissions in 2008 for all three counties encompassing the DOE ULP lease tracts (Mesa, Montrose, and San Miguel Counties), except for CO_2. See Table 3.1-2.

[d] Numbers in parentheses are percentages of three-county total emissions except for CO_2, for which the numbers are percentages of Colorado total emissions and percentages of U.S. total emissions.

[e] Annual emissions in 2010 for Colorado on a CO_2-equivalent basis.

[f] Annual emissions in 2009 for the United States on a CO_2-equivalent basis.

Source: CDPHE (2011a); EPA (2011a); Strait et al. (2007).

criteria pollutants (such as CO, NO_x, $PM_{2.5}$, PM_{10}, and SO_2), VOCs, and GHGs (e.g., the primary GHG CO_2), while soil disturbances and wind erosion would generate mostly PM emissions. Explosive use would also generate all criteria pollutants, VOCs, and CO_2, but most explosives produce more CO than any other combustion-related pollutants, and large quantities of PM are generated in the shattering of the rock and earth by explosives. Typically, the amount of fugitive dust emissions (e.g., PM_{10}) would be larger during mine development, while the amount of exhaust emissions (e.g., NO_x) would be larger during operations. Mitigation measures and BMPs to address both types of emissions are identified in Table 4.6-1 (Section 4.6).

Air emissions of criteria pollutants, VOCs, and CO_2 from the mine development and operations phase are estimated for the peak year and presented in Table 4.3-1 and compared with emission totals for three counties combined (Mesa, Montrose, and San Miguel), which encompass the DOE ULP lease tracts. Detailed information on emission factors for each activity and on a mine-group basis (such as small, medium, large, and very large mines), underlying assumptions, emission control efficiencies, and emission inventories is presented in Appendix C. As shown in the table, total peak-year emission rates are estimated to be rather small compared with emission totals for all three counties. During mine development, the amount of non-PM emissions would be relatively small (up to 0.19%), and PM_{10} and $PM_{2.5}$ emissions would amount to about 1.5% and 0.66%, respectively, of the three-county combined emissions. PM_{10} emissions would result equally from site preparation (44%) and explosive use (43%), followed by wind erosion (13%), but exhaust emissions contribute only a little to total PM_{10} emissions. During mine operations, NO_x emissions of 138 tons/yr would be highest, amounting to about 1.0% of three-county total emissions. Most NO_x emissions would be from diesel-fueled heavy equipment, such as heavy trucks, bulldozers, scrapers, or power generators. Potential impacts would be minimized by implementing good industry practices and fugitive dust mitigation measures such as watering unpaved roads, disturbed surfaces, and temporary stockpiles (see Section 4.6). Therefore, potential impacts on ambient air quality would be minor and temporary.

The three counties encompassing the DOE ULP lease tracts are currently in attainment for ozone (EPA 2011b), and ozone levels in the area approached the standard (about 90%) (see Table 3.1-3). Recently, wintertime ozone[4] exceedances have frequently been reported at higher-elevation stations in northwestern Colorado, northeastern Utah, and southwestern Wyoming. However, ozone precursor emissions from mine development or operations would be relatively small, less than 1.0% and 0.02% of three-county combined NO_x and VOC emissions, respectively, and would be much lower than those for the regional airshed in which emitted precursors are transported and transformed into O_3. In addition, the wintertime high-ozone areas are located more than 100 mi (160 km) from the DOE ULP lease tracts and are not located downwind of the prevailing westerlies in the region. Accordingly, the potential impacts of O_3

[4] High-ozone incidents during wintertime result from several factors: high solar radiation due to high elevation enhanced by high albedo (defined as solar reflectivity of the earth's surface) caused by snow cover; shallow mixing height below temperature inversion; no or few clouds; stagnant or light winds; and abundant ozone precursors (such as NO_x and VOC) from existing oil and gas development activities (Kotamarthi and Holdridge 2007; Morris et al. 2009). In particular, snow cover plays an important role in UV reflection and insulation from the ground, which reduces the surface heating that promotes the breakup of temperature inversions.

precursor emissions from the mine development and operations phase on regional ozone would not be of concern.

As discussed in Section 3.1, there are several Class I areas around the DOE ULP lease tracts where AQRVs, such as visibility and acid deposition, might be a concern. Primary pollutants affecting AQRVs include NO_x, SO_2, and PM. NO_x and SO_2 emissions from mine development and operations in any peak year would be relatively small (up to 1.0% of three-county combined emissions), while PM_{10} emissions would be about 1.5% of three-county combined emissions. Air emissions from mine development and operations could result in minor impacts on AQRVs at nearby Class I areas, but the implementation of good industry practices and fugitive dust mitigation measures could minimize these impacts.

Annual total CO_2 emissions from mine development and operations were estimated as shown in Table 4.3-1. CO_2 emissions would be much higher during operations than during development. During operations, annual total CO_2 emissions would be about 13,000 tons (12,000 metric tons). These accounted for about 0.009% of Colorado GHG emissions in 2010 (at 140 million tons [130 million metric tons] of CO_2e) and for 0.00018% of U.S. GHG emissions in 2009 (at 7,300 million tons [6,600 million metric tons] of CO_2e) (EPA 2011a; Strait et al. 2007). Thus, potential impacts from mine development and operations on global climate change would be negligible.

4.3.1.3 Reclamation

The type of impacts from reclamation under Alternative 3 are similar to those described under Alternative 1 (Section 4.1.1). It is also assumed that reclamation activities under Alternative 3 would occur on about 310 acres (130 ha) of surface area at the peak year of reclamation.

Peak-year emissions during the reclamation phase under Alternative 3 are presented in Table 4.3-1. PM_{10} emissions would be highest, accounting for about 0.98% of three-county combined emissions. Among non-PM missions, NO_x emissions from diesel combustion of heavy equipment and trucks would be highest, up to 0.11% of three-county total emissions. Good industry practices and mitigation measures would be implemented to ensure compliance with environmental requirements. Thus, potential impacts on ambient air quality associated with reclamation activities under Alternative 3 are anticipated to be minor and temporary in nature. These low-level emissions are not anticipated to cause any measureable impacts on regional ozone or AQRVs, such as visibility or acid deposition, at nearby Class I areas. In addition, CO_2 emissions during the reclamation phase were about 0.001% of Colorado GHG emissions in 2010 and about 0.00002% of U.S. GHG emissions in 2009, respectively (EPA 2011a; Strait et al. 2007). Thus, under Alternative 3, potential impacts from reclamation activities on global climate change would be negligible.

4.3.2 Acoustic Environment

The noise levels generated by heavy construction equipment would vary significantly depending on various factors, such as the type, model, size, and condition of equipment; operation schedule; and condition of the area where work was being done. Not only are there daily variations in activities, but major construction projects are accomplished in several different phases. Each phase has a specific equipment mix, depending on the work to be accomplished during that phase. Any potential impact analysis should be based on typical activities in each phase.

4.3.2.1 Exploration

For the exploration phase, if existing roads did not provide site access, noise sources would include a grader or bulldozer for construction of an access road. Other noise sources would include vehicular traffic for commuting or delivery to and from the site and, where siting could not avoid brush, chainsaws and chippers for brush clearing.

Most noise-generating activities would occur intermittently during the exploration phase. It is anticipated that all of these activities would be conducted by using only a small crew and a small fleet of heavy equipment and would occur during daytime hours, when noise is tolerated better than it is at night because of the masking effect of daytime background noise. Accordingly, it is anticipated that potential noise impacts during the exploration phase on neighboring residences or communities, if any, would be minor and intermittent.

4.3.2.2 Mine Development and Operations

During this phase, heavy construction and mining equipment would be used. Underground equipment would include loaders, haul or support trucks, and drills, while aboveground equipment would include bulldozers, graders, loaders, haul or support trucks, scrapers, and power generators. During surface-plant area improvements, most activities would occur aboveground. However, most mine development and operational activities would occur above the ground for surface open-pit mines and under the ground for underground mines. Ventilation shafts would also contribute noise during mine development and the operation of underground mines.

Primary sources of noise during this phase would include operation of machinery, on-road and off-road vehicle traffic, and, if necessary, blasting. Aboveground equipment includes backhoes, dozers, graders, power generators, and scrapers, while underground equipment includes rock drills; various types of loaders and trucks would be used both above and under the ground. The average noise levels from most of these pieces of heavy equipment range from 80 to 90 dBA, except for a rock drill at a distance of 50 ft (15 m), which is 98 dBA (Hanson et al. 2006). In general, the dominant noise source from most construction equipment is a diesel engine without sufficient muffling that is continuously mining around a fixed location or with limited movement. Except for rock drills, noise levels for typical construction equipment that would likely be used at the DOE ULP lease tracts range from about 80 to 90 dBA at a distance of 50 ft (15 m) from an equipment.

To estimate noise levels associated with these activities, a composite noise level of 95 dBA at a distance of 50 ft (15 m) from the construction site is conservatively assumed, if impact equipment such as rock drills is not being used. Typically, this level could be reached when several pieces of noisy heavy equipment operated simultaneously in close proximity to each other at peak load.

When only geometric spreading and ground effects are considered (Hanson et al. 2006), noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the lease tracts, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the construction site. In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours, would reduce noise levels further. Thus, noise attenuation to Colorado or EPA limits would occur at distances somewhat shorter than the aforementioned distances. In many cases, these limits would not reach any nearby residences or communities. However, when construction occurred near the lease tract boundary, noise levels at residences around Lease Tract 13 would exceed the Colorado limit.

It is assumed that most operational activities would occur during the day, when noise is better tolerated because of the masking effects of background noise during daytime. In addition, mine development activities are temporary (typically lasting only a few months), and they would have some unavoidable but localized short-term noise impacts on neighboring residences or communities, particularly if activities occurred near the residences or communities adjacent to the lease tract boundary.

During mine operations, ventilation fans would run continuously at mine sites, for which noise calculations were made separately. The number of fans used for a mine depends on how extensive the mine activities are but typically would be one or two fans for small mines, two or three fans for medium mines, and three or four fans for large mines at an interval of every 366–457 m (1,200–1,500 ft) (Williams 2013). The composite noise level for a ventilation fan, such as that used at JD-9 mine, is about 86 dBA at a distance of 3 m (10 ft) (Spendrup 2013), corresponding to about 70 dBA at a reference distance of 15 m (50 ft), which is far lower than noise levels for typical heavy equipment. For a single fan, noise levels would attenuate to 55 and 50 dBA at distances of about 60 m (200 ft) and 90 m (300 ft) from the fan, respectively, which are the Colorado daytime and nighttime maximum permissible limits of 55 and 50 dBA in a residential zone. The EPA guideline level of 55 dBA L_{dn} for residential areas would occur at about 110 m (360 ft). For four identical fans that are located equidistant from a receptor, these distances would be extended to about 100 m (330 ft), 160 m (530 ft), and 190 m (620 ft), respectively. During daytime hours, beyond some distances, a noise of interest can be overshadowed by relatively high background levels along with skyward refraction caused by temperature lapses (i.e., temperature decreases with increasing height, so sound tends to bend towards the sky). However, on a calm, clear night typical of ULP lease tract settings, the air temperature would likely increase with increasing height (temperature inversion) because of strong radiative cooling. Such a temperature profile tends to focus noise downward toward the ground. Thus, there would be no shadow zone[5] within 1 or 2 mi (2 or 3 km) of the source in the presence of a strong temperature inversion (Beranek 1988). In particular, such conditions add to the effect of noise being more discernible during nighttime hours, when the background levels are the lowest. Considering these facts, potential impact distances would be extended further, to several hundred meters. Accordingly, noise control measures (e.g., the installation of front and rear silencers, which can reduce noise levels from 5 to 10 dBA [Spendrup 2013]) would be warranted if any residences were located within these distances from ventilation fans. Also, the outlet could have a 45 degree or 90 degree elbow pointed away from the sensitive receptors (Williams 2013).

During mine operations, over-the-road heavy haul trucks would transport uranium ores from ULP lease tracts to either the proposed Piñon Ridge Mill or White Mesa Mill in Utah. These shipments could produce noise along the haul routes. Under Alternative 3, about 1,000 tons per day of uranium ores would be produced. Assuming 25 tons of uranium ore per truck and round-trip travel, the traffic volume would be 80 truck trips per day (40 round trips per day) and 10 truck trips per hour (for 8-hour operation). A peak pass-by noise level of 84 dBA from a heavy truck operating at 55 mi/h or mph (88 km/h) was estimated based on Menge et al. (1998). At a distance of 120 ft (37 m) and 230 ft (70 m) from the route, noise levels would attenuate to 55 and 50 dBA, respectively, which are Colorado daytime and nighttime maximum permissible limits in a residential zone. Noise levels above the EPA guideline level of 55 dBA L_{dn} for residential areas would be reached up to the distance of 60 ft (18 m) from the route. Accordingly, Colorado limits or EPA guideline levels would be exceeded within 230 ft (70 m) of the haul route, and any residences within this distance might be affected.

Depending on local geological conditions, explosive blasting during mine development and operations might be needed. Blasting would generate a stress wave in the surrounding rock, causing ground and structures on the ground surface to vibrate. The blasting also would create a compressional wave in the air (air blast overpressure), the audible portion of which would be manifested as noise. Potential impacts of ground vibration include damage to structures, such as broken windows. Potential impacts of blast noise include effects on humans and animals. Estimates of the potential increases in ambient noise levels, ground vibration, and air blast overpressure and evaluations of any environmental impacts associated with such increases would be required at the site-specific project phase if potential impacts at the nearby residences or structure are anticipated.

Blasting techniques are designed and controlled by blasting and vibration control specialists to prevent damage to structures or equipment. These controls attenuate blasting noise as well. Under Alternative 3, there are several residences within 0.5 mi (0.8 km) of the boundaries of some of the lease tracts. However, given the impulsive nature of blasting noise, it is critical that blasting activities be avoided at night and on weekends and that affected neighborhoods be notified in advance of scheduled blasts.

5 A shadow zone is defined as the region where direct sound does not penetrate because of upward refraction.

There are several specially designated areas (e.g., Dolores River SRMA, Dolores River Canyon WSA) and other nearby wildlife habitats around the DOE ULP lease tracts and haul routes where noise might be a concern. Negative impacts on wildlife begin at 55–60 dBA, a level that corresponds to the onset of adverse physiological impacts (Barber et al. 2010). As discussed above, these levels would be limited up to distances of up to 1,650 ft (500 m) from the mine sites and 120 ft (37 m) from the haul routes. However, there is the potential for other effects to occur at lower noise levels (Barber et al. 2011). To account for these impacts and the potential for impacts at lower noise levels, impacts on terrestrial wildlife from construction noise and mitigation measures would have to be considered on a project-specific basis. These studies would need to consider site-specific background levels and the hearing sensitivity for site-specific terrestrial wildlife of concern.

In summary, the potential for noise impacts from mine development on humans and wildlife is anticipated near the mine sites and along the haul routes, but impacts would be minor and limited to proximate areas unless the activities occurred near a lease tract boundary adjacent to nearby residences or communities or areas specially designated to be of concern with regard to wildlife, if any. Implementation of mitigation measures and BMPs identified in Table 4.6-1 (Section 4.6) and adherence to coherent noise management plans could minimize these impacts.

4.3.2.3 Reclamation

It is assumed that reclamation activities under Alternative 3 would occur over about 300 acres (120 ha) at any peak year. As discussed in Section 4.1.2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the reclamation site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the construction site. Most residences are located beyond these distances, but if reclamation activities occurred near the boundary of Lease Tract 13, noise levels at the nearby residences could exceed the Colorado limit.

It is assumed that most reclamation activities would occur during the day, when noise is better tolerated than at night, because of the masking effects of background noise in the daytime. In addition, reclamation activities at ULP lease tracts are temporary in nature (typically a few weeks to months, depending on the area size to be reclaimed). Accordingly, reclamation within the DOE ULP lease tracts would cause some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities. The same mitigation measures and BMPs as those adopted during the construction phase would also be implemented during the reclamation phase (see Table 4.6-1 in Section 4.6).

4.3.3 Geology and Soil Resources

Potential impacts under Alternative 3 on soil resources during exploration, mine development and operations, and reclamation are evaluated and discussed in Sections 4.3.3.1 to 4.3.3.3 below.

4.3.3.1 Exploration

Exploration activities would involve some ground-disturbing activities, such as vegetation clearing, grading, trenching (and sampling), drilling, and building access roads and drill pads. Direct adverse impacts from these activities relate mainly to the increased potential for soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff, and sedimentation of nearby surface water bodies. The degree of impact would vary among the lease tracts, depending on the activities needed to explore each mine site and on site-specific factors, such as soil properties, slope, vegetation cover, weather conditions (e.g., precipitation rate and intensity, prevailing wind direction and speed), and distance to surface water bodies. However, because exploration activities would occur over relatively small areas and involve little or no ground disturbance, potential impacts associated with this phase are expected to be minor. Implementing mitigation measures and BMPs (Table 4.6-1 in Section 4.6) would further reduce the level of adverse impacts associated with these activities.

4.3.3.2 Mine Development and Operations

Mine development activities could potentially result in minor to moderate impacts on soil resources because they would involve ground disturbances that could increase the potential for soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff, and sedimentation of nearby surface water bodies on both lease tracts and off-lease land. Ground-disturbing activities would be associated mainly with mine site improvements, such as the construction of buildings (offices and maintenance), utilities, parking areas, roads, service areas (for vehicles and heavy equipment), storage areas (for fuel, chemicals, materials, solvents, oils, and degreasers), discharge/treatment ponds (for mine water discharge), and diversion channels and berms; the use of trucks, heavy earth-moving equipment, and mining equipment; and the construction of various stockpile and loading areas (for waste rock, ore, and topsoil). Off-lease land disturbances would occur on adjacent BLM land and would mainly involve obtaining or improving ROWs for haul roads and utilities and would be subject to BLM's NEPA process. Potential fuel or chemical contamination could result from the use of trucks and mechanical equipment or fuel storage and handling and from the application of chemical stabilizers to control fugitive dust emissions.

Ground-disturbing activities during the operational period would be associated with the stripping of topsoil from areas to be disturbed, the stockpiling of topsoil, and the hauling and storing of ore and waste rock and maintenance of storage areas (for ore and waste rock). These activities could result in minor impacts on soil resources when compared to the level of impacts resulting from mine development.

Under Alternative 3, ground disturbance during the peak production year would occur on an estimated 300 acres (120 ha) across 12 lease tracts, mainly during mine development. Impacts associated with this phase are expected to be minor to moderate. The degree of impact would vary among the lease tracts, depending on the activities needed to prepare and develop each mine site (because some sites are more developed than others) and depending on site-specific factors, such as soil properties, slope, vegetation, weather, and distance to surface water. Implementing mitigation measures and BMPs listed in Table 4.6-1 (Section 4.6) would reduce the potential for adverse impacts associated with these activities.

4.3.3.3 Reclamation

The types of impacts related to reclamation under Alternative 3 would be similar to those described for Alternative 1 (Section 4.1.3.2); however, ground disturbance would occur over a larger area—an estimated 300 acres (120 ha) across 12 lease tracts—than that for Alternative 1.

4.3.3.4 Paleontological Resources

4.3.3.4.1 Exploration. Exploration activities would involve some ground-disturbing activities, such as vegetation clearing, grading, trenching (and sampling), drilling, and building access roads and drill pads. These activities could result in adverse impacts on paleontological resources, if present, because they would involve ground disturbances that could expose fossils, making them vulnerable to damage or destruction and looting/vandalism. Field surveys, conducted by a qualified paleontologist early in the reclamation process, would identify areas of moderate to high fossil-yield potential or known significant localities so that these areas could be avoided. In addition, mine operators would notify the BLM of any fossil discoveries so appropriate measures could be taken to protect discoveries from adverse impacts (see also Table 4.6-1). For this reason, it is anticipated that impacts on paleontological resources would be minor.

4.3.3.4.2 Mine Development and Operations. Mine development activities could potentially result in adverse impacts on paleontological resources, if present, because they would involve ground disturbances that could expose fossils, making them vulnerable to damage or destruction and looting/vandalism. Ground-disturbing activities would be associated mainly with mine site improvements, such as the construction of buildings (offices and maintenance), utilities, parking areas, roads, service areas (for vehicles and heavy equipment), storage areas (for fuel, chemicals, materials, solvents, oils, and degreasers), discharge/treatment ponds (for mine water discharge), and diversion channels and berms; the use of trucks, heavy earth-moving equipment, and mining equipment; and the construction of various stockpile and loading areas (for waste rock, ore, and topsoil). Off-lease land disturbances would occur on adjacent BLM land and would mainly involve obtaining or improving ROWs for haul roads and utilities and would be subject to BLM's NEPA process.

Ground-disturbing activities during the operational period would be associated with the stripping of topsoil from areas to be disturbed, the stockpiling of topsoil, and the hauling and storing of ore and waste rock and maintenance of storage areas (for ore and waste rock). These activities could result in minor impacts on paleontological resources, if present.

Field surveys, conducted by a qualified paleontologist early in the exploration phase, would identify areas of moderate to high fossil-yield potential or known significant localities so that these areas could be avoided. In addition, mine operators would notify the BLM of any fossil discoveries so appropriate measures could be taken to protect discoveries from adverse impacts (see also Table 4.6-1). For this reason, it is anticipated that impacts on paleontological resources would be minor.

4.3.3.4.3 Reclamation. The types of impacts related to reclamation under Alternative 3 would be similar to those described for Alternative 1 (Section 4.1.3.3); however, ground disturbance would occur over a larger area (an estimated 300 acres [120 ha] across 12 lease tracts) than the area under Alternative 1.

4.3.4 Water Resources

Potential impacts on water resources are considered for the three phases of mining (exploration, mine development and operations, and reclamation) in Sections 4.3.4.1 through 4.3.4.3.

4.3.4.1 Exploration

Exploration activities would involve some land disturbance activities, such as vegetation clearing, grading, drilling, and building of access roads and drill pads, but these activities would occur over relatively small areas. Impacts on water resources associated with runoff generation and erosion would be minor, considering the small spatial extent over which exploration activities would occur.

The drilling of exploration boreholes and wells has the potential to alter the geochemical properties of an aquifer and to provide a connection between disconnected aquifers. Drilling and trenching techniques could introduce drilling muds and oxygen into aquifers, which could alter water chemistry and result in changes in pH and solubility conditions relevant to many metal ions, including uranium (Curtis et al. 2006; National Research Council 2012). The exploratory boreholes or wells could also provide a conduit connection between aquifers that could allow the mixing of water of potentially poorer quality (e.g., higher TDS concentrations) from one aquifer to another (National Research Council 2012).

As discussed in Section 3.4, the main water-bearing formations, in ascending order by depth, are Alluvium, Dakota Sandstone, Burro Canyon, Saltwash Member, Entrada Sandstone, Navajo Sandstone, and Wingate Sandstone. In lease tract areas, the shallow (or perched) aquifers, such as Alluvium, Dakota Sandstone, and Burro Canyon, have a limited amount of water but are relatively fresh, while the relatively deep aquifers (Saltwash Member and Entrada Sandstone) contain elevated TDS and sulfate (Section 3.4.2), exceeding the EPA secondary drinking water standard (Weir 1983; CGS 2003). The scarcity of groundwater in shallow aquifers results from extremely low groundwater recharge because of low precipitation (12.5 in. or 31.8 cm) and from the high potential for evaporation (38 in. or 97 cm) in the area. Groundwater in the shallow aquifer is used only locally for domestic or stock supply. The upper portion of the Navajo Sandstone aquifer has low TDS and is often a targeted underground source of drinking water (CGS 2003). In the Uravan area, several domestic and industrial wells were completed in the Wingate aquifer (Cotter Corp. 2012c, CM-25). Within 5 mi (8 km) of lease tracts, however, no public water supply (PWS) wells are present.

The exploratory drill holes are expected to go through alluvial aquifers along the rivers and Paradox Valley or Dakota Sandstone and Burro Canyon aquifers (or perched aquifers) at mesas to reach Saltwash Member, the uranium-containing unit. Historically, most of underground mines are dry in the ULP lease tracts. The potential for groundwater mixing and leaching via exploratory drill holes is minimal. In Paradox and Slick Rock, some groundwater accumulation at a low rate has been found in underground mines in Lease Tracts 7 and 9 near Paradox Valley and in Lease Tract 13 along the Dolores River (Slick Rock) (DOE 2007). During exploration at these lease tracts, impacts associated with the drilling of exploratory boreholes and wells can be minimized by using BMPs and standards set forth by the CDWR (2005) (see also Table 4.6-1 in Section 4.6), such as grouting open boreholes to reduce the volume of groundwater that enters, using underground sumps to contain seeped groundwater, or removing groundwater to the surface treatment facility. In addition, a substantial number of historical exploration studies have been performed in the Uravan Mineral Belt region (Nash 2002), limiting the amount of exploratory boreholes and wells needed for future mining activities. These historical exploration studies have also indicated the existence of groundwater throughout the region is quite minimal and very localized.

The Navajo Sandstone aquifer, a frequently targeted underground source of drinking water in the region, is located more than 100 ft (30 m) below the uranium-containing unit of the Saltwash Member and is confined by overlying confining units of the Carmel Formation and Wanakah Formation (Summerville Formation) (Figure 3.4-5). The exploratory activities would have no impact on the groundwater quality of the Navajo Sandstone aquifer or the underlying Wingate aquifer.

4.3.4.2 Mine Development and Operations

Of the three phases evaluated, the mine development and operations phase has the greatest potential to affect water resources, primarily as a result of land disturbance activities, erosion, mine water runoff, the staging of ores and waste rock, the alteration of shallow aquifers, the mixing of groundwater with varying chemical characteristics, the use of chemicals, consumptive water use, and wastewater generation. These activities take place over different durations of time and at different times during the mine development and operations phase, which occurs over a period of about 10 years. It is assumed that during the peak year, a total of eight mines (two small, four medium, one large, and one very large) would be in operation across the DOE ULP lease tracts. Assumptions used in the assessment of mine operations are presented in Section 2.2.3.1.

4.3.4.2.1 Elements Potentially Affecting Water Resources. Land disturbance activities associated with mine development and operations include vegetation clearing, grading for surface structures, access road construction or improvements, drainage contouring, detention basin construction, and mine excavation. Assumed total land disturbance during the peak year would be 300 acres (120 ha). These activities would increase erosion and runoff by exposing unconsolidated materials and by compacting soils. Removal of the overburden for surface mines or mine excavation for underground mines would generate unconsolidated materials that would need to be stored at the mine site. The accumulation of unconsolidated material, along with vegetation clearing, would increase the potential for erosion, primarily by flash flooding events (Nash 2002; BLM 2008b). Runoff from mine sites has the potential to increase sediment and pollutant loadings to nearby surface waters; pollutants result from sediment-associated compounds, chemical dust control compounds (e.g., magnesium chloride), fuels and other chemicals used in mining, and mineral leachates (National Research Council 2011). In the Uravan Mineral Belt region, runoff from historical mining areas has been shown to have elevated concentrations of arsenic, molybdenum, and selenium, but the amount of runoff was small, resulting in only localized contamination of water quality (Nash 2002).

Stormwater infrastructure consisting of berms, drainage swales, and detention basins would need to accommodate the permitting requirements for stormwater discharge according to state and Federal regulations administered by the CDPHE. In general, the mine site would be developed to divert upgradient stormwater away from the mine and to collect stormwater generated on site and in detention basins for settling and potential chemical treatment prior to release (DOE 1995; BLM 2008b,c). In addition, stormwater BMPs would be followed to minimize impacts related to stormwater (EPA 2012a) (see also Table 4.6-1 in Section 4.6). While stormwater regulations are typically adequate to accommodate large flooding events, western Colorado has the potential for infrequent and localized flash flooding that could overwhelm even properly designed stormwater infrastructure (Nash 2002).

Surface and underground mines have the potential to disrupt shallow aquifers by exposing or creating an open cavity within aquifers, which could lower groundwater surface elevations, alter groundwater flow paths, and degrade water quality. Groundwater typically accumulates in underground mines via percolation of shallow groundwater; it could be used to support mine operations, such as drilling and dust control (DOE 1995). The open cavity of a surface or underground mine increases groundwater discharge, which could lower groundwater surface elevations and alter groundwater flow paths. The dewatering effect created by the mine cavity has the potential to disrupt nearby features dependent on groundwater, such as vegetation, springs, and other groundwater users (National Research Council 2011). On the basis of information on historical mining in the area, most of underground mines are relatively dry.

Some underground mines in Paradox and Slick Rock, such as those in Lease Tracts 7, 9, and 13, encountered groundwater in underground working areas via intercepting perched and/or shallow alluvial aquifers (DOE 2007). The amount of water encountered was contained during normal operations. Groundwater seepage to the underground mines was also reported at 0.3 gal/min (1.1 L/min) for the Sunday Mines in the area (Denison 2008). The Sunday Mines are located near and downgradient from the perennial river, receiving groundwater recharge from the river in addition to infiltration from precipitation. A similar effect might be expected in the portion that is along the Dolores River at Lease Tract 13. For Lease Tracts 7 and 9, the perched water is anticipated to enter mine workings from the Dakota/Burro Canyon Formations via intercepting vents and from the ore-containing rock, Saltwash Member. Unlike at the other lease tract areas, the saturation was found in the upper sandstone unit of the Saltwash Member and probably resulted from local recharge over the relatively large exposure area of the unit along the surrounding canyons at Lease Tract 9 (Cotter Corp. 2012b). The estimated seepage rate from the Dakota/Burro Canyon Formation is 1 to 2 gal/min (4 to 8 L/min) and the total dewatering rate from underground workings is likely 8 gal/min (30 L/min) at Lease Tract 9 and 6 gal/min (23 L/min) at Lease Tract 7 (Cotter Corp. 2012b). Because of the low rate of groundwater seeping from the perched or alluvial aquifer above the ore horizon, equivalent to the normal pumping rate for one household, the extent of dewatering for portable water would be limited, and its effects would be localized. As discussed in Section 3.4.2, there are only five domestic wells within or near the edge of ULP lease tracts that have wet mines. The impact on other groundwater users and springs is considered to be moderate for Lease Tracts 7 and 9 and minor for all other lease tracts.

In addition to decreasing groundwater quantity, surface and subsurface mines can degrade water quality by creating conduits between aquifers with varying chemical characteristics. For example, introducing oxygen to reduced environments would affect the solubility of metals (National Research Council 2011). Uranium is typically insoluble under the chemically reduced conditions, but it can be mobilized through oxidation to a more soluble form. The exposure of groundwater in uranium-containing aquifer to oxidizing conditions with relatively fresh alluvial groundwater or rain infiltration in the mines may increase uranium concentration in groundwater. However, the uranium adsorption study also indicates that the uranium mobility is highly sensitive to the alkalinity in groundwater (Curtis et al. 2006). The mixing of groundwater from uranium-containing aquifer with water from shallow alluvial aquifer or rain infiltration may decrease alkalinity of the source water. Experiments focused on the leaching of metals from uranium-containing sandstones from Lease Tracts 9 and 21 as well as other areas of the Uravan Mineral Belt region suggest that leachates have a neutral pH (thus indicating potential acid mine drainage is not a primary concern); low metal concentrations; and elevated concentrations of arsenic, molybdenum, selenium, and vanadium (Cotter Corp. 2012b; Nash 2002).

The elevated uranium concentration in groundwater (two to three orders of magnitude higher than the source groundwater in the Saltwash Member) at the historical mine tailing site in the area was mainly caused by tails leached by carbonate and acids (Curtis et al. 2006). The adsorption of uranium (VI) can be decreased by five orders of magnitude from pH 9 to pH 6 and is even more sensitive to increases in alkalinity. As discussed in Section 3.4.2, elevated concentrations of manganese, molybdenum, nitrate, selenium, and uranium were found in groundwater in the shallow alluvial aquifer beneath the two former tailing sites along the Dolores River near Lease Tract 13. However, under the proposed mine development and operations, no carbonate, acid leaches, or any ore processing or residuals from it will be involved or kept at the mine sites. The observed historical impacts at the mine tailing sites in the area would not be expected.

Chemicals used at mining sites are primarily fuels, solvents, oils, and degreasers used for trucks and earth-moving machinery, which can contaminate surface water and groundwater by accidental spills. Impacts associated with the accidental release of chemicals would be minimized through permitting processes with appropriate state and Federal agencies and through BMPs.

Water use during mine development and operations is for dust suppression, mining machines in operation, and a potable water supply for workers. Under Alternative 3, it is assumed that a total of 3,200,000 gal/yr (9.8 ac-ft/yr) would be used by all eight mines operating during the peak year. Since local surface water and groundwater sources are scarce and often of relatively poor quality with high TDS, it is assumed that the water supply would be trucked to the site from another region. The estimate of water use is considered as the conservative scenario that all underground mines are dry and no water is encountered from groundwater seepage, which is commonly collected for mining operation. The possible sources of water use for ULP activities would be the existing water right owners in the mining industry and municipal water in the Dolores River Basin across three counties: Mesa, Montrose, and San Miguel. The amount of water use is about 1.45% of the current water use for mining and 0.05% of the current public water supply within the three counties. The impacts of water use on the local water supplies would be minor. Consumptive water use is a fraction of the estimated water use. This part of water use will be returned to the hydrologic system in the region (potable water, etc.). The detailed water allocation for each mining project would be identified when the specific mining plan is developed. Subsequently, the water development plan for the water supply would address options of either applying for a state water right permit or purchasing from another region.

The wastewater generated during mine development and operations could be classified as sanitary and industrial wastewater. Sanitary wastewater would be collected in portable fixtures, treated off site or in underground septic systems, and released to a subsurface drain field. If a septic system is planned, the septic permit for the sewage system will be obtained, and waste management will be implemented to minimize the contribution to the water currently impaired by E. coli along the Dolores River near and downgradient of the lease tract area, as discussed in Section 3.4. Industrial wastewater would primarily consist of unused (i.e., not reused for drilling or dust control) groundwater seepage water in the mine and stormwater that was collected on site. These industrial wastewaters would be diverted or pumped into sedimentation basins as mentioned previously for stormwater management. For most of the lease tracts, industrial wastewater from dewatering for mine workings is minimal except for Lease Tracts 7 and 9, which would produce wastewater pumped from mine workings up to 8 gal/min (30 L/min) and be required to be treated to reduce elevated TDS, radium, and uranium prior to discharge from the treatment facility. Impacts associated with sanitary and industrial wastewater would be minimized through permitting with appropriate state and Federal agencies.

4.3.4.2.2 Potential Impacts and Mitigation Measures. The potential for impacts on surface water and groundwater in the vicinity of the DOE ULP lease tracts during mine development and operations that would result from erosion, runoff, dewatering, consumptive water use, and the impacts associated with groundwater-contamination-related causes, chemical spills, and wastewater could be minimized through permitting and BMP implementation.

Of the lease tracts considered in Alternative 3, the ones closest to the Dolores River and San Miguel River have the greatest potential for affecting water quality because of their proximity to perennial water bodies. The lease tracts located in the Slick Rock and Uravan lease tracts are the closest to the Dolores River and San Miguel River, respectively. As discussed in Section 4.2.4, Lease Tract 13 encompasses a 3-mi (5-km) reach of the Dolores River and is where erosion poses the greatest threat to water quality. An increase in erosion and runoff may increase the potential of sediment and pollutant loadings to nearby rivers. Possible pollutants may include sediment-associated compounds, chemical dust control compounds, fuels and other chemicals used in mining, and mineral leachates. As recently evaluated by the CDPHE (2012a,b), the existing impaired surface water that exceeds Colorado standards is mainly located upstream and not associated with the DOE ULP lease tracts (Section 3.4.1.2). During future mine development and operations, impacts of erosion by runoff are considered to be moderate in some areas near Lease Tracts 13 and 18. However, the potential of sediment and pollutant loadings could be minimized by implementing a stormwater control system, a diversion ditch, a sedimentation pond, and an appropriate monitoring system, as well as by restricting mine activity within 0.25 mi (0.40 km) of the Dolores River and San Miguel River (Table 4.6-1). The site-specific requirements for the protection system would be evaluated and incorporated in the future drainage design plan for each lease tract.

Potential impacts of dewatering on portable groundwater are minimal, localized, and temporary within the period of operations, since the groundwater seepage rate is anticipated to be low, approximate to typical water use for one household. The area of impacts is limited to Lease Tracts 7, 9, and 13. Five domestic wells are identified at or near Lease Tract 13. Using BMPs and mitigation measures in Table 4.6-1—such as (1) grouting exploratory boreholes to reduce the volume of groundwater entered from the alluvial, perched, and shallow aquifers and (2) placing drill holes at locations distant to the existing water rights—would further minimize the impacts.

The potential for groundwater contamination is likely to be limited to wet mines in Lease Tracts 7 and 9 in Paradox and Lease Tract 13 in Slick Rock. At Lease Tract 9, saturation of the upper sandstone unit in the Saltwash Member resulted in the elevated TDS, sulfate, radium, selenium, and uranium in groundwater from the unit and in water collected at the sump from dewatering (Cotter Corp. 2012b). Appropriate dewatering, groundwater monitoring, and surface treatment could minimize its impact.

There are 5 domestic wells within or near the edge of Lease Tract 13, and 14 domestic wells are located along the potential groundwater flow pathways from Lease Tracts 7, 9, and 18 to the groundwater discharge area. In addition, activities on the Paradox lease tract pose possibly the greatest risk of contaminating locally perched aquifers by the underlying poorer-quality aquifer in the area. The impacts of groundwater contamination could be minimized by the following actions (Table 4.6-1):

- Control groundwater seepage entering underground mines by plugging open exploratory drill holes and the area around vent shafts during operations to the extent possible, containing water in underground sumps, and removing water from groundwater seepage, if necessary, to the surface mine water treatment pond;

- Pump groundwater to the surface mine water treatment facility with a permit, if groundwater flow cannot be controlled by underground containment, and manage discharge in accordance with Federal and state regulations;

- Divert surface water overland flow and shallow groundwater via a diversion ditch to reduce water directly from precipitation and infiltration into underground mines;

- Install lysimeters to monitor infiltration to the subsurface as an early warning system; and

- Provide off-site (downgradient) groundwater monitoring consistent with Colorado requirements for groundwater protection permits.

Impacts of chemical spills and wastewater would also be minimized through mitigation measures, permitting, BMPs, and Federal and state regulations (Table 4.6-1). The site-specific requirements and plans for drainage design, stormwater management, and spill prevention and control would be expected to be evaluated and incorporated in the future project-specific action.

4.3.4.3 Reclamation

Under Alternative 3, the scale of reclamation activities would be greater than the scale under Alternative 1, even though the types of impacts would be the same as those described for Alternative 1 (Section 4.1.4). The assumed level of active prospecting during the previous operations phase would require more underground working areas to be backfilled and more boreholes to be plugged in this phase than under Alternative 1. The potential would be higher than the potential under Alternative 1 for impacts on groundwater quality that would result from leaching via backfills and poor sealing of drill holes. However, the actual impact could be minimized by the appropriate backfilling of mine portal and vent holes, complete sealing of drill holes that intercept multiple aquifers, and adequate water reclamation in accordance with reclamation performance measures required by CDRMS. It is not anticipated that the reclamation activities would injure any existing water rights in the region.

Land disturbance is expected to be similar to that under Alternative 1. The potential impact on soil erosion from water would be moderate but temporary in lease tracts along the Dolores River.

4.3.5 Human Health

The analysis of human health impacts focuses on the consequences from uranium mine development and operations and the reclamation of the lease tracts. Since the drilling conducted during exploration would disturb only small areas (a borehole has a diameter of a few inches) and the drill holes would be backfilled in a short period of time (less than a few weeks), it is expected that human health impacts would be minimal and limited to only a few workers. To provide a perspective of the potential radiation dose, a RESRAD analysis was conducted assuming a pile of excavated soils as the radiation source. The drilling of a borehole (8 in. [20 cm] in diameter and 600 ft [180 m] in depth) was assumed to bring up about 210 ft^3 (6 m^3) of soil, which was spread on ground surface covering an area of about 100 ft^2 (3 × 3 m). The soils were assumed to have the same radionuclide concentrations as waste rocks (i.e., the upper-end concentrations as discussed in Section 4.1.5). To obtain a conservative estimate of radiation dose, an exploration worker was assumed to stand on top of the excavated soils. The potential radiation exposure would result almost entirely from direct radiation, which was estimated to be about 0.3 mrem for each working day (i.e., 8 hours). Because most of the time, an exploration worker would stand at some distance away from the excavated soils pile, the radiation dose he would actually receive would be much lower than 0.3 mrem per day. Therefore, it can be reasonably expected that the total dose an exploration worker would receive from mine exploration would be less than 5 mrem.

4.3.5.1 Worker Exposures – Uranium Miners

As is the case with many other occupations, physical injuries or fatalities could result from uranium mining. According to the data published by U.S. Department of Labor, Bureau of Labor Statistics, in 2010, the fatal occupational injury rate for the mining industry was 19.8 per 100,000 full-time workers (BLS 2011a), and the nonfatal occupational injury and illness rate was 2.3 per 100 full-time workers (BLS 2011b). Assuming the injury and fatality rates for uranium mining are similar to those for other types of mining, during the year of peak operations, there could be two nonfatal injuries and illnesses among the 98 workers assumed for this alternative (see Section 2.2.3.1). However, no mining-related fatality is predicted among the workers. The above estimates of injury and fatality were made on the basis of statistical data and should be interpreted from a statistical perspective as well. The actual injury and fatality rates among individual mines could be different. Proper worker training and extensive experience in uranium mining would reduce mining accidents, thereby reducing the potential of injury and fatality.

Past records and studies on the health of uranium mine workers show that in addition to the physical hazards that are associated with the mining activities, inhalation exposure to radon gas could also cause long-term health risks to uranium miners. Mining for uranium ores would accelerate the release of radon, which can cause lung cancers. In addition to inhalation of radon, uranium miners are also exposed to external radiation when they work close to the mineralized ores that contain the uranium isotopes and their decay products.

The MSHA requires that underground uranium mines be monitored for radon levels in air to ensure the safety of mine workers. In 30 CFR Part 57, specific requirements for radon monitoring are included, as follows:

> "Where uranium is mined—radon daughter concentrations representative of worker's breathing zone shall be determined at least every two weeks at random times in all active working areas such as stopes, drift headings, travelways, haulageways, shops, stations, lunch rooms, magazines, and any other place or location where persons work, travel, or congregate. However, if concentrations of radon daughters are found in excess of 0.3 WL in an active working area, radon daughter concentrations thereafter shall be determined weekly in that working area until such time as the weekly determinations in that area have been 0.3 WL or less for 5 consecutive weeks."

> An exposure concentration of radon is usually expressed in terms of a working level or WL, which is a measure of the release of alpha energy by the short-lived progenies of radon. The exposures are measured in working level months (WLMs). One WLM is equivalent to an exposure of 170 hours to a concentration of 1 WL. An individual worker's exposure must not exceed 4 WLM in any calendar year (30 CFR Part 57).

Mining regulations also require operators to keep records of worker exposures to the decay products of radon gas. Federal regulations governing underground mining also require that workers not be exposed routinely to levels exceeding 1 WL in active work areas.

According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2010), among workers involved in nuclear power production, those involved in uranium mining receive the highest collective doses; a significant part of that exposure is from radon inhalation. Over the period of 1985 to 1989, the average radiation exposure for monitored uranium mine workers in the United States was 350 mrem/yr; the average radiation exposure for measurably exposed workers was 433 mrem/yr (UNSCEAR 2010). These average exposures exclude the radiation dose associated with natural background radiation, which was estimated to be about 430 mrem/yr in this area. In general, underground miners receive a higher radiation exposure than open-pit miners, because underground cavities accumulate higher radon concentrations and airborne uranium ore dust concentrations than does aboveground, open space. According to UNSCEAR (1993), external exposure accounts for 28% of the total dose for underground miners and for 60% of the total dose for open-pit miners; the inhalation of radon accounts for 69% and 34% of the total dose for underground miners and open-pit miners, respectively; and the inhalation of uranium ore dust accounts for 3% and 6% of the total dose for underground miners and open-pit miners, respectively. Based on the assumption that the average dose for underground miners is 433 mrem/yr and based on the distributions of the total dose among different pathways, an LCF risk of 4×10^{-4}/yr is calculated for an average miner (see Table 4.3-2). This translates to a probability of about 1 in 2,500 of developing a latent fatal cancer through 1 year of radiation exposure. For a worker who would conduct underground uranium mining for 10 years, the total cumulative dose he would receive would be 4,330 mrem, which would translate to a lifetime LCF risk of 4×10^{-3}; i.e., the probability of developing a fatal cancer would be about 1 in 250.

TABLE 4.3-2 Radiation Doses and LCF Risks Received by Underground Uranium Miners under Alternative 3

Radiation Dose	Fraction of Total	Dose (mrem/yr)
External radiation	0.28	121
Inhalation of radon	0.69	299
Inhalation of particulates	0.03	13
Total	1	433

LCF Risk[a]	Fraction of Total	Risk (1/yr)
External radiation	0.19	7E-05
Inhalation of radon	0.79	3E-04
Inhalation of particulates	0.02	8E-06
Total	1	4E-04

[a] The LCF risks were calculated with a conversion factor of 5×10^{-4}/WLM for the inhalation of radon exposure (ICRP 2011), and a conversion factor of 6×10^{-4}/rem for the external radiation and inhalation of particulates exposure pathways.

Uranium miners could also incur chemical exposures due to the chemical toxicity of uranium and vanadium, which are present in the uranium ores. Because measured air concentrations in uranium mines are not available, potential chemical risks can only be inferred from the measured radiation exposures. Assuming the radiation dose of 13 mrem/yr as listed in Table 4.3-2 from inhalation of particulate was incurred over an exposure duration of 2,000 hours, then with an inhalation rate of 42 ft^3/h (1.2 m^3/h) and under the secular equilibrium assumption between uranium isotopes and their decay progenies, the air concentration of uranium (attached to particulates) was estimated to be 1.6×10^{-12} lb/ft^3 (2.6×10^{-8} g/m^3). If the ratio of air concentration between vanadium and uranium is the same as the ratio of their concentrations in uranium ores, then the air concentration of vanadium would be five times the air concentration of uranium. If vanadium is present as divanadium pentoxide (V_2O_5), then the air concentration of V_2O_5 in uranium mines during the operation and developmental phase would be about 2.9×10^{-11} lb/ft^3 (4.7×10^{-7} g/m^3). The potential hazard index calculated with these estimated air concentrations is slightly over 1 (1.06), which is contributed mostly by exposure to V_2O_5. This hazard index indicated that potential adverse health effect might result from working in underground uranium mines.

4.3.5.2 Worker Exposure – Reclamation Workers

During the reclamation phase, the largest sources of radiation exposure would be the aboveground waste-rock piles accumulated over the operational period. The potential radiation dose that could be incurred by reclamation workers would depend on the size of the waste-rock pile and its uranium content. Because future mining plans are currently not known, the potential radiation exposure of a reclamation worker was estimated on the basis of four varying sizes of waste-rock piles. Detailed discussions on the development of the four hypothetical waste-rock piles are provided in Section 4.1.5 for Alternative 1.

Radiation exposure of an individual worker resulting from performing reclamation activities is expected to be about the same as that analyzed in Section 4.1.5 for Alternative 1. Based on the RESRAD (Yu et al. 2001) analysis, the total radiation dose incurred by a reclamation worker would be about 14.3 mrem or slightly lower. The total dose is estimated on the basis of the assumption that the worker would work 8 hours per day for 20 days on top of a waste-rock pile. The radiation exposure is dominated by the external radiation pathway, which contributes about 94–96% of the total dose, followed by the incidental soil ingestion pathway, which accounts for about 3% of the total dose. The remaining dose is contributed by exposures from inhalation of radioactive particulate and radon gas. The potential LCF risk associated with this radiation exposure is estimated to be 1×10^{-5}; i.e., the probability of developing a latent fatal cancer is 1 in 100,000. The above estimates were obtained by assuming the base radionuclide concentrations in waste rocks (with a Ra-226 concentration of 70 pCi/g). If the higher Ra-226 concentration of 168 pCi/g) was used, the potential dose or LCF risk would increase by a factor of less than 3; i.e., the radiation dose could be as high as 34.2 mrem (LCF risk of 3×10^{-5}, i.e. 1 in 330,00). See Section 4.1.5 for discussion on waste-rock radionuclide concentrations.

In addition to working above the ground, a reclamation worker may be required to work underground to reclaim workings in the mine cavities; however, the time spent underground is expected to be much shorter than the time spent above the ground. Based on past monitoring data for uranium miners (433 mrem/yr in average, see Section 4.3.5.1), it is estimated that a reclamation worker would need to spend 66–158 hours at underground workings to receive the same dose (14.3–34.2 mrem) as he would receive from working on top of a waste-rock pile for 160 hours (i.e., 20 workdays).

In addition to the radiation that is emitted by the uranium isotopes and their decay products in the waste rocks, the chemical toxicity of the uranium and vanadium minerals in the waste rocks could also affect the health of a reclamation worker. The potential chemical risk that a reclamation worker would incur under Alternative 3 is expected to be about the same as that under Alternative 1. Based on the evaluation results for Alternative 1 (Section 4.1.5.1), the total hazard index associated with the chemical exposures would be about 0.13, with 95% contributed by vanadium exposure and 5% contributed by uranium exposure, if the base concentrations in waste rocks were assumed. If higher radionuclide concentrations (168 pCi/g for Ra-226) were used, then the total hazard index would increase to about 0.31. Because the hazard index would be well below the threshold value of 1, potential adverse health effects are not expected for the reclamation worker.

4.3.5.3 General Public Exposure – Residential Scenario

A member of the general public who lived near the ULP lease tracts could be exposed to radiation as a result of the release of radon gas and radioactive particulates that contain uranium isotopes and their decay products from mining-related activities. Because the exact locations and sizes of the mines that would be developed under Alternative 3 are not known at this time, the potential radiation exposure was estimated as a function of distance from the release point of radionuclides, which can be used to estimate the potential exposure of an individual living close to the ULP lease tracts once the location and size of the mine are known. The maximum doses were estimated for four sizes of uranium mines based on the assumptions described in Chapter 2 for Alternative 3.

Except for potential exposures resulting from airborne release of radon gas and radioactive particulates, a less likely exposure pathway for nearby residents after the reclamation phase would be for these residents to let livestock graze in the ULP lease tracts and then consume the meat or milk produced by the livestock. The potential exposures are also analyzed and summarized in the following sections.

4.3.5.3.1 Exposure during Uranium Mine Development and Operations.

Exposure to an Individual Receptor. During the operational phase of underground mining, the major source of radon (Rn-222) emissions to the ambient air is through the exhaust vents of the ventilation systems. Rn-222 emissions from these vents are highly variable and depend on many interrelated factors, including the ventilation rate, ore grade, production rate, age of the mine, size of active working areas, mining practices, and several other variables. In addition to the exhaust vents, Rn-222 is emitted to air from several aboveground sources. These sources are the ore, sub-ore, and waste-rock storage piles, as well as the loading and dumping of these materials. Pacific Northwest National Laboratory has estimated that the Rn-222 emissions from these aboveground sources are about 2–3% of the emissions from the vents (Jackson et al. 1980).

According to the EPA's NESHAP background document (EPA 1989a), the aboveground sources also emit radionuclides to air as particulates. The particulate emissions result from ore dumping and loading operations, wind erosion of storage piles, and vehicular traffic. An assessment of the risks from the particulate emissions showed that they were much smaller (a factor of 100 times less) than the risks from Rn-222 emissions. On the basis of this information and the finding from Pacific Northwest National Laboratory, emissions of Rn-222 from mine workings would be the primary sources of radiation exposures for the general public. They are therefore the focus of the human health impact analysis discussed in this section.

Table 4.3-3 presents the radon emission rates assumed for human health impact analysis during mine development and operations. The uranium ore production rates for the four mine sizes are discussed in Section 2. The emission rates of Rn-222 were calculated with the equation developed by the EPA (EPA 1985) in a study on the Rn-222 emissions from underground uranium mines, in which the emission rates were found to be proportional to the cumulative production of uranium ores. The linear correlations were developed by using radon emission data from more than 25 years ago and have not been re-examined by using newer data. The examination also does not consider the reduction in emissions achieved by using emission

TABLE 4.3-3 Radon Emission Rates per Type of Mine during Mine Operations Assumed for Alternative 3

Parameters	Small[a]	Medium[a]	Large[a]	Very Large[b]	Total
Uranium ore production per mine (tons/d)	50	100	200	300	
Cumulative uranium ore production per mine (tons)	1.20E+05	2.40E+05	4.80E+05	7.20E+05	
Rn-222 emission rate per mine (Ci/yr)[c]	5.28E+02	1.06E+03	2.11E+03	6.00E+02	
Alternative 3 in peak year of operations					
No. of active mines	2	4	1	1	8
Total Rn-222 emission rate (Ci/yr)	1.06E+03	4.22E+03	2.11E+03	6.00E+02	7.99E+03

[a] Underground mine.

[b] Open-pit mine.

[c] The emission rates of radon from underground mines were estimated with the correlation developed by the EPA in 1985: Rn-222 emission (Ci/yr) = 0.0044 × cumulative uranium ore production (tons) (EPA 1985). A cumulative period of 10 years was assumed for this calculation. The emission rate from the very large open-pit mine was determined based on the data compiled by the EPA for open-pit uranium mines (EPA 1989a).

control measures. Therefore, it is judged that the estimates obtained with the EPA equation would overestimate the actual emission rates. For the human health impact analysis, an operational period of 10 years was assumed in order to develop the radon emission rates. Since some uranium mines might not be developed immediately after the ULP PEIS is finalized and issued (i.e., 2013), and since some might be completed in fewer than 10 years, the estimates of radon emission rates based on a 10-year operational period could be higher than the actual emission rates (and the radiation doses) from the underground mine that would be developed. The Rn-222 emission rate for a very large mine (i.e., the existing open-pit mine in Lease Tract 7) was estimated on the basis of the data compiled by the EPA in 1989 (Table 12-7 in EPA 1989a) for surface mines. The estimated value is also expected to be greater than the actual emission rate and would similarly provide more conservative dose results.

CAP88-PC (Trinity Engineering Associates, Inc. 2007) was employed to obtain the radon levels for the estimates of maximum radiation doses and corresponding LCF risks associated with the emissions of radon from four hypothetical uranium mines. For comparison purposes, COMPLY-R (EPA 1989b) was also used to estimate the maximum radiation doses associated with the emissions of radon from the four hypothetical mines. COMPLY-R is pre-approved by EPA for use to analyze radon exposures and to demonstrate compliance with the NESHAP dose limit of 10 mrem/yr for the general public (40 CFR Part 61). However, because it handles only stack emissions of radon, which can be reasonably assumed as point sources, and does not calculate radiation doses associated with radon emissions from area sources, emissions of radionuclides attaching to particulates, or collective exposures for a population, to keep consistency in air emission modeling, CAP88-PC was selected as the primary code for evaluating human health impacts in the ULP PEIS. Table 4.3-4 lists the estimated results. The radiation exposures would decrease with increasing distance because of greater dilution in the radon concentrations, which are expressed in terms of WL and are also listed in Table 4.3-4. The maximum exposure at a fixed distance from the center of each mine, which was assumed to be the emission point for an underground mine, would always occur in the sector that coincides with a dominant wind direction. In any other sector, the potential exposure would be less than the maximum values.

Comparison of CAP88-PC and COMPLY-R

CAP88-PC was used for the calculations performed for the ULP PEIS to maintain consistency in the methodology for evaluating the potential radiation exposures to the general public, both individually and collectively. The COMPLY-R computer code is pre-approved by EPA for use to demonstrate compliance with the dose requirement in 40 CFR 61 Part B. However, it evaluates only radon emissions and does not calculate collective population exposure. However, a calculation for potential individual exposure associated with the release of radon during the operation of a small underground mine was made by using both CAP88-PC and COMPLY-R in order to provide a comparison. The radon doses calculated by CAP88-PC were smaller than those calculated by COMPLY-R for shorter distances (from the emission point; in this case, the potential mine site), but the difference in calculated doses became smaller as distance from the emission point increased. This difference was partly due to different conversion factors used to convert radon levels to effective doses in the calculations. The conversion factor used in the CAP88-PC calculation is 388 mrem/WLM, while COMPLY-R uses a conversion factor of 920 mrem/WLM. Details of this comparison are discussed in Appendix D, Section D.5.6.

The maximum dose estimates are listed in Table 4.3-4. Based on this table, if the resident lived a distance of 3,300 ft (1,000 m) from the emission point of a small underground mine, then the maximum radiation dose he could incur would be about 5.63 mrem/yr based on CAP88-PC results, which is 56% of the NESHAP dose limit (40 CFR Part 61) for airborne emissions of radionuclides. If the distance was increased to 6,600 ft (2,000 m), then the maximum exposure would be less than 3 mrem/yr. The radiation doses calculated by COMPLY-R are higher; at a distance of 3,300 ft (1,000 m) from a small underground mine, the maximum dose was calculated to be 12 mrem/yr; increasing the distance to 6,600 ft (2,000 m), the maximum dose was reduced to 4.3 mrem/yr. In general, the radon doses calculated by CAP88-PC were smaller than those calculated by COMPLY-R for shorter distances (from the emission point), but the difference became smaller as the distance from the emission point increased. This difference in estimated radon doses was partly due to different conversion factors used to convert radon levels to effective doses in the calculations. The conversion factor used in the CAP88-PC calculation is 388 mrem/WLM (UNSCEAR 2008), while COMPLY-R uses a conversion factor of 920 mrem/WLM. The maximum doses associated with a medium or a large mine would be two or four times, respectively, the maximum doses associated with a small mine, because according to the EPA radon emission model (EPA 1985), the amount of radon released from a medium or large mine would be two or four times, respectively, the amount of radon released from a small mine. Therefore, at a distance of 3,300 ft (1,000 m) from a medium or large mine, the maximum dose (11.26 mrem/yr or 22.52 mrem/yr from CAP88-PC calculations; 24 mrem/yr or 48 mrem/yr from COMPLY-R calculations) would exceed the NESHAP dose limit of 10 mrem/yr. Currently, compliance with the NESHAP dose limit of 10 mrem/yr for radon emissions from underground mines is required for owners or operators of active uranium mines that meet either of two conditions: (1) it has mined (or will, or is designed to mine) 100,000 tons of ore during the life of the mine, or (2) it has produced (or will produce) more than

TABLE 4.3-4 Potential Maximum Radon Levels, Radiation Doses, Radon Concentrations, and LCF Risks to a Resident Associated with the Emission of Radon from Four Uranium Mine Sizes under Alternative 3

	Radiation Dose (mrem/yr) and Radon Level (WL) per Mine Size[a]				LCF Risk (1/yr) per Mine Size[b]			
Distance (m)	Small	Medium	Large	Very Large	Small	Medium	Large	Very Large
500	7.83/35.70 (0.00065)	15.66/71.40 (0.0013)	31.32/142.80 (0.0026)	27.40 (0.0023)	1E-05	2E-05	4E-05	4E-05
1,000	5.63/12.00 (0.00047)	11.26/24.00 (0.00094)	22.52/48.00 (0.0019)	9.05 (0.00076)	7E-06	1E-05	3E-05	1E-05
1,500	3.72/6.50 (0.00031)	7.44/13.00 (0.00062)	14.88/26.00 (0.0012)	5.53 (0.00046)	5E-06	1E-05	2E-05	7E-06
2,000	2.67/4.30 (0.00022)	5.34/8.60 (0.00044)	10.68/17.20 (0.00089)	3.72 (0.00031)	3E-06	7E-06	1E-05	5E-06
2,500	2.04/2.90 (0.00017)	4.08/5.80 (0.00034)	8.16/11.60 (0.00068)	2.7 (0.00023)	3E-06	5E-06	1E-05	3E-06
3,000	1.63/2.50 (0.00014)	3.26/5.00 (0.00027)	6.52/10.00 (0.00054)	2.09 (0.00017)	2E-06	4E-06	8E-06	3E-06
4,000	1.22/1.70 (0.00010)	2.44/3.40 (0.00020)	4.88/6.80 (0.00040)	1.53 (0.00013)	2E-06	3E-06	6E-06	2E-06
5,000	0.97/1.30 (0.00008)	1.94/2.60 (0.00016)	3.88/5.20 (0.00032)	1.2 (0.00010)	1E-06	3E-06	5E-06	2E-06

[a] Radiation dose is on top line, and radon concentration (as working level) is in parentheses below. Two dose results are listed; the first one was obtained with CAP88-PC, and the second one was obtained with COMPLY-R.

[b] Cancer risks were estimated on the basis of the CAP88-PC results. COMPLY-R does not provide estimates of cancer risks.

10,000 tons of ore during a 12-month period, unless the owner or operator can prove that total lifetime ore production will be 100,000 tons or less (40 CFR 61 Subpart B). The “small” mine assumed for the ULP PEIS would generate 12,000 tons of ore during a 12-month period during the peak year. The NESHAP dose limit of 10 mrem/yr for radon emissions from underground mines would apply.

It should be noted that the maximum doses listed in Table 4.3-4 are for a resident living in a dominant wind direction and were obtained by using the radon emission rates corresponding to an operational period of 10 years. The radiation doses at nondominant wind locations would be less. Likewise, the emission rates for uranium mines developed and operated for fewer than 10 years would be less. If there were one or more uranium mines close to a given residence and they were being operated at the same time, the potential dose that the resident could receive would be the sum of the doses contributed by each mine.

Based on the maximum doses presented in Table 4.3-4, it is possible that a resident could receive a radon dose of more than 10 mrem/yr, if he lives less than 1.6 mi (2.5 km) from a uranium mine and the residence happened to be located in a dominant wind direction from the emission point. However, the estimates in Table 4.3-4 were obtained by using conservative assumptions; the actual radon dose could be much smaller based on actual radon emission data, since monitoring would be implemented to ensure radiation levels were consistent with requirements. In case the radon dose estimated with actual emission data shows a potential for exceeding the 10-mrem/yr dose limit, mitigation measures (see discussions that follow) would be required to reduce the radon emissions; increased reporting of monitoring status and results would also be required.

The maximum LCF risk for a resident living close to a small underground uranium mine was estimated to range from 1×10^{-6}/yr at a distance of 3.1 mi (5,000 m) to 1×10^{-5}/yr at a distance of 0.3 mi (500 m). That is, the probability of developing a latent fatal cancer ranges from 1 in 1,000,000 at a distance of 3.1 mi (5,000 m) to 1 in 100,000 at a distance of 0.3 mi (500 m) from each year of exposure. The probability would increase by a factor of two or four if the resident lived close to a medium-sized or a large underground mine, respectively.

Potential chemical exposures resulting from emissions of particulates containing uranium and vanadium during development and operation of uranium mines are not expected to cause adverse health effects to the general public living near the ULP lease tracts. According to the analysis of potential chemical exposures to underground uranium miners, which is detailed in Section 4.3.5.1, the hazard index (1.06) associated with the exposures was estimated to be just slightly over the threshold value of 1. Because after being released through the emission stacks, the air concentrations of uranium and vanadium would be greatly diluted, potential chemical exposures experienced by a nearby resident would be much lower than those experienced by a worker; therefore, the hazard index associated with the exposures of a nearby resident would be much lower than 1.

Because potential radon exposures of the general public living near the ULP lease tracts could exceed the NESHAP dose limit of 10 mrem/yr, compliance measures, mitigation measures, and BMPs are identified in Section 4.6, Table 4.6-1, to achieve the following two objectives: (1) obtain actual radon emission rates to refine the dose estimates associated with radon exposures and (2) reduce the impact on the general public, if the refined estimates would exceed the 10-mrem/yr dose limit. Specific measures that would be mandatory include the following:

- Measures for obtaining actual radon emission rates:
  - Monitor the radon discharge concentration continuously whenever the mine ventilation system is operational;
  - Measure each mine vent exhaust flow rate; and
  - Calculate and record a weekly radon-222 emission rate for the mine.

- Measures for reducing impact to the general public:
  - Increase the ventilation flow rate;
  - Reroute ventilation flow;

- Reroute ventilation to a new vent;
- Modify the vent stack;
- Decrease vent stack diameter;
- Increase vent stack release height; and
- Construct additional bulkheads.

Exposure to a Collective Population. In addition to the residents who lived near the DOE ULP lease tracts, members of the general public who lived further away from the lease tracts could also be exposed to radiation associated with the radon emissions from mining activities, although their exposures would be much lower than those of the nearby residents. Because of air dispersion, in general, the radon level would decrease as the distance from the emission point increases. The potential radiation exposure of a population within an area can be characterized with a collective dose, which is equivalent to the sum of the individual doses over the population and typically assumes the unit of person-rem. The collective dose of the general public who live within 50 mi (80 km) around the active uranium mines were estimated in the ULP PEIS by using CAP88-PC (Trinity Engineering Associates, Inc. 2007). A distance of 50 mi (80 km) was selected because it is the largest distance accepted by CAP88-PC.

Collective exposures of the general public were estimated for the peak year of operations by using the assumptions described in Chapter 2. To estimate the range of collective exposure, radon emissions from all the underground mines were combined and assumed to be released from a single exhaust vent. This single vent was selected to be at the center of each lease tract group. The lease tracts were divided into four groups for analysis (see the methodology discussed in Section D.5.1).

In addition to the emissions from underground mining, the collective exposure to the emissions from surface mining was also calculated. Because the only open-pit mine considered in the ULP PEIS is located in Lease Tract 7, when calculating the collective exposure, it was assumed that the emission came from the center of lease tract group 3. The sum of the collective doses from underground mining and open-pit mining were used to approximate the total collective dose during the year of peak operations.

The collective exposures were estimated by using the population distribution data developed around the center of each lease tract group. The distribution data account for the population living 3.1 to 50 mi (5 to 80 km) from the center. The distribution within the first 3.1 mi (5 km) was not utilized for two reasons: (1) the population within 3.1 mi (5 km) could not be determined and distributed as accurately as the population beyond 3.1 mi (5 km); and (2) the population within 3.1 mi (5 km) of the ULP lease tracts is very small compared with the total population within 50 mi (80 km). This approach is expected to provide a reasonable estimate of the potential range of collective exposures.

Table 4.3-5 presents the collective doses estimated for the peak year of operations under Alternative 3. According to the estimates, the collective dose associated with underground mining ranges from 6.6 to 38 person-rem. The collective dose associated with the one very large open-pit mine is about 0.88 person-rem. Combined, the underground and open-pit mines would

TABLE 4.3-5 Collective Doses and LCF Risks to the General Public from Radon Emissions from Uranium Mines during the Peak Year of Operations under Alternative 3

Type of Mining and Location	Collective Dose (person-rem/yr)	Collective LCF (1/yr)[a]
From underground mines[b]		
Based on the center of Group 1[c]	3.84E+01	5E-02
Based on the center of Group 2[d]	2.05E+01	3E-02
Based on the center of Group 3[e]	1.04E+01	1E-02
Based on the center of Group 4[f]	6.59E+00	8E-03
From open-pit mines[g]		
Based on the center of Group 3[e]	8.81E-01	1E-03
Total		
Minimum	7.47E+00	1E-02
Maximum	3.93E+01	5E-02

[a] Denotes the number of latent lung cancers that could result from radiation exposure.

[b] The total radon emission rate from underground mining during the peak year of operations is 7,390 Ci/yr.

[c] If the emission is from the center of lease tract Group 1, the total population between 3 and 50 mi (5 and 80 km) is 178,473.

[d] If the emission is from the center of lease tract Group 2, the total population between 3 and 50 mi (5 and 80 km) is 86,657.

[e] If the emission is from the center of lease tract Group 3, the total population between 3 and 50 mi (5 and 80 km) is 27,062.

[f] If the emission is from the center of lease tract Group 4, the total population between 3 and 50 mi (5 and 80 km) is 33,166.

[g] The total radon emission rate from open-pit mines during the peak year of operations is 600 Ci/yr.

result in a total collective dose ranging from 7.5 to 39 person-rem during the year of peak operations. This collective exposure would result in a collective LCF of 0.01 to 0.052. Therefore, no LCF among the population would be expected to result from the collective exposure to the radon emitted from the eight uranium mines that would be operated simultaneously during the peak year of operations under Alternative 3. The total populations involved in these estimates range from 27,062 to 178,473, depending on the location assumed for the emission point. If the collective dose is evenly distributed among the population, the corresponding average individual dose would be less than 0.4 mrem (LCF risk of 3×10^{-7}; i.e., 1 in 3,300,000) during the peak year of operations. In reality, because the active lease tracts (the lease tracts with mining operations) could be spread out among the four lease tract groups rather than concentrating in one single group (as was assumed for the calculations), the population size within 3 to 50 mi (5 to 80 km) of the lease tracts should be greater than the 178,473 used in the calculations.

Therefore, the actual average individual dose should be just a fraction of the calculated average value.

4.3.5.3.2 Accidental Release of Uranium during Operations. No mining accident would be expected to expose the public or ecological systems to greater amounts of the ore than the amount that occurs during operations, as discussed in this section and Section 4.3.6. Accidents involving the low-grade uranium ore at a lease tract mine are not expected to result in release of radioactive material that would pose a health risk to the public greater than the risks assessed for routine operations. Mine operations already involve the movement of large volumes of ore that are open to the environment during the actual mining of the ore (for the open-pit mine), stockpiling, and loading of the haul trucks. In addition, the stony, aggregate nature of the ore precludes any widespread dispersion by air or water. Some dust and fines are present, but their suspension in air is minimized because they are sprayed with water or a similar suppression agent to limit worker exposures and off-site dispersion. Any work at the mines would be isolated from surface water, thus reducing the potential of surface water contamination to a minimum.

4.3.5.3.3 Exposure during and after Reclamation. Residents who live close to a uranium mine during or after the reclamation phase could be exposed to radiation as a result of emissions of radioactive particulates and radon gas from the waste-rock piles left aboveground. The potential radiation dose would depend on the direction and distance between the residence and the waste-rock piles and the emission rates of particulates and radon. The potential range of the radiation dose that a resident would incur under Alternative 3 is expected to be similar to the range of the radiation dose incurred under Alternatives 1 and 2, because the exposures would be dominated by the emissions from the waste-rock pile(s) that is (are) closest to this resident.

Based on the estimates presented in Section 4.1.5.4, if a resident lived at a distance of 3,300 ft (1,000 m) from a waste-rock pile, the radiation dose he could receive would be less than 3.5 mrem/yr; if the distance was increased to 6,600 ft (2,000 m), the exposure would be less than 1.3 mrem/yr. If there were two waste-rock piles nearby, the potential dose this resident could incur would be the sum of the doses contributed by each waste-rock pile. Based on the listed maximum doses in Table 4.1-8, the potential dose incurred by any resident living at a distance of more than 1,600 ft (500 m) from the center of a waste-rock pile is expected to be smaller than the NESHAP dose limit of 10 mrem/yr for airborne emissions (40 CFR Part 61). The potential LCF risk would be less than 9×10^{-6}/yr, which means the probability of developing a latent fatal cancer from living close to the ULP lease tracts for 1 year during or after the reclamation would be 1 in 110,000. If a resident lived in the same location for 30 years, then the cumulative LCF risk would be less than 3×10^{-4}. The above estimates were obtained with the base concentrations assumed for waste rocks (70 pCi/g for Ra-226); should the higher 168 pCi/g concentrations be used, the potential radiation doses and LCF risks would increase by a factor of less than 3; therefore, the potential LCF risk would be less than 7×10^{-6}/yr at a distance of 3,300 ft (1,000 m), and for 30 years, the total LCF risk would be less than 2×10^{-4}.

In reality, waste-rock are expected to be covered by a layer of soil materials during reclamation to facilitate vegetation growth. Because of this cover, emissions of radioactive particulates would be greatly reduced, if not eliminated completely. Emissions of radon from waste-rock piles could continue, although the emission rates would be reduced. In fact, because uranium isotopes and their decay products have long decay half-lives, the potential of radon emissions from waste-rock piles could persist for millions of years after the reclamation was completed.

In addition to radiation exposure, the residents living close to the ULP lease tracts could incur chemical exposures due to the chemical toxicity of uranium and vanadium minerals contained in the waste rocks. Potential chemical exposures would be associated with emissions of particulates and with the inhalation and incidental dust ingestion pathways. The same exposure parameters as those used for radiation dose modeling were used to evaluate potential chemical risks to nearby residents. According to the evaluation results, the total hazard index would be well below the threshold value of 1, with inhalation being the dominant pathway. Therefore, nearby residents are not expected to experience any adverse health effects associated with the potential exposures.

The above discussions consider the exposures of nearby residents to the airborne emissions of radon and particulates from waste-rock piles. A less likely exposure scenario after the reclamation phase is for a nearby resident to raise livestock in the lease tract and consume the meat and milk produced. According to the RESRAD calculation results, the potential dose would be less than 5.5 mrem/yr, which is a small fraction of the DOE dose limit of 100 mrem/yr for the general public from all applicable exposure pathways (DOE Order 458.1). The corresponding LCF risk would be 3×10^{-6}/yr; i.e., the probability of developing a latent fatal cancer would be less than 1 in 330,000 per year. Section 4.1.5.2. provides detailed discussions on this analysis.

4.3.5.4 General Public Exposures – Recreationist Scenario

In addition to the residents who live near the ULP lease tracts and could therefore be exposed to the emissions from the lease tracts, a recreationist who unknowingly entered the lease tracts could also potentially be exposed to radiation. He could enter the lease tracts prior to reclamation (when active mining is going on), during reclamation, or after reclamation. During the first two phases, the presence of mining/reclamation equipment, mining infrastructure, and workers would deter a recreationist from entering a lease tract. Even if he did enter, the duration of time spent there would be much shorter than the duration after reclamation. Therefore, the potential impact on a recreationist after reclamation is the focus of the ULP PEIS.

The potential radiation exposure that a recreationist might incur from entering a lease tract would be higher during active mining than during active reclamation. The radiation exposure during active mining would be bounded by the exposure of an open-pit uranium miner. Past monitoring data for uranium miners indicated that on average, a uranium miner would receive a radiation dose of about 433 mrem/yr; open-pit miners received less exposure than underground miners. If this average value is conservatively used as the radiation dose to an open-pit miner, and if the number of hours he worked is assumed to be 2,000 per year, an average dose rate of 0.22 mrem/h can be calculated. This dose rate would include 0.13 mrem/h from external radiation, 0.07 mrem/h from radon inhalation, and 0.013 mrem/h from inhalation of particulates (the contributions to the total dose from individual pathways are 60%, 34%, and 6%, respectively) (see discussions in Section 4.3.5.1). This dose rate is 2.5 times the dose rate (0.089 mrem/h, equivalent to 30 mrem for 2 weeks) estimated considering the recreationist entering the lease tract after reclamation (spending time on top of a waste-rock pile, discussed in the following paragraphs). The higher dose rate during active mining is primarily due to the presence of uranium ores (in a pile or in the open pit). If the lease tract has an active underground mine rather than an active open-pit mine, the dose rate would not be higher, because there would not be any exposed uranium ores in the ground.

Although the ventilation stacks of the underground mine would release large amounts of radon, the radon concentration would be greatly diluted upon exiting the stack because of mixing with surrounding air. Based on the CAP88-PC modeling results, the maximum radon concentration from stack emissions from a small underground mine is about 0.005 WL (at a distance of about 50 m from the release point); the corresponding radon dose is 0.012 mrem/h. For a large underground mine, the maximum radon level would be about 0.02 WL, with a corresponding dose rate of 0.048 mrem/h. These two radon dose rates estimated for an underground mine are less than that estimated for an open-pit mine, as discussed above (0.07 mrem/h).

To model the potential radiation exposure incurred after reclamation, it is assumed the recreationist would camp on top of a waste-rock pile for 2 weeks during each trip, eat wild berries collected in the areas, and hunt wildlife animals for consumption. This recreationist could receive radiation exposure through the direct external radiation, inhalation of radon, inhalation of particulates, and incidental soil ingestion pathways while camping on waste rocks. The potential exposures would vary with the thickness of soil cover placed on top of waste rocks during reclamation. In the analysis, the thickness was assumed to range from 0 to 1 ft (0.3 m).

The potential dose that could be incurred by a recreationist under Alternative 3 would be similar to that under Alternatives 1 and 2. According to the RESRAD (Yu et al. 2001) calculation results, the radiation dose incurred by the recreationist from camping on waste rocks for 2 weeks would range from 0.88 mrem with a cover thickness of 1 ft (0.3 m) to 30 mrem with no cover. The corresponding LCF risk would range from 1×10^{-6} to 2×10^{-5}; i.e., the probability of developing a latent fatal cancer would be about 1 in 1,000,000 to 1 in 50,000. The majority of the radiation dose would result from direct external radiation. These dose estimates were made by using the base concentration (70 pCi/g for Ra-226) assumed for waste rocks. If the concentrations were increased to the higher 168 pCi/g concentrations, potential dose and LCF risks would be increased by a factor of less than 3.

The potential radiation dose associated with eating wild berries and wildlife animals was calculated with assumed ingestion rates of 1 lb (0.45 kg) and 100 lb (45.4 kg), respectively. The potential dose was estimated to range from1.08 mrem to 1.66 mrem, depending on the depth of plant roots assumed for the estimate. The corresponding LCF risk was estimated to be less than 8×10^{-7}; i.e., the probability of developing an LCF would be less than 1 in 1,250,000.

No chemical risks would result from camping on a waste-rock pile if the pile was covered by a few inches of soil materials. In the worst situation in which there was no soil cover, a hazard index of 0.039 was calculated. The potential chemical risk associated with ingesting contaminated wild berries would be small, with a hazard index of less than 0.003. The hazard index associated with eating wildlife animals would be more than 100 times greater than that associated with eating wild berries, because of the potential accumulation of vanadium in animal tissues. The hazard index calculated was 0.39. However, because the sum of all these hazard indexes was much less than 1, the recreationist is not expected to experience any adverse health effect from these two ingestion pathways.

Most of the encounters between recreationists and ULP lease tracts are expected to be much shorter than 2 weeks. When the total dose associated with exposures to waste rocks from camping is used, a dose rate of less than 0.09 mrem/h (LCF risk of 7×10^{-8}, i.e., 1 in 14,000,000) was estimated.

A detailed analysis of the potential exposure to an individual receptor under post-reclamation conditions at the mine sites is discussed in Section 4.1.5.3. Mitigation measures to reduce the potential for exposure at sites following reclamation are listed in Table 4.6-1 (Section 4.6).

4.3.5.5 Intentional Destructive Acts

The impacts of intentional destructive acts (IDAs) are addressed here to provide perspective on the risks that the uranium ore could pose should such an act occur. The consequences of an IDA involving hazardous material depend on the material's packaging, chemical composition, radioactive and physical properties, accessibility, quantity, and ease of dispersion, and on the surrounding environment, including the number of people who are close to the event. An IDA could occur during mining, temporary storage of the mined ore, loading of the haul trucks, and transportation activities for Alternatives 3, 4, and 5.

The low-grade nature of the uranium ore considered in the ULP PEIS (0.2% as U_3O_8) poses little risk, in general, to human health and the environment, even under accident conditions, as discussed in Sections 4.3.5.3.2, 4.3.6.3, and 4.3.10.4. There are already large quantities of the ore exposed to the environment during mining (for the open-pit mine), stockpiling, and loading of the haul trucks. In addition, the stony, aggregate nature of the ore precludes any widespread dispersion by air or water during mining operations or following a potential accident. In the case of transportation, the uranium ore being transported is treated by DOT regulations as a low-specific-activity material and requires minimal packaging (i.e., a tarp is required to cover the top of the haul truck to minimize the dispersion of any loose material). Because of the low-grade nature of the uranium ore, an ore spill of the entire shipment (25 tons) would not constitute a reportable quantity for uranium as defined in 49 CFR 172.101. Thus, an IDA would not be expected to result in chemical or radiological impacts any greater than those present during mining operations and transport to a mill.

In addition, the remote locations of the lease tracts and the transportation routes also would reduce the likelihood of the already minimal impacts from a potential IDA event. An IDA at a location farther from potential victims would affect fewer individuals and would likely be a less attractive option for terrorists. Terrorists might also find it harder to blend into the local population in the sparsely populated areas surrounding the lease tracts (i.e., they might be more easily detected while they were planning, preparing, and executing a potential IDA).

4.3.6 Ecological Resources

4.3.6.1 Vegetation

Previous disturbance from exploration or mine development occurred in each of these lease tracts; however, new exploration could occur in either disturbed or undisturbed areas of these lease tracts. Exploration activities generally include drilling one or more bore holes for geologic sampling followed by reclamation of the explored area. Impacts from exploration would occur from the disturbance of vegetation and soils that could result from equipment operation. In some areas, the removal of trees or shrubs might be necessary to provide access to sampling locations. Impacts would include compaction of soils, disturbances to plants, and burial of vegetation under waste material. Erosion and sedimentation could occur where soil compaction or loss of biological soil crusts increased surface runoff, loosened soils were not stabilized, or vegetation was removed. Impacts on ephemeral or intermittent drainages crossed by heavy equipment could result in sediment deposition in downstream areas. Measures, such as minimizing the extent of ground-disturbing activities, using existing roads, and avoiding steep slopes and natural drainages, which are listed in Table 4.6-1, would mitigate potential impacts. Exploration activities are expected to affect relatively small areas at each sampling location, and impacts on vegetation would generally be short term, with recovery generally occurring within 5 years. The localized destruction of biological soil crusts, where present, would be considered a longer-term impact, particularly where soil erosion had occurred. In either case, because of the small areas involved relative to the extent of the affected plant communities and because most impacts could be avoided and plant communities would be expected to fully recover from remaining impacts, the impacts of exploration activities would be considered minor.

Under Alternative 3, it is assumed mine development and operations would occur in the 12 lease tracts and ground disturbance would range from 10 acres (4.0 ha) for small mines to 20 acres (8.1 ha) for a large mine, with the total being 100 acres (40 ha). In addition, the 210-acre (85-ha) open-pit mine at JD-7 would resume operations, resulting in a total of 310 acres (130 ha) of disturbance under Alternative 3. Disturbance would be expected to extend over a period of more than 10 years, prior to the initiation of reclamation activities. Direct impacts associated with the development of mines would include the destruction of habitats during site clearing and excavation as well as the loss of habitats at the locations of the waste-rock disposal area (about one-third of the total area disturbed), soil storage areas, project facilities, and access roads. Stored waste rock could contain up to 0.05% uranium. Based on the assumed concentration of uranium (23.7 pCi/g) as well as other radionuclides that might be present in the waste rock, the potential radiation exposure to plants would be below screening levels for ecological risk (see Section 4.1.5.1). Storage areas for woody vegetation removed from project areas during land clearing would affect additional areas. The area of direct effects is the area that could be physically modified during mine development (i.e., where ground-disturbing activities could occur) and includes the area of the 12 lease tracts. Although the loss of habitat would be unavoidable, the plant communities that would be affected are generally common in the area. Measures listed in Table 4.6-1, for example, would mitigate potential impacts, and impacts on sensitive habitats would be minimized. Therefore, the impacts would be moderate.

The lease tracts included in Alternative 3 support a variety of vegetation types; however, the predominant types are piñon-juniper woodland and shrubland and big sagebrush shrubland. Some of the areas affected might include high-quality, mature habitats (i.e., habitats with few weedy species and a high diversity of native species less tolerant of disturbance), which would result in greater impact levels than the levels in previously degraded areas. Indirect impacts of mining would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or water quality. The area of indirect effects includes the lease tracts and the area within 5 mi [8 km] of the lease tracts, where ground-disturbing activities would not occur but that could be indirectly affected by activities in the area of direct effects. The potential degree of indirect effects would decrease with increasing distance from the lease tracts. This area of indirect effect was identified on the basis of professional judgment and was considered sufficiently large to bound the area that would potentially be subject to indirect effects.

Fugitive dust would be generated during site clearing, excavation, processing, and use of access roads. Deposition of fugitive dust could reduce photosynthesis and productivity in plant communities near project areas. Prolonged exposure to fugitive dust could alter a plant community's composition, reducing the occurrence of species less tolerant of disturbance, resulting in habitat degradation. Open-pit mines would generate more fugitive dust than would underground mines, since most of the project area would consist of exposed soils, rock materials, and operating mining equipment. Because fugitive dust would be produced throughout the life of the project (more than 10 years), the deposition of fugitive dust would constitute a long-term impact. Measures, such as the application of dust suppressants on roads, which are listed in Table 4.6-1, would reduce the generation of fugitive dust. Plant communities would be expected to fully recover from impacts of fugitive dust from underground mines, and impacts would be minor. Impacts from open-pit mines, such as JD-7, would be moderate, however, since unavoidable impacts (for example, from wind erosion) could occur but would not threaten the persistence of affected plant communities.

Disturbed soils could provide an opportunity for the introduction and spread of invasive species or noxious weeds. Seeds of these species could be inadvertently brought to a project site from infested areas by vehicles or equipment used at the site. Invasive species or noxious weeds might also colonize disturbed soils from established populations in nearby areas. Vehicle traffic to and from mine sites might contribute to the spread of seeds of these species, expanding populations along roadways. Invasive species or noxious weeds might alter fire regimes, including increasing the frequency and intensity of wildfires, particularly as a result of the establishment of annual grasses such as cheatgrass. Habitats that are not adapted to frequent or intense fires could experience long-term effects, requiring decades to recover or being replaced by non-native species. Monitoring the lease area regularly throughout all mining phases, including intermittent mining phases, and controlling noxious weeds constitute a mitigation measure used at some mine sites (JD-6, JD-8) to protect native plant communities.

Soils disturbed by land clearing or excavation might be subject to erosion. Soil erosion might also occur in areas where biological soil crusts have been disturbed by equipment or foot traffic (Belnap and Herrick 2006). The destruction of biological soil crusts could also alter nutrient cycling and availability, reduce water infiltration, reduce germination of native species, and increase the occurrence of non-native species, affecting plant community characteristics (Fleischner 1994; Belnap et al. 2001; Gelbard and Belnap 2003; Rosentreter et al. 2007). Soil compaction from the operation of heavy equipment could reduce the infiltration of precipitation or snowmelt and result in increased runoff and subsequent erosion. Erosion could result in the localized loss of plant communities in areas where surface soil materials were lost; this might include areas outside the mine site. Effects might include mortality or reduced growth of plants, changes in species composition, or reduced biodiversity. Species more tolerant of disturbance, including invasive species, might become dominant in affected plant communities.

Reclamation activities under Alternative 3 would be similar to those described for Alternative 1. Upland areas affected by grading would generally consist of previously disturbed areas. Most of the reclamation would be associated with covering the waste-rock pile. Indirect impacts associated with reclamation activities could include the deposition of fugitive dust, erosion, sedimentation, the introduction of non-native species including noxious weeds, and the introduction of new genetic strains of native species.

Measures, such as invasive species monitoring and eradication, avoiding natural drainages, controlling runoff and sediment, and placing barriers around drainages and wetlands (which are listed in Table 4.6-1) could mitigate potential indirect impacts associated with the three mining phases considered under Alternative 3. Stormwater management plans and drainage design plans developed for mining operations (e.g., JD-6, JD-8, CM-25, LP-21, SM-18, SR-11, SR-13A) generally include BMPs for stormwater control to minimize soil erosion and sedimentation, such as diversion ditches to direct off-site run-on from the mining areas, berms, stormwater retention/sedimentation ponds, and other sediment and erosion prevention measures. Impacts on plant communities from invasive species, erosion, sedimentation, and hydrologic changes would be moderate since, although many impacts could be minimized, unavoidable impacts (for example, unavoidable changes in drainage patterns or undetected invasive species) could occur but would not threaten the persistence of affected plant communities. As described in Section 4.1.6.1, impacts from reclamation activities would be expected to be minor.

4.3.6.1.1 Wetlands and Floodplains. Direct impacts would primarily affect upland plant communities; however, wetlands present on project sites could also be affected. Federal agencies are required by E.O. 11990, "Protection of Wetlands," to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Impacts on jurisdictional wetlands (those under the regulatory jurisdiction of the CWA, Section 404, and the USACE) would require permitting. Wetlands occur on each of the lease tracts included in Alternative 3, as well as in immediate downstream areas. Streams located within lease tracts, such as the Dolores River (Lease Tracts 13 and 13A) or Atkinson Creek (Lease Tract 18), would not likely be directly affected because mines would be required to be located at a distance from these streams (e.g., 1,300 ft [0.25 mi] from the Dolores River). Indirect impacts on these streams, however, could occur. Indirect impacts of mining would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or water quality.

Soil compaction from the operation of heavy equipment could reduce the infiltration of precipitation or snowmelt and result in increased runoff and subsequent erosion. Erosion could result in the localized loss of plant communities in areas where topsoil was lost and might include areas outside the mine site. Erosion might result in sedimentation in downgradient wetland habitats and increased sediment deposition in ephemeral drainages or riparian habitats of receiving streams. Effects might include mortality or reduced growth of plants, changes in species composition, or reduced biodiversity. Species more tolerant of disturbance, including invasive species, might become dominant in affected plant communities. As noted in Section 4.3.6.1 above, BMPs for stormwater control are designed to minimize erosion and sedimentation.

Changes in surface drainage patterns, such as the elimination of ephemeral drainages or other changes in runoff patterns, could alter hydrologic characteristics of downstream wetland or riparian habitats and could result in changes in plant community composition or distribution. For example, the drainages associated with Atkinson Creek in Lease Tract 18 and the Dolores River in Lease Tracts 13 and 13A, are upstream of wetlands located in those streams. Increases in the volumes or velocities of flows could result in the erosion of substrates or vegetation in downstream habitats, while decreased flows could result in desiccation of habitats. Underground mines would be less likely to result in large changes to surface water flow patterns and associated impacts on plant communities than would open-pit mines, which cause extensive modifications to landscape surfaces. Waste-rock storage for underground mines, however, could disrupt surface drainage patterns over a large area. Leachate from waste-rock storage areas could result in impacts on the quality of surface water or groundwater and affect downgradient habitats. Groundwater pumped from mines could affect habitats receiving surface water flows as a result of reduced water quality or increased flow velocities or volumes.

Mining operations could affect groundwater flows if excavations intercepted groundwater resources. Reductions in groundwater flows could affect downgradient habitats that depend on groundwater discharges (such as springs, seeps, or within streams with flows supplemented or maintained by groundwater). Plant communities could be degraded as a result of reductions in water availability. For example, Lease Tracts 13, 13A, and 14 likely include shallow alluvial aquifers of the Dolores River that may be intercepted by a mine excavation. Measures, such as plugging open drill portals and areas around vent shafts (which are listed in Table 4.6-1), could mitigate potential impacts. See Section 4.3.4 for a thorough discussion of potential impacts on groundwater flow. Impacts on groundwater flows would be small and would result in minor impacts on downgradient habitats, which would be expected to fully recover.

4.3.6.2 Wildlife

Potential impacts on wildlife from exploration would primarily result from disturbance (e.g., due to equipment and vehicle noise and the presence of workers). Impacts would generally be temporary and at a smaller scale than those that occur during other phases (i.e., mine development and operations and reclamation). Some mortality to less mobile wildlife could occur at the exploration sites, and vehicles could hit wildlife.

The following discussion provides an overview of the potential impacts on wildlife that could result from the development and operation of mines. On-site activities could include the (1) placement, construction, and operation of surface components and (2) mine development and operations. Off-site activities could include the construction and use of access roads and utilities, as necessary. The overall impact of mine development and operational activities on wildlife populations at a lease tract site would depend on the types and amounts of wildlife habitat affected by a given stressor, the length of time that the effects persist, and the species of wildlife that inhabit or utilize the mine site and surrounding areas. Impacts on wildlife could occur from habitat disturbance, wildlife disturbance, and wildlife injury or mortality.

As described in mine permit amendment applications, the lessee will consult with the BLM, USFWS, and/or CPW prior to surface-disturbing activities to determine if the agencies have concerns regarding wildlife in the area to be disturbed (Cotter Corp. 2011, 2012a–g). If required, the lessee shall conduct surveys or provide other documentation regarding the presence of the wildlife species of concern. The lessee shall conduct all operations so as to protect all natural resources and the environment, including aquatic habitats and fish and wildlife resources, as required by applicable statutes and regulations. The lessee shall control all mine wastes, contaminants, pollutants, and sediments associated with stormwater runoff in accordance with existing regulations, and the lessee shall comply with all environmental regulations regarding discharge into or degradation of water resources.

4.3.6.2.1 Habitat Disturbance. Mine development and operations would affect wildlife through habitat reduction, alteration, and fragmentation. Habitats within the construction footprint of the projects, utility ROWs, access roads, and other infrastructure would be destroyed or disturbed. Direct impacts resulting from mine development could include destruction of habitats from site clearing and excavation, storage of waste-rock and surface soil materials, placement of project facilities, development of access roads, and, as necessary, clearing for utility lines. The 310 acres (130 ha) disturbed for the eight mine sites during the peak year of operations is 3.4% of the total acreage of the 12 lease tracts now considered under Alternative 3 (Lease Tracts 7 and 7A have been combined into a single Lease Tract 7) and 1.2% of the total acreage of DOE’s lease program. This acreage includes the 210 acres (85 ha) of this total that is a previously disturbed area for the JD-7 open-pit mine site. The remainder of the lease tracts (excluding areas where access roads and utility corridors could be required) would be undisturbed by mining activities under Alternative 3.

Habitat reduction could result in a long-term (e.g., decades-long) decrease in wildlife abundance and richness within a mine-site area. Species affected by habitat reduction might be able to shift their habitat use. However, the habitat into which displaced individuals moved might not be able to sustain an increased level of use. Many of the individuals that would make use of areas adjacent to a development could be subjected to increased physiological stress as a result of complications from overcrowding (e.g., increased competition for space and food, increased vulnerability to predators, and increased potential for the propagation of diseases and parasites) (Edge Environmental, Inc. 2009). Areas used by wildlife before development can be considered preferred habitat. Thus, observed shifts in areas used because of development would be toward less preferred and presumably less suitable habitats (Sawyer et al. 2006).

Overcrowding of species such as mule deer (*Odocoileus hemionus*) in winter ranges could cause density-dependent effects, such as increased fawn mortality (Sawyer et al. 2006). All of the Alternative 3 lease tracts and all but Lease Tract 11 are within the winter range for mule deer and elk (*Cervis canadensis*), respectively. Lease Tracts 8, 9, 11, 13, and 13A are within the winter range for the desert bighorn sheep. Hobbs (1989) determined that the mortality of mule deer does during a severe winter period could double if they were disturbed twice a day and forced to move a minimum of 1,500 ft (460 m) per disturbance. Most mine development would probably occur during warmer seasons, which would minimize disturbance to big game during winter. Mine development would likely not occur during severe winter conditions when impacts on big game would be of most concern (WEST, Inc. 2007). Among the Alternative 3 lease tracts, Lease Tracts 7, 13, 13A, 15, 18, 21, and 25 contain severe winter range for mule deer, while all of the lease tracts except Lease Tract 11 contain severe winter range for elk. While none of the lease tracts occur within severe winter range for the desert bighorn sheep, Lease Tracts 11, 13, and 13A occur within a winter concentration area. Expanded uranium mining within the Dolores River corridor could have adverse impacts on continued unrestricted movement of desert bighorn sheep between the upper Dolores and middle Dolores populations. Exclusion of new mining and other surface-disturbing activities within 0.25 mi (0.4 km) of the river would minimize impacts on the desert bighorn sheep movement corridor.

Although habitats adjacent to a mine site might remain unaffected, wildlife might tend to make less use of these areas (primarily because of the disturbance that would occur within the project site). This impact is an indirect habitat loss and could affect a greater area than would direct habitat loss (Sawyer et al. 2006). A utility line might also lead to a loss of usable feeding areas for those species that avoid the close proximity of these facilities due to their use by predators (BirdLife International 2003). For example, common ravens (*Corvus corax*) and some birds of prey might become more common along utility lines because of the presence of perch and nest sites (Knight and Kawashima 1993). Use of anti-perching devices could minimize such impacts (see Section 4.6, Table 4.6-1). Access roads can affect wildlife by increasing mortality, modifying behavior, altering habitat, and helping to spread nonindigenous plants (Ingelfinger and Anderson 2004). Even along roads driven on by fewer than 12 vehicles per day, Ingelfinger and Anderson (2004) observed the density of sagebrush obligate bird species to be reduced within a 330-ft (100-m) access road zone. The relative abundance of the horned lark (*Eremophila alpestris*), a grassland species, increased in the access road zone due to an increase in forage (windblown seeds) that collected along the road (Ingelfinger and Anderson 2004).

Mine development and operational activities could also result in increased erosion and runoff from freshly cleared and graded sites. The potential for erosion and the resulting sediment loading of nearby aquatic or wetland habitats would be proportional to the amount of surface disturbance, the condition of disturbed lands at any given time, and the proximity to the aquatic or wetland habitats. The potential for water quality impacts during construction would be short term, lasting until disturbed surface soil materials were stabilized (e.g., from the use of BMPs to control erosion or the reestablishment of ground cover; see Table 4.6-1, Section 4.6). Although the potential for runoff would be temporary, erosion could result in impacts on local amphibian populations, particularly if an entire recruitment class was eliminated (e.g., complete recruitment failure could occur in a given year because of the siltation of eggs or mortality of aquatic larvae). The impacts of sedimentation on amphibians could be heightened if the sediments contained toxic materials (Maxell 2000). The red-spotted toad (*Bufo punctatus*) is the amphibian species most likely to be affected.

Habitat disturbance could also facilitate the spread and introduction of invasive plant species by altering existing habitat conditions, stressing or removing native plant species, and allowing easier movement by wildlife or human vectors (Trombulak and Frissell 2000). Wildlife habitat could be adversely affected if invasive vegetation became established in the construction-disturbed areas and adjacent off-site habitats. This could adversely affect wildlife occurrence and abundance.

Increased human activity could increase the potential for fires. In general, short-term and long-term effects of fire on wildlife are related to impacts on vegetation, which, in turn, affect habitat quality and quantity, including the availability of forage and shelter. Long-term changes in vegetation from a fire (such as loss of sagebrush or the invasion or increase of non-native annual grasses) might affect food availability and the quality and quantity of available wildlife habitats; the changes could also increase the risk from predation for some species (Groves and Steenhof 1988; Sharpe and Van Horne 1998; Lyon et al. 2000b; Knick and Dyer 1997; Schooley et al. 1996).

Raptor populations generally are unaffected by, or respond favorably to, burned habitats (Lyon et al. 2000b). In the short term, fires could benefit raptors by reducing cover and exposing prey; raptors might also benefit if prey species increased in response to post-fire increases in forage (Lyon et al. 2000b). Direct mortality of raptors from fire is rare (Lehman and Allendorf 1989). Most adult birds can escape fires, while fires during the nesting season (prior to fledging) might kill young birds, especially those from ground-nesting species. Fires in wooded areas, such as piñon-juniper woodlands, could decrease the populations of raptors that nest in these habitats.

The very large mine site contains mostly barren ground and partially grassed habitats; the other mine sites could be located in areas dominated by piñon-juniper woodlands and sagebrush habitats. Loss of 310 acres (130 ha) of these habitats spread throughout the lease tracts would be considered a minor to moderate impact, since an abundance of such habitats occurs in the region and since many of the wildlife species that could potentially be affected are habitat generalists that could inhabit other areas in the region. Impacts to sagebrush obligates or species that prefer sagebrush habitats, such as the sage sparrow (*Amphispiza belli*) and sage thrasher (*Oreoscoptes* *montanus*), would also be expected to be minor to moderate, since only small areas would be disturbed for individual mines sites and since sagebrush habitats make up less than 10% of the habitat types within the lease tracts (Section 3.6.1).

4.3.6.2.2 Wildlife Disturbance. During mine development and operations, wildlife disturbance could be of greater concern than habitat loss (Arnett et al. 2007). The response of wildlife to disturbances caused by noise and human presence would be species-specific. Responses for a given species could be affected by the physiological or reproductive conditions of individuals; their distance from the disturbance; and the type, intensity, and duration of the disturbance. Wildlife could respond to a disturbance in various ways, including attraction, habituation, or avoidance (Knight and Cole 1991). All three behaviors can be considered adverse impacts. Wildlife might cease foraging, mating, or nesting near areas where the disturbance occurred. There could even be a temporary interference to migration routes due to increased human activity. For example, disturbance near active sage grouse leks could lead to lek abandonment, displacement, and reduced reproduction. In contrast, wildlife such as bears, foxes, and squirrels can habituate to disturbances and might be attracted to human activities, primarily when a food source was accidentally or deliberately made available.

Regular or periodic disturbance during mine development and operations could cause adjacent areas to be less attractive to wildlife and result in a reduction of wildlife use in areas exposed to a repeated variety of disturbances such as noise. Principal sources of noise would include vehicle traffic, the operation of heavy equipment, blasting, and ventilation fans. The average noise levels from most heavy equipment range from 74 to 90 dBA at 50 ft (15 m), while the noise level from a ventilation fan would be about 70 dBA at 50 ft (15 m) (Section 4.3.2.2). Noise levels would drop to 40 dBA at a distance of 1 mi (1.6 km). Negative impacts on wildlife begin at 55 to 60 dB, a level that corresponds to the onset of adverse physiological impacts (Barber et al. 2010). As discussed in Section 4.3.2.2, these levels would be limited up to distances of 1,650 ft (500 m) from the mine sites and 120 ft (37 m) from the haul routes. However, there is the potential for behavioral effects to occur at lower noise levels (Barber et al. 2011). Sound levels above 90 dB are likely to adversely affect wildlife (Manci et al. 1988). The potential effects of noise on wildlife include acute or chronic physiological damage to the auditory system, increased energy expenditures, physical injury incurred during panicked responses, interference with normal activities (e.g., feeding), breeding activities (e.g., lekking behavior), and impaired communication (AMEC Americas Limited 2005; Habib et al. 2007; Larkin 1996; Manci et al. 1988; Pater et al. 2009; Salt and Hullar 2010; USFWS 2011c). The response of wildlife to noise would vary by species; physiological or reproductive condition; distance; and the type, intensity, and duration of disturbance (BLM 2002). Unpredictable, erratic, or sudden sounds (e.g., blast noise) may cause site abandonment or decreases in population numbers because the sounds are perceived as threats (Francis and Barber 2013). Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use by wildlife in those areas. However, wildlife can habituate to noise (Krausman et al. 2004). Also, the cause of the observed reaction in wildlife could be the visual element of the event rather than the auditory component, or it could be both components (AMEC Americas Limited 2005).

Vehicle noise might affect the ability of amphibians to hear calls and locate breeding aggregations (Maxell 2000). However, plasticity in vocalizations could allow maintenance of acoustic communications in the presence of traffic noise (Cunnington and Fahrig 2010).

Much of the research on wildlife-related noise effects has focused on birds. This research has shown that noise might affect territory selection, territorial defense, dispersal, foraging success, fledging success, and song learning (e.g., Reijnen and Foppen 1994; Foppen and Reijnen 1994; Larkin 1996). Responses of birds to disturbance often involve activities that are energetically costly (e.g., flying) or affect their behavior in a way that might reduce food intake (e.g., shift away from a preferred feeding site) (Hockin et al. 1992). A variety of adverse effects of noise on raptors have been demonstrated, but for some species, the effects were temporary, and the raptors became habituated to the noise (Brown et al. 1999; Delaney et al. 1999). Noise can reduce bird nesting success and alter species interactions, resulting in different avian communities (Francis et al. 2009). On the basis of a review of the literature by Hockin et al. (1992), the effects of disturbance on bird breeding and breeding success include reduced nest attendance, nest failures, reduced nest building, increased predation on eggs and nestlings, nest abandonment, inhibition of laying, increased absence from the nest, reduced feeding and brooding, exposure of eggs and nestlings to heat or cold, retarded chick development, and lengthening of the incubation period. The most adverse impacts associated with noise could occur if critical life-cycle activities were disrupted (e.g., mating and nesting). For instance, disturbance of birds during the nesting season can result in nest or brood abandonment. The eggs and young of displaced birds would be more susceptible to cold or predators.

During winter, the average mean flush distance for several raptor species was 390 ft (120 m) from people walking and 250 ft (75 m) from vehicles (Holmes et al. 1993). Disturbance from light traffic (e.g., 1 to 12 vehicles per day) during the breeding season might reduce nest-initiation rates and increase distances moved from sage grouse leks during nest site selection (Lyon and Anderson 2003). The density of sagebrush obligate passerines was reduced 39– 60% within a 330-ft (100-m) buffer around dirt roads with traffic volumes ranging from 10 to 700 vehicles/day. However, traffic volumes alone might not explain the observed effect. The birds might also have been responding to edge effects, habitat fragmentation, and increases in other passerine species along the road corridors. Thus, declines might persist even after traffic subsides, lasting until the road areas are reclaimed and fully vegetated (Ingelfinger and Anderson 2004).

Various adverse effects of noise on raptors occur, but for some species, the effects are temporary as the raptors habituate to the noise (Brown et al. 1999; Delaney et al. 1999). As reviewed by Hockin et al. (1992), the effects of noise disturbance on bird breeding and breeding success include reduced nest attendance, nest failures, reduced nest building, increased predation on eggs and nestlings, nest abandonment, inhibition of laying, increased absences from the nest, reduced feeding and brooding, exposure of eggs and nestlings to heat or cold, retarded chick development, lengthened incubation period, increased physiological stress, increased energy expenditures, habitat avoidance, decreased population or nesting densities, altered species composition, and disruption and disorientation of movements. The most severe impacts associated with noise could occur if critical life-cycle activities were disrupted (e.g., mating and nesting). For instance, disturbance of birds during the nesting season could result in nest or brood abandonment.

Mule deer and elk have been reported to respond at a distance of 3,300 ft (1,000 m) or more from roads on which more than one vehicle is driven per day (Gaines et al. 2003). However, big game species such as mule deer can habituate to and ignore motorized traffic, provided they are not pursued (Yarmoloy et al. 1988). Harassment, an extreme type of disturbance caused by intentional actions to chase or frighten wildlife, generally increases the magnitude and duration of displacement. As a result, there is a greater potential for physical injury from fleeing and higher metabolic rates due to stress. Bears can habituate to human activities, particularly moving vehicles, making them more vulnerable to legal and illegal harvest (McLellan and Shackleton 1988).

Noise from traffic and other sources can interfere with bat echolocation (Jones 2008), while blasting during mine construction and operations can disrupt roosting bats (Brown et al. 2000).

Lighting could also disturb wildlife in the mine area. Lights directly attract migratory birds (particularly in inclement weather and during other low-visibility conditions), and they could indirectly attract birds and bats by attracting flying insects.

4.3.6.2.3 Wildlife Injury or Mortality. Clearing, grading, mining, mine spoils placement, vehicles, and other mine development and operational activities could result in direct injury to or the death of less mobile wildlife species (e.g., reptiles, small mammals) or those that inhabit burrows or mines. If clearing or other ground-disturbing activities occurred during the spring and summer, bird nests and eggs or nestlings could be destroyed, which could be a violation of the Migratory Bird Treaty Act. Although more mobile wildlife species, such as big game and adult birds, can avoid mine development and operational activities by moving to adjacent areas, it is conservatively assumed that adjacent habitats would be at carrying capacity for the species that live there and could not support additional individuals from the mine areas for an extended period of time. As previously mentioned, competition for resources in adjacent habitats might preclude the incorporation of the displaced individuals into the resident populations.

Direct mortality from vehicle collisions could occur along access and haul roads, especially in wildlife concentration areas or migration corridors. When roads cut across migration corridors, the effects can be dangerous for both animals and humans. No mapped migration corridors for big game species occur on any of the lease tracts (Section 3.6.2.3). Amphibians, being somewhat small and inconspicuous, are vulnerable to road mortality when they migrate between wetland and upland habitats; reptiles are vulnerable on roads they use for thermal cooling and heating. Sage grouse are susceptible to road mortality in spring because they often fly to and from leks near ground level. They are also susceptible to vehicular collisions along dirt roads because they sometimes use them to take dust baths. In general, the species most vulnerable to vehicle collisions are day-active, slow-moving species (Hels and Buchwald 2001). However, road kills rarely cause population-level impacts. The avoidance of habitats near roads, especially due to traffic noise, tends to have a greater ecological impact than does mortality from vehicular collisions (Forman and Alexander 1998). Ore haul trucks generally travel at slow speeds on unpaved, narrow, winding county or other dirt roads (i.e., Colorado speed limit on winding, narrow mountain highways and blind curves is 20 mph or 32 km per hour [Salek 2011]), which would minimize their potential to collide with big game.

Little information is available about the effects of fugitive dust on wildlife; however, if the exposure was of sufficient magnitude and duration, the effects could be similar to those on humans (e.g., breathing and respiratory symptoms, including dust pneumonia). A more probable effect would be the dusting of plants, which could make forage less palatable. The highest rates of dust deposition would generally occur within the area where wildlife would be disturbed by human activities). Dusting impacts could be potentially more pervasive along unpaved access roads. Use of calcium or magnesium chloride to control road dust could desiccate amphibians crossing roads, while the use of oils could contaminate aquatic habitats (Maxell 2000). With use of appropriate BMPs to control dust (see Section 4.6), fugitive dust is not expected to result in any population-level effects to wildlife. Potential effects of radionuclides, which could be associated with dust at mine sites, are discussed later in this section.

As previously mentioned, increased human activity could increase the potential for fires. While individuals caught in a fire could incur increased mortality, depending on how quickly the fire spread, most wildlife would likely escape by either outrunning the fire or seeking underground or aboveground refugia within the fire (Ford et al. 1999; Lyon et al. 2000a). However, some mortality of burrowing mammals from asphyxiation has been reported (Erwin and Stasiak 1979).

Overhead electrical lines, rather than generators, might be used at mine sites located near existing electrical lines. Some birds, especially raptors, are susceptible to electrocution on power lines. However, the potential for electrocution should be negligible since modern power lines designs minimize such risks (e.g., adequate spacing between conductors and use of appropriate insulation). The potential for bird collisions with utility lines depends on variables such as habitat, the relationship of the line to migratory flyways and feeding flight patterns, the migratory and resident bird species present, and the structural characteristics of the lines. Birds that migrate at night, fly in flocks, and/or are large and heavy with limited maneuverability are particularly at risk (BirdLife International 2003). Waterfowl, wading birds, shorebirds, and passerines are most vulnerable to colliding with transmission lines near wetlands, while raptors and passerines are most susceptible in habitats away from wetlands (Faanes 1987). Sage grouse and other upland game birds are potentially vulnerable to colliding with utility lines, in part because they lack good visual acuity (Bevanger 1995). Of highest concern with regard to bird collisions are locations where utility lines span flight paths, such as river valleys, wetland areas, lakes, areas between waterfowl feeding and roosting areas, and narrow corridors (e.g., passes that connect two valleys). Young inexperienced birds, as well as migrants in unfamiliar terrain, appear to be more vulnerable to wire strikes than are resident breeders. Also, many species appear to be most highly susceptible to collisions when alarmed, pursued, searching for food while flying, engaged in courtship, taking off, and landing, and during the night and inclement weather (BirdLife International 2003).

Although they are not immune to collisions, raptors have several attributes that decrease their susceptibility to collisions with utility lines: (1) they have keen eyesight; (2) they soar or fly by using relatively slow, flapping motions; (3) they can generally maneuver while in flight; (4) they learn to use utility poles and structures as hunting perches or nests and become conditioned to the presence of lines; and (5) they do not fly in groups (like waterfowl), so their position and altitude are not determined by other birds. Therefore, raptors are not as likely to collide with utility lines except when they are distracted (e.g., while pursuing prey) or when other environmental factors (e.g., adverse weather conditions such as heavy fog or snowfall) increase their susceptibility (Olendorff and Lehman 1986).

Electrocution of raptors or other birds would not be expected if the spacing between the conductors or between a conductor and a ground wire or other grounding structure exceeds the wingspan of bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), the largest birds that occur in southwestern Colorado and that perch on electrical line support structures. Although it is a rare event, electrocution can occur during current arcing when flocks of small birds cross an electrical line or when several roosting birds take off simultaneously. This is most likely to occur in humid weather conditions (Bevanger 1995; BirdLife International 2003). Arcing can also occur from the waste streams of large birds roosting on the crossarms above insulators (BirdLife International 2003). The electrocution of other wildlife from contact with electrical lines is even less common; it occurs more often on smaller distribution lines and at substations. Nonavian wildlife species such as snakes, squirrels, and raccoons can also be electrocuted on smaller distribution lines and at substations. Even electrocutions of cougars (*Puma ancelar*) have been reported (Thompson and Jenks 2007). Because electrocution is a relatively rare event, population-level effects are not expected.

The potential effects of electromagnetic field (EMF) exposure on animal behavior, physiology, endocrine systems, reproduction, and immune functions have been found to be negative, very minor, or inconclusive (WHO 2007). Generally, these results are for exposures much higher and longer than would be encountered by wildlife under actual field conditions. Also, there is no evidence that EMF exposure alone causes cancer in animals, and the evidence that EMF exposure in combination with known carcinogens can enhance cancer development is inadequate (WHO 2007).

Utility lines could provide perch sites for raptors and corvids (e.g., ravens, crows, and magpies), thereby increasing predatory levels on other wildlife (e.g., small mammals, gallinaceous birds). Utility support structures could also protect some bird species from mammalian predators, range fires, and heat (Steenhof et al. 1993).

A potential source of injury or mortality to wildlife would include exposure to contaminants such as herbicides, fuel, or other chemicals (e.g., lubricating oils). Potential exposure to chemical materials would most likely occur from a spill. A spill could result in direct contamination of individual animals, contamination of habitats, and contamination of food resources. Potential impacts on wildlife from exposure to fuel spills or accidental releases of other chemicals would vary according to the chemical spilled, volume of the spill, location of the spill, and the exposed species. A spill could have a population-level adverse impact if the spill was very large or if it contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event is very unlikely. In addition, wildlife near the mine sites would be limited, since there would be disturbances there related to mine development and operations, which would thus greatly reduce the potential for wildlife to be present and get exposed to contaminants. Furthermore, a spill prevention and response plan would be required, work crews would be trained in spill response, and materials required for spill cleanup would be kept on hand. Prompt spill response should minimize potential impacts on wildlife. As mentioned in mine permit amendment applications, if a fuel tank is used at a mine site, it would be located within a lined containment area adequate to contain 120% of the tank volume (Cotter Corp. 2011, 2012a–g).

Mining activity might increase the exposure of wildlife to uranium and other radioactive decay products and to other chemical elements. Negative impacts on terrestrial invertebrates, birds, and mammals from uranium radionuclides occur from 0.2 to 40 mGy/h, 0.14 to 40.0 mGy/h, and 0.004 to 40.0 mGy/h, respectively (Hinck et al. 2010). The potential magnitude of impacts would be influenced by life history strategy, habitat requirements, and the mass of the organism (Hinck et al. 2010). Some birds might be at greater risk to radiation exposure than other wildlife due to their foraging and ingestion of grit, which increases the radiation dose (Driver 1994). Species that spend considerable amounts of time underground in caves, mines, or burrows could potentially inhale, ingest, or be directly exposed to uranium and other radionuclides while digging, eating, preening, and/or hibernating. Herbivores could also be exposed by ingesting radionuclides that aerially deposited on vegetation or concentrated in surface waters at or near mine sites (BLM 2011b). As discussed in Section 4.1.6.2, the average concentration of radionuclides in the waste-rock piles and, presumably, in the mine would be less than the biota concentration guidelines; although in isolated hot spots, concentrations may be several times higher than recommended guidelines.

Water treatment ponds may be used at some of the mine sites. These bodies of water could attract a number of wildlife species, including waterfowl and shorebirds at mines located near the San Miguel or Dolores Rivers. While providing a potential source of water and prey (e.g., aquatic invertebrates), the treatment ponds may have elevated levels of contaminants, such as total dissolved solids and selenium, that could result in adverse impacts on wildlife. Also, the ponds could potentially provide habitat for mosquitoes that are vectors of West Nile virus, which is a significant stressor on sage grouse and other at-risk bird species (Naugle et al. 2004).

As stated in the mine permit amendment applications (Cotter Corp. 2011, 2012a–g), uranium ore and waste rock are not designated as chemicals, nor do they generate designated chemicals. They are regarded under the Hard Rock Rule 1.1(I) as potentially acid- and toxic-producing materials. Common minerals for uranium ores (carnotite, tyuyamunite, and uraninite [pitchblende]) lack sulfides. Thus, there are no acid-forming properties of uranium minerals like those of metal minerals. Any acid pyrite produced by pyrite deposition would be quickly neutralized by alkalinity released from carbonate minerals in associated waste rock.

During uranium mining operations, excavated subsurface materials are exposed to oxidative conditions that can elevate the potential levels of bioavailable selenium that could enter the food chain (Sharmasarkar and Vance 2002). Selenium is a nutritionally required trace element, but it can become toxic at concentrations only twice those required (Lemly 1997). Diet is the primary pathway of selenium exposure (Chapman et al. 2009). Skorupa and Ohlendorf (1991) reported that water with a selenium concentration of >20 µg/L is hazardous to aquatic birds. Chronic exposure to selenium can suppress the immune system in birds (Fairbrother et al. 1994), which can make them more susceptible to disease and predation. Selenium exposure can also cause embryonic deformities and mortality (Chapman et al. 2009; See et al. 1992; Skorupa and Ohlendorf 1991). Overall, a waterborne selenium concentration ≥2 µg/L is detrimental to the survival of wildlife due to the high potential for food chain bioaccumulation, dietary toxicity, and reproductive effects (Lemly 1997). A concentration of 3 to 20 µg/L can be considered peripherally hazardous to aquatic birds, and concentrations of >20 µg/L can be considered widely hazardous (Skorupa and Ohlendorf 1991).

Salinity concentrations may increase at retention and sedimentation ponds as water evaporates and ultimately result in the accumulation of evaporates/precipitates. Windingstad et al. (1987) reported salt toxicosis in waterfowl inhabiting a lake with sodium concentrations of >17,000 mg/L, while Gordus et al. (2002) and Wobeser and Howard (1987) reported bird mortalities at hypersaline lakes with conductivities of >70,000 µmhos/cm. Salt toxicosis is associated with high sodium concentrations in the brain. Birds can suffer from general dehydration, hemorrhages, salt encrustation of feathers, ocular lens opacity and cataract formation, acute muscle degeneration, and eventual mortality (Gordus et al. 2002; Meteyer et al. 1997).

Fencing and netting of the ponds that contain high concentrations of contaminants such as selenium or salts are the best management practice for providing barriers that prevent exposure of birds and other wildlife and for avoiding take under the Migratory Bird Treaty Act (see the USFWS BO in Appendix E). It is mentioned in mine permit amendment applications that a fence around the ponds would minimize wildlife access, and that the ponds are treated and would not pose a threat to wildlife (Cotter et al. 2011, 2012a–g). The need to net the ponds could be decided through a consultation among the USFWS, CPW, and the lessee prior to mine operations.

4.3.6.2.4 Summary of Common Impacts on Wildlife. Overall, impacts from site characterization, construction, operations, and reclamation of mines under Alternative 3 (including access roads and transmission lines) on wildlife populations would depend on the following:

- The type and amount of wildlife habitat that would be disturbed;
- The nature of the disturbance;
- The wildlife that occupied the mine site and surrounding areas; and
- The timing of construction activities relative to the crucial life stages of wildlife (e.g., breeding season).

Table 4.3-6 summarizes the potential impacts on wildlife species resulting from Alternative 3. Impacts on wildlife from reclamation activities would be similar to those described

TABLE 4.3-6 Summary of Potential Impacts on Wildlife Associated with Alternative 3

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
Individual Impacting Factor[d]							
Alteration of topography and drainage patterns	Construction, operations	Changes in surface temperature, soil moisture, and hydrologic regimes, and distribution and extent of aquatic, wetland, and riparian habitats; erosion; changes in groundwater recharge; spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by avoiding development of drainages and using appropriate stormwater management strategies.
Human presence and activity	Site characterization, construction, operations, reclamation	Behavioral disturbance, harassment, nest abandonment, avoidance of areas, territory adjustments, reduction in carrying capacity.	None	Amphibians, reptiles, small mammals	Birds, large mammals	None	Can be mitigated during site characterization and construction by timing activities to avoid sensitive periods. Difficult to mitigate impacts during operations.
Blockage of dispersal and movement	Construction, operations	Genetic isolation, loss of access to important habitats, reduction in diversity, reduction in carrying capacity.	None	Amphibians, reptiles, birds, small mammals	Large mammals	None	Can be mitigated by restricting project size, avoiding important movement corridors.
Erosion	Construction, operations, reclamation	Habitat degradation; loss of plants; sedimentation of adjacent areas especially aquatic, wetland, systems, loss of productivity; reduction in carrying capacity; spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Easily mitigated with standard erosion control practices.

TABLE 4.3-6 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
Individual Impacting Factor[d] (Cont.)							
Equipment noise	Site characterization, construction, operations, reclamation	Behavioral disturbance, harassment, nest abandonment, avoidance of areas, territory adjustments, reduction in carrying capacity.	None	Amphibians, reptiles, small mammals	Birds, large mammals	None	Can be mitigated using mufflers and other sound-dampening devices.
Fugitive dust	Site characterization, construction, operations, reclamation	Decrease in photosynthesis, reduction in productivity, increase turbidity and sedimentation in aquatic habitat, spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by retaining vegetative cover, soil covers, or soil stabilizing agents.
Groundwater withdrawal	Construction, operations	Change in hydrologic regime, reduction in surface water, reduction in soil moisture, reduction in productivity.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by reducing water consumption requirements or altering water source.
Habitat fragmentation	Construction, operations	Genetic isolation, loss of access to important habitats, reduction in diversity, reduction in carrying capacity, spread of invasive species.	None	Amphibians, reptiles, birds, small mammals	Large mammals	None	Minimize disruption of intact communities..
Habitat establishment	Reclamation	Establishment of habitat for wildlife in mines, particularly roost sites for bats	Amphibians, birds, large mammals	Reptiles, most small mammals	Bats	None	Use of bat gates rather than backfilling mines.

TABLE 4.3-6 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
Individual Impacting Factor[d] (Cont.)							
Increased human access	Construction, operations	Harassment, collection, increased predation risk, increased collision mortality risk.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by reducing the number of mines, transmission lines and access roads in important habitats.
Contaminant exposure	Site characterization, construction, operations, reclamation	Death of directly affected individuals, uptake of toxic materials, reproductive impairment, reduction in carrying capacity.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated using project mitigation measures (e.g., spill prevention and response planning, fencing and netting of water treatment ponds)
Project infrastructure	Operations	Increased predation rates from predators using structures, collision mortality.	Large mammals	Amphibians, reptiles, birds, and small mammals	None	None	Can be mitigated using appropriate markers on lines and guy wires, or elimination of guy wires, design transmission lines to discourage use by ravens and raptors.
Restoration of topography and drainage patterns	Reclamation	Beneficial changes in temperature, soil moisture, and hydrologic regimes.	None	Amphibians, reptiles, birds, mammals	None	None	Mostly beneficial; adverse impacts can be mitigated by using standard erosion and runoff control measures.
Restoration of surface soil materials	Reclamation	Beneficial changes in soil moisture, increased productivity and carrying capacity.	None	Amphibians, reptiles, birds, mammals	None	None	Mostly beneficial; adverse impacts can be mitigated using standard erosion and runoff control measures.

TABLE 4.3-6 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
Individual Impacting Factor[d] (Cont.)							
Restoration of native vegetation	Reclamation	Beneficial changes in soil moisture, increased productivity and carrying capacity, increased diversity.	None	Amphibians, reptiles, birds, mammals	None	None	Mostly beneficial; adverse impacts can be mitigated by ensuring species mix includes a diverse weed-free mix of native species.
Site lighting	Construction, operations	Behavioral disturbance, harassment, nest abandonment, avoidance of areas, territory adjustments, reduction in carrying capacity, collision with structures.	None	Amphibians, reptiles, birds, mammals	None	None	Easily mitigated by ensuring lighting is minimized to that needed for safe construction and operations and does not project past mine site boundaries.
Surface soil material compaction	Site characterization, construction, operations, reclamation	Reduction in productivity, reduction in diversity, reduction in carrying capacity, increased runoff and erosion, spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by minimizing off-road travel and mine site development (e.g., area of waste rock storage).
Surface soil material removal	Construction, operations	Reduction in productivity, reduction in diversity, reduction in carrying capacity, direct mortality of individuals, increased sedimentation in aquatic habitat, spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Readily mitigated by stockpiling surface soil materials to maintain seed viability, vegetating to reduce erosion, and replacing at appropriate depths when other site activities are complete.

TABLE 4.3-6 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
Individual Impacting Factor[d] (Cont.)							
Vegetation clearing	Construction, operations	Elimination of habitat, habitat fragmentation, direct mortality of individuals, loss of prey base, changes in temperature and moisture regimes, erosion, increased fugitive dust emissions, reduction in productivity, reduction in diversity, reduction in carrying capacity, spread of invasive species.	None	None	Amphibians, reptiles, birds, mammals	None	Difficult to mitigate; most mine site areas are likely to require clearing.
Vegetation maintenance	Operations	Reduction in vegetation cover or vegetation maintained in early successional-stage or low-stature, habitat fragmentation, direct mortality of individuals, reduction in diversity, reduction in carrying capacity, spread of invasive species.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated by managing for low-maintenance vegetation (e.g., native shrubs, grasses, and forbs), invasive species control, minimizing the use of herbicides near sensitive habitats (e.g., aquatic and wetland habitats), and only using approved herbicides consistent with safe-application guidelines.
Vehicle and equipment emissions	Construction, operations, reclamation	Reduced productivity.	None	Amphibians, reptiles, birds, mammals	None	None	Readily mitigated by maintaining equipment in proper operating condition.

TABLE 4.3-6 (Cont.)

			Expected Relative Impact[a] for Different Wildlife[b]				
Impacting Factor	Project Phase	Consequence	Negligible	Minor	Moderate	Large	Ability to Mitigate Impacts[c]
Individual Impacting Factor[d] (Cont.)							
Vehicle and foot traffic	Site characterization, construction, operations, reclamation	Direct mortality of individuals through collision or crushing, surface soil materials compaction, increased fugitive dust emissions.	None	Amphibians, reptiles, birds, mammals	None	None	Can be mitigated using worker education programs, signage, and traffic speed restrictions.
All Impacting Factors Combined							
	Site characterization		None	Amphibians, reptiles, birds, mammals	None	None	Relatively easy.
	Construction		None	None	Amphibians, reptiles, birds, mammals	None	Relatively difficult; residual impact mostly dependent on the size of mine areas developed.
	Operations		None	None	Amphibians, reptiles, birds, mammals	None	Relatively difficult; residual impact mostly dependent on the size of mine areas developed.
	Reclamation		None	None	Amphibians, reptiles, birds, mammals (short-term adverse impacts, long-term benefits)	None	Relatively easy to mitigate adverse impacts of reclamation. May be difficult to achieve restoration objectives.

TABLE 4.3-6 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b]: Negligible	Minor	Moderate	Large	Ability to Mitigate Impacts[c]
All Impacting Factors Combined (Cont.)							
	Overall project		None	None	Amphibians, reptiles, birds, mammals	None	Relatively difficult; residual impact mostly dependent on the size of areas developed and the success of restoration activities.

[a] Relative impact magnitude categories were based on professional judgment utilizing CEQ regulations for implementing NEPA (40 CFR 1508.27) by defining significance of impacts based on context and intensity. Impact magnitude definitions are as follows: (1) *negligible*—no impact would occur; (2) *minor*—effects are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource (e.g., ≤1% of the population or its habitat would be lost in the region); (3) *moderate*—effects are sufficient to alter noticeably but not to destabilize important attributes of the resource (e.g., >1 but ≤10% of the population or its habitat would be lost in the region); and (4) *large*—effects are clearly noticeable and are sufficient to destabilize important attributes of the resource (e.g., >10% of a population or its habitat would be lost in the region). Actual impact magnitudes on wildlife species would depend on the location of projects, project-specific design, application of mitigation measures (including avoidance, minimization, and compensation), and the status of wildlife species and their habitats in project areas. Impact magnitudes provided are conservative (i.e., they could be less than stated).

[b] Wildlife species are placed into groups based on taxonomy (amphibians, reptiles, birds, and mammals). Other categories such as ecological system (aquatic, wetland, riparian, and terrestrial) or size (e.g., small and large mammals) are used when the category is relevant to impact magnitude.

[c] Actual ability to mitigate impacts will depend on site-specific conditions and the species present in the project area. Measures identified to minimize potential impacts are presented in Table 4.6-1 (Section 4.6).

[d] Impacting factors are presented in alphabetical order.

for Alternative 1 (Section 4.1.6.2). Reclamation activities would occur in areas previously disturbed by mine development and operations. Mitigation measures, compliance measures, and BMPs would minimize impacts on wildlife consistent with applicable laws and regulations (see Table 4.6-1 in Section 4.6). Wildlife would benefit from habitat development following reclamation activities.

Under Alternative 3, impacts on wildlife would be largely short term and negligible during site exploration, and minor to moderate during mine development and operations. While wildlife impacts would be long term (last for decades), they would be scattered temporally and, especially, spatially. In general, it is expected that impacts would be largely localized and would not affect the viability of wildlife populations, especially if mitigation measures were used (see Section 4.6).

4.3.6.3 Aquatic Biota

4.3.6.3.1 Impacts. Impacts on aquatic biota from uranium mining could occur from the (1) direct disturbance of aquatic habitats within the footprint of the mine site, (2) sedimentation of nearby aquatic habitats as a consequence of soil erosion from mine areas, and (3) changes in water quantity or water quality as a result of releases of contaminants into nearby aquatic systems. These impacts would primarily occur during the mine development period and throughout the operational life of the mine.

Exploration activities would occur in upland areas and not directly within aquatic habitats (including intermittent and ephemeral drainages). Because of the limited number of perennial streams in the area and the short duration of exploration activities, the crossing of any individual stream is expected to be infrequent. In some cases, individual streams might be crossed only a single time. As a result, any potential impacts from stream crossings would be short term and localized to individual crossing locations.

Because of the limited area in which exploration activities would take place, the small amount of soil disturbance that might occur during exploration, and the short duration during which exploration at a particular area would occur, most impacts would be very localized and short term. Potentially affected habitats would likely be smaller, low-order and headwater intermittent and ephemeral streams. Aquatic biota and habitats in larger surface water bodies, such as the main channels of the San Miguel and Dolores Rivers, are not expected to be affected by site exploration activities.

Ground disturbance during mine development and operations might increase soil erosion and runoff that could lead to increases in sedimentation and turbidity in downgradient surface water habitats. Increased turbidity might affect foraging and predator avoidance, reduce the oxygen content of the water, interfere with photosynthesis of algae, and interfere with gill function in some invertebrates and fish. Increased sedimentation might foul the eggs and smother the larvae of invertebrates and fish and alter sediment characteristics. Changes in surface drainage patterns could eliminate ephemeral drainages or cause other changes in runoff patterns.

Any changes in discharges to springs, seeps, or streams due to groundwater withdrawals could, as a result, affect aquatic habitats.

Aquatic biota and habitats most likely to be affected during mine development and operations are those associated with small intermittent and ephemeral drainages. Such habitats might be crossed with some regularity by vehicles. In addition, impacts from soil erosion and accidental releases of regulated or hazardous materials might be expected in drainages that most often exhibit no or low volumes and flows. Impacts on aquatic biota and habitats from the accidental release of contaminants into intermittent or ephemeral drainages would be localized and small, especially if spill response to a release was rapid.

The accidental spill of uranium or vanadium ore into an intermittent or ephemeral stream, or more notably a permanent stream or river such as the Dolores or San Miguel River, could pose a localized short-term impact on the aquatic resources. However, the potential for such an event is extremely low. For example, SENES (2009) determined that the frequency of a rollover and/or crash of an ore truck at a water crossing en route to the proposed Piñon Ridge Mill would be 8.4×10^{-5}/yr (less than 1 in 10,000). In addition to uranium and vanadium, the ore contains other potentially toxic elements, such as aluminum, arsenic, barium, copper, iron, lead, manganese, selenium, on zinc. Most ore solids would settle in the water body within a short distance from a spill site (Edge Environmental, Inc. 2009). It is expected that expedient and comprehensive cleanup actions would be required under DOT regulations and that an emergency response plan would be in place for responding to accidents and cargo spills (Edge Environmental, Inc. 2009). Overall, the potential for impacts on aquatic biota from an accidental spill would be localized and negligible to minor (i.e., environmental effects are not detectable or so small that they will neither destabilize nor noticeably alter any aquatic species populations or their habitats).

4.3.6.3.2 Summary of Common Impacts on Aquatic Biota and Habitats. Overall, impacts from site characterization, construction, operations, and reclamation under Alternative 3 on aquatic habitats and aquatic biota would depend on the following:

- The type and amount of aquatic habitat that would be disturbed;
- The nature of the disturbance; and
- The types, numbers, and uniqueness of the aquatic biota that occupy the surrounding areas.

Potential impacts on aquatic resources (without mitigation) from the various impacting factors associated with Alternative 3 are summarized in Table 4.3-7. Potential impacts on threatened, endangered, and sensitive aquatic species are presented in Section 4.3.6.4, and potential impacts on other types of organisms that could occur in aquatic habitats (e.g., amphibians and waterfowl) are presented in Section 4.3.6.2.

Impacts on aquatic biota and habitats during reclamation should be similar in nature to, and not greater in magnitude than, impacts that might have occurred from mine development and

TABLE 4.3-7 Potential Impacts on Aquatic Biota Associated with Alternative 3

Impacting Factor	Project Phase	Consequence	Expected Impact[a]	Ability to Mitigate Impacts[b]
Individual Impacting Factor[c]				
Alteration of topography and drainage patterns	Construction, operations	Changes in water temperature; change in distribution and structure of aquatic, wetland, and riparian habitat and communities; erosion; changes in groundwater recharge.	Negligible to minor	Can be mitigated by avoiding development of drainages and using appropriate stormwater management strategies.
Human presence and activity	Site characterization, construction, operations, reclamation	Ground disturbance from vehicles and foot traffic; behavioral avoidance of areas; habitat degradation; non-native species introductions.	Negligible to minor	Can be mitigated during site characterization and construction by timing activities to avoid sensitive periods and locations. Difficult to mitigate impacts during operations. Decontaminating equipment would reduce the risk of non-native species introductions.
Blockage of dispersal and movement	Construction, operations	Genetic isolation; loss of access to important habitats; change in community structure; reduction in carrying capacity.	Negligible	Can be mitigated by restricting project size, avoiding aquatic habitat disturbance.
Erosion	Construction operations, reclamation	Sedimentation of adjacent aquatic systems; loss of productivity; change in communities; physiological stress.	Negligible to minor	Easily mitigated with standard erosion control practices.
Fugitive dust	Site characterization, construction, operations, reclamation	Increase in turbidity and sedimentation in aquatic habitat; decrease in photosynthesis; change in community structure; physiological stress.	Negligible to minor	Can be mitigated by retaining vegetative cover, surface soil material covers, or soil stabilizing agents.
Groundwater withdrawal	Construction, operations	Change in hydrologic regime; reduction in productivity and aquatic habitat at the surface.	minor to moderate[d]	Difficult to mitigate; water consumption is expected for all mining operations. It assumed that all water will come from the Upper Colorado River Basin.

TABLE 4.3-7 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Impact[a]	Ability to Mitigate Impacts[b]
Individual Impacting Factor[c] (Cont.)				
Habitat fragmentation	Construction, operations	Genetic isolation; loss of access to important habitats; reduction in carrying capacity; change in community structure.	Negligible to minor	Can be mitigated by restricting project size, avoiding aquatic habitat disturbance.
Increased human access	Construction, operations	Habitat degradation; fishing pressure.	Negligible to minor	Can be mitigated by reducing the number of new transmission lines and access roads that cross aquatic habitats.
Contaminant spills	Site characterization, construction, operations, reclamation	Mortality; physiological stress; reproductive impairment; reduction in carrying capacity.	Minor	Can be mitigated using project mitigation measures (e.g., spill prevention and response planning).
Restoration of topography and drainage patterns	Reclamation	Impacts initially adverse; some degree of restoration to pre-construction conditions.	Negligible to minor	Mostly beneficial; adverse impacts can be mitigated using standard erosion and runoff control measures.
Restoration of surface soil materials and native vegetation	Reclamation	Reduced erosion and fugitive dust; increased productivity.	Negligible to minor	Mostly beneficial; adverse impacts can be mitigated using standard erosion and runoff control measures.
Surface soil material removal	Construction, operations	Increased sedimentation in aquatic habitat; change in community structure; physiological stress.	Negligible to minor	Readily mitigated by stockpiling surface soil materials to maintain seed viability, vegetating to reduce erosion, and replacing at appropriate depths when other site activities are complete.

TABLE 4.3-7 (Cont.)

Impacting Factor	Project Phase	Consequence	Expected Impact[a]	Ability to Mitigate Impacts[b]
Individual Impacting Factor[c] (Cont.)				
Vegetation clearing and maintenance	Construction, operations	Change in water temperature; increased sedimentation from erosion and fugitive dust; changes in productivity and diversity; reduction in carrying capacity; herbicide inputs; acute and chronic toxicological impacts.	Negligible to minor	Difficult to mitigate; most project areas are likely to require clearing. Can be mitigated by managing for low-maintenance vegetation (e.g., native shrubs, grasses, and forbs), invasive species control, minimizing the use of herbicides near sensitive habitats (e.g., aquatic and wetland habitats), and using only approved herbicides consistent with safe application guidelines. Restoration of a vegetative cover consistent with the intended land use would reduce some impacts.
Vehicle traffic	Site characterization, construction, operations, reclamation	Direct mortality of individuals through crushing; increased fugitive dust emissions.	Negligible to minor	Can be mitigated using worker education programs, signage, and traffic restrictions.
All Impacting Factors Combined				
	Site characterization		Negligible	Relatively easy.
	Construction		Negligible to minor	Relatively difficult; residual impact mostly dependent on the size of area developed.
	Operations		Negligible to minor	Relatively difficult; residual impact mostly dependent on the size of area developed.
	Reclamation		Negligible to minor	Relatively easy to mitigate adverse impacts of reclamation. May be difficult to achieve restoration objectives.
	Overall project		Negligible to minor	Relatively difficult; residual impact mostly dependent on the size of area developed and the success of restoration activities.

Footnotes on next page.

TABLE 4.3-7 (Cont.)

[a] Relative impact magnitude categories were based on professional judgment utilizing CEQ regulations for implementing NEPA (40 CFR 1508.27) by defining significance of impacts based on context and intensity. Impact magnitude categories and definitions are as follows: (1) *negligible*—no impact would occur; (2) *minor*—effects are so small that they will neither destabilize nor noticeably alter any important attribute of the resource. (e.g., <1% of the population or its habitat would be lost in the region); (3) *moderate*—effects are sufficient to alter noticeably but not to destabilize important attributes of the resource (e.g., >1 but <10% of the population or its habitat would be lost in the region); and (4) *large*—effects are clearly noticeable and are sufficient to destabilize important attributes of the resource (e.g., >10% of a population or its habitat would be lost in the region). Assigned impact magnitudes assume no mitigation. Actual magnitudes of impacts on aquatic habitat and biota would depend on the location of projects, project-specific design, application of mitigation measures (including avoidance, minimization, and compensation), and the ecological condition of aquatic habitat and biota in project areas.

[b] Actual ability to mitigate impacts will depend on site-specific conditions and the species present in the project area.

[c] Impacting factors are presented in alphabetical order.

[d] Impacts are expected to be minor for most aquatic biota. Moderate impacts are most likely to occur for threatened, endangered, and sensitive species (including Colorado River endangered fish).

operations. In general, impacts on aquatic biota from reclamation activities would be similar to those described for Alternative 1 (Section 4.1.6.2). Measures (i.e., compliance measures, mitigation measures, and BMPs) would be implemented to minimize potential impacts on aquatic resources, consistent with applicable laws and regulations (see Table 4.6-1 in Section 4.6).

Overall, impacts on aquatic biota are expected to be negligible during site exploration and negligible to minor during mine development operations and reclamation. Potential impacts from mine development and operations would last at least 10 years prior to reclamation. Potentially moderate impacts would be possible only for mine sites located near perennial water bodies. In general, any impacts on aquatic biota would be localized and not affect the viability of affected resources, especially if mitigation measures were used (e.g. those aimed at protecting soils from erosion and those aimed at protecting surface water bodies from contamination and sedimentation; see Table 4.6-1).

4.3.6.4 Threatened, Endangered, and Sensitive Species

Impacts on threatened, endangered, and sensitive species from uranium mining activities would fundamentally be similar to, or the same as, impacts on more common and widespread plant communities and habitats, wildlife, and aquatic resources (see Sections 4.3.6.1, 4.3.6.2, and 4.3.6.3). However, listed species, because of their low populations, would be far more sensitive to impacts than more common and widespread species. Their small population makes these species more vulnerable to the effects of habitat fragmentation, habitat alteration, habitat degradation, human disturbance and harassment, mortality of individuals, and the loss of genetic diversity. Although listed species often reside in unique and potentially avoidable habitats, the loss of even a single individual from such a species could have a much greater impact on the species population than would the loss of an individual from a more common species.

Table 4.3-8 presents the potential for impacts to on threatened, endangered, and sensitive species under Alternative 3. Of the 46 species listed, there are 12 plants, 1 insect, 7 fish, 4 amphibians, 2 reptiles, 12 birds, and 8 mammals. A discussion of impacts on these species by listing status is provided in the text that follows.

4.3.6.4.1 Impacts on Species Listed under the Endangered Species Act. Of the species listed in Table 4.3-8, there are 10 that are listed as threatened or endangered under the ESA or are proposed or candidates for listing under the ESA. Four are fish—the bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker (these four fish species are collectively referred to as the Colorado River endangered fishes); four are birds—the Gunnison sage-grouse, Mexican spotted owl, southwestern willow flycatcher, and western yellow-billed cuckoo; and two are mammals—the black-footed ferret and Gunnison's prairie dog. These species are discussed below. As discussed in Section 3.6.4.1, there are no plants or invertebrates listed under the ESA that could occur in the vicinity of the ULP lease tracts.

TABLE 4.3-8 Potential Effects of the Uranium Leasing Program under Alternative 3 on Threatened, Endangered, and Sensitive Species

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants				
Dolores River skeletonplant	*Lygodesmia doloresensis*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Eastwood's monkeyflower	*Mimulus eastwoodiae*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Grand Junction milkvetch	*Astragalus linifolius*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27	Potential for negative impact—direct and indirect effects. Program activities in Lease Tracts 5, 6, 7, 8, 9, 18, 21, and 25 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
Gypsum Valley cateye	*Cryptantha gypsophila*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Helleborine	*Epipactis gigantea*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Kachina daisy	*Erigeron kachinensis*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Program activities in Lease Tracts 5, 6, 7, 8, 9, 18, 21, and 25 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Naturita milkvetch	*Astragalus naturitensis*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
Paradox breadroot	*Pediomelum aromaticum*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Paradox lupine	*Lupinus crassus*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Program activities in Lease Tracts 5, 6, 7, 8, 9, 18, 21, and 25 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
San Rafael milkvetch	*Astragalus rafaelensis*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27	Potential for negative impact—direct and indirect effects. Program activities in Lease Tracts 5, 6, 7, 8, 9, 18, 21, and 25 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Sandstone milkvetch	*Astragalus sesquiflorus*	BLM-S	5, 5A, 6, 7, 8, 8A, 9, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25	Potential for negative impact—direct and indirect effects. Program activities in Lease Tracts 5, 6, 7, 8, 9, 18, 21, and 25 could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Plants (Cont.)				
Wetherill's milkvetch	*Astragalus wetherillii*	FS-S	All	Potential for negative impact—direct and indirect effects. Program activities in all Alternative 3 lease tracts could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Invertebrates				
Great Basin silverspot butterfly	*Speyeria nokomis nokomis*	BLM-S	All	Potential for negative impact—indirect effects only. Program activities in all Alternative 3 lease tracts could affect this species. Neither this species nor its habitat is not expected to occur on any of the lease tracts. Direct impacts on the species or its habitat (riparian areas) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Fish				
Bluehead sucker	*Catostomus discobolus*	BLM-S; FS-S	All	Potential for negative impact—indirect effects only. Program activities in all Alternative 3 lease tracts could affect this species. It is known to occur in the Dolores River. Suitable habitat for this species might occur in the Dolores and San Miguel Rivers, which are downgradient from all lease tracts and intersect Lease Tracts 13 and 13A. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on suitable habitat from water withdrawals, runoff, sedimentation, or fugitive dust deposition might be possible.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Bonytail	*Gila elegans*	ESA-E; CO-E	All	Potential for negative impact—indirect effects only. Program activities in all Alternative 3 lease tracts could affect this species. Suitable habitat for this species does not occur in any of the lease tracts. However, both suitable habitat and designated critical habitat for this species occur within the Colorado River, which is downstream from the Dolores River. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the Dolores River from water withdrawals, runoff, sedimentation, or release of radioactive material fugitive dust deposition might be possible, which might affect the species and its habitat (including designated critical habitat) in the Colorado River. For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the bonytail and its critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS).

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Colorado pikeminnow	*Ptychocheilus lucius*	ESA-E; CO-T	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. Suitable habitat for this species does not occur in any of the lease tracts. However, both suitable habitat and designated critical habitat for this species occur within the Colorado River, which is downstream from the Dolores River. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the Dolores River from water withdrawals, runoff, sedimentation, or release of radioactive material might be possible, which might affect the species and its habitat (including designated critical habitat) in the Colorado River. For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the Colorado pikeminnow and its critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS).

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Flannelmouth sucker	*Catostomus latipinnis*	BLM-S; FS-S	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. It is known to occur in the Dolores River. Suitable habitat for this species might occur in the Dolores and San Miguel Rivers, which are downgradient from all lease tracts and intersect Lease Tracts 13 and 13A. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Humpback chub	*Gila cypha*	ESA-E; CO-T	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. Suitable habitat for this species does not occur in any of the lease tracts. However, both suitable habitat and designated critical habitat for this species occur within the Colorado River, which is downstream from the Dolores River. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the Dolores River from water withdrawals, runoff, sedimentation, or release of radioactive material might be possible, which might affect the species and its habitat (including designated critical habitat) in the Colorado River. For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the humpback chub and its critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS).

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Fish (Cont.)				
Razorback sucker	*Xyrauchen texanus*	ESA-E; CO-E	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. Suitable habitat for this species does not occur on any of the lease tracts. However, both suitable habitat and designated critical habitat for this species occur within the Colorado River, which is downstream from the Dolores River. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the Dolores River from water withdrawals, runoff, sedimentation, or release of radioactive material might be possible, which might affect the species and its habitat (including designated critical habitat) in the Colorado River. For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the razorback sucker and its critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS).
Roundtail chub	*Gila robusta*	BLM-S; FS-S	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. It is known to occur in the Dolores River. Suitable habitat for this species might occur in the Dolores and San Miguel Rivers, which are downgradient from all lease tracts and intersect Lease Tracts 13 and 13A. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Amphibians				
Boreal toad	*Bufo boreas*	CO-E	18, 19, 19A, 26, 27	Potential for negative impact—indirect effects only. Program activities on Lease Tract 18 could affect this species. Suitable habitat for this species is not expected to occur on this lease tract. Direct impacts on the species or its habitat (riparian areas) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Canyon treefrog	*Hyla arenicolor*	BLM-S	All	Potential for negative impact—indirect effects only. Program activities on all lease tracts under Alternative 3 could affect this species. Direct impacts on the species or its habitat (canyonlands and riparian areas) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Great Basin spadefoot	*Spea intermontana*	BLM-S	11, 11A	Potential for negative impact—direct and indirect effects. Program activities in Lease Tract 11 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance, as well as indirect impacts such as those resulting from water withdrawals, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Northern leopard frog	*Rana pipiens*	BLM-S; FS-S	13, 13A, 14, 15, 18, 19, 19A, 24, 25	Potential for negative impact—indirect effects only. Program activities on Lease Tracts 13, 13A, 15, 18, and 25 could affect this species. Direct impacts on the species or its habitat (riparian areas and water bodies) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Reptiles				
Longnose leopard lizard	*Gambelina wislizenii*	BLM-S	18, 19, 19A, 20, 24, 26, 27	Potential for negative impact—indirect effects only. Program activities on Lease Tract 18 could affect this species. Direct impacts on the species or its habitat (riparian areas) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Midget-faded rattlesnake	*Crotalus oreganus concolor*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality and habitat disturbance, as well as indirect impacts such as those resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Birds				
Bald eagle	*Haliaeetus leucocephalus*	BLM-S; FS-S; CO-T	5, 5A, 6, 7, 7, 8, 8A, 9, 13, 13A, 14, 18, 19, 19A, 20, 21, 22, 22A, 23, 26, 27	Potential for negative impact—direct and indirect effects. Program activities on Lease Tracts 5, 6, 7, 8, 9, 13, 13A, 18, and 21 could affect this species. Direct effects would include disturbance of foraging habitat and the winter concentration areas within the lease tracts. Winter concentration areas along the Dolores River might be directly affected by program activities on Lease Tracts 13 and 13A. Indirect impacts on these winter concentration areas from noise, water withdrawal, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Brewer's sparrow	*Spizella breweri*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of sagebrush habitats, as well as indirect impacts such as those resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Burrowing owl	*Athene cunicularia*	BLM-S; CO-T	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect impacts such as those resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Ferruginous hawk	*Buteo regalis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect impacts such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Gunnison sage-grouse	*Centrocercus minimus*	ESA-P; BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitats (sagebrush, shrublands, and grasslands), as well as indirect impacts such as those resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure. ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the Gunnison sage-grouse.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Mexican spotted owl	*Strix occidentalis lucida*	ESA-T; CO-T	All	Potential for negative impact—indirect effects only. Program activities on all lease tracts under Alternative 3 could affect this species. Direct impacts on the species or its habitat (canyonlands and coniferous forests) are unlikely to occur. Indirect impacts on the species or its habitat from water withdrawals, noise, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible. However, with the implementation of minimization and mitigation measures, ULP activities under Alternative 3 will have no effect on the Mexican spotted owl.
Northern goshawk	*Accipiter gentilis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from disturbance of foraging habitats (sagebrush, shrublands, and grasslands), as well as indirect impacts such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Peregrine falcon	*Falco peregrinus*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of foraging or nesting habitats, as well as indirect impacts such as those resulting from noise runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure. Nests near Paradox Valley lease tracts might be indirectly affected by program activities in Lease Tracts 5, 6, 7, 8, and 9.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Birds (Cont.)				
Sage sparrow	*Amphispiza belli*	FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of sagebrush habitats, as well as indirect impacts such as those resulting from runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; CO-E	All	Potential for negative impact—indirect effects only. Program activities on all lease tracts under Alternative 3 could affect this species. Direct impacts on the species or its habitat (riparian woodlands) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, noise, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible. ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the southwestern willow flycatcher.
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	ESA-C; BLM-S; FS-S	All	Potential for negative impact—indirect effects only. Program activities on all lease tracts under Alternative 3 could affect this species. Direct impacts on the species or its habitat (riparian woodlands) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, noise, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible. ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the western yellow-billed cuckoo.
White-faced ibis	*Plegadis chihi*	BLM-S; FS-S	13, 13A, 14, 15, and 15A.	Potential for negative impact—indirect effects only. Program activities on Lease Tracts 13, 13A, and 15 under Alternative 3 could affect this species. Direct impacts on the species or its habitat (wetlands and water bodies) are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, noise, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Mammals				
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect impacts on roosting or foraging habitats such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Black-footed ferret	*Mustela nigripes*	ESA-E; ESA-XN; CO-E	All	No impact. This species is considered extirpated from the ULP project counties. Prairie dog colonies in the vicinity of the ULP lease tracts are not at suitable densities for supporting ferret populations. ULP activities under Alternative 3 will have no effect on the black-footed ferret.
Fringed myotis	*Myotis thysanodes*	BLM-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect impacts on roosting or foraging habitats such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Gunnison's prairie dog	*Cynomys gunnisoni*	ESA-C; BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitat, as well as indirect impacts such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure. ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the Gunnison's prairie dog.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Mammals (Cont.)				
Nelson's bighorn sheep	*Ovis canadensis nelsoni*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from disturbance of habitat, as well as indirect impacts such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Northern river otter	*Lutra canadensis*	CO-T	All	Potential for negative impact—indirect effects only. Program activities on all Alternative 3 lease tracts could affect this species. It is known to occur in the Dolores River, which is downgradient from all lease tracts and intersects Lease Tracts 13, 13A, and 14. Direct impacts on the species or its habitat are unlikely to occur. However, indirect impacts on the species or its habitat from water withdrawals, runoff, sedimentation, fugitive dust deposition, or those related to contaminant exposure might be possible.
Spotted bat	*Euderma maculatum*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities on all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect impacts on roosting or foraging habitats such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; FS-S	All	Potential for negative impact—direct and indirect effects. Program activities in all lease tracts under Alternative 3 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of roosting or foraging habitat, as well as indirect impacts on roosting or foraging habitats such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

TABLE 4.3-8 (Cont.)

Common Name	Scientific Name	Status[a]	Potential to Occur on or near the Following Lease Tracts[b]	Potential for Effect[c]
Mammals (Cont.)				
White-tailed prairie dog	*Cynomys leucurus*	BLM-S; FS-S	18, 19, 19A, 24, 25, 26, and 27	Potential for negative impact—direct and indirect effects. Program activities on Lease Tracts 18 and 25 could affect this species. Impacts could occur through direct effects such as those resulting from mortality or disturbance of habitat, as well as indirect impacts such as those resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure.

[a] BLM-S = BLM-designated sensitive species; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; ESA-P = proposed for listing under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population as defined by Section 10 of the ESA; FS-S = USFS-designated sensitive species.

[b] Refer to Table 3.6-20 (Section 3.6.4) for a description of species' habitat requirements and potential to occur on or near lease tracts. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011b). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the vicinity of the lease tracts.

[c] Potential impacts are based on the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 1 lease tracts. Impacts on species might occur as either direct or indirect effects. Direct effects are considered to be physical impacts resulting from ground-disturbing activities; these include impacts such as direct mortality and habitat disturbance. The impact zone for direct effects does not extend beyond the lease tract boundaries. Indirect effects result from factors including, but not limited to, noise, runoff, dust, accidental spills, and contaminant exposure. The impact zone for indirect effects might extend beyond the lease tract boundaries, but the potential degree of indirect effects would decrease with increasing distance from the lease tracts. Impacts on species listed under the ESA are discussed by using impact levels consistent with determinations made in the ESA Section 7 consultation with the USFWS.

[d] Two mammal species—the Canada lynx (ESA-T) and North American wolverine (ESA-C)—might occur in the project counties. However, suitable habitat for these species does not occur in the vicinity of the ULP lease tracts and is not likely to be affected by ULP activities.

The BA and BO prepared as part of the ESA Section 7 consultation is presented in Appendix E. Although the BA and BO discuss impacts related to the preferred alternative (Alternative 4), the programmatic consultation provided appropriate information for impact determinations under Alternative 3. Additional lease-specific minimization and mitigation measures (if appropriate) would be identified in the EPPs prepared for individual leases. In addition, lease-specific consultation with the CPW may also be needed to determine any state mitigation requirements for listed species. Additional ESA Section 7 consultation may be necessary should new species be listed under the ESA or if new information become available that may alter anticipated impacts on listed species becomes available. See the discussion of the ESA Section 7 consultation in Sections 1.8 and 6.2.

Colorado River Endangered Fishes. Four listed species of fish might be affected by ULP activities under Alternative 3: the bonytail chub; Colorado pikeminnow; humpback chub; and razorback sucker. Each of these fish species historically inhabited tributaries of the Colorado River system, including portions of the Dolores and San Miguel Rivers in the ULP project counties. Current populations of the Colorado River endangered fishes no longer inhabit these rivers in the vicinity of the lease tracts. However, suitable habitat and populations occur in the Colorado River downstream from the Dolores River, which is downgradient from several lease tracts and flows through Lease Tracts 13, 13A, and 14. Designated critical habitat for the Colorado River endangered fishes also occurs in the Colorado River, downstream from the Dolores River.

Under Alternative 3, direct impacts on the Colorado River endangered fish or their habitats are unlikely to occur. However, indirect impacts on the Dolores and San Miguel Rivers may occur from water withdrawals, contaminants, runoff, sedimentation, physical stream alteration, or the spread of introduced species, which might affect the species and their habitats (including designated critical habitat in the Colorado River) (Table 4.3-8). Water consumption from the Dolores River Basin has the potential to affect downstream aquatic habitat for the endangered fish in the Colorado River. Since local surface water and groundwater sources are scarce and often of poor quality, it is assumed that most of the water supply would be brought to the site from sources outside the lease tracts. However, it is expected that water would come from the same hydrologic basin as that for the ULP lease tracts (Dolores River Basin) and that the consumed water would also be discharged within the same hydrologic basin. Although local water sources (surface water or groundwater) are not abundantly available in most ULP lease tracts, the source of water used by the lessees to support ULP activities would be purchased from sources from the local area. The surface water and groundwater sources in the Dolores River Basin where the ULP lease tracts occur are considered over-appropriated by the Colorado Division of Water Resources (CDWR 2007). Therefore, water used to support ULP activities would come from purchased sources. For example, as discussed in the EPP for the JD-8 Mine (Cotter Corp. 2011), water to be used for development and mining would be purchased from the Nucla Municipal System, and no adjudicated water rights would be impacted by the project.

Uranium mining and milling activities can release contaminants into surrounding surface and groundwater sources. The primary contaminants include radionuclides (e.g., radium, thorium, uranium, radon), heavy metals (e.g., iron, lead, copper, zinc, cadmium, nickel, cobalt), trace metals (e.g., arsenic, selenium), and other potentially toxic substances (e.g., ammonia, nitrates, sulphates) (Mkandawire and Dudel 2005; Karp and Metzler 2006; Kelly and Janz 2009; Pollmann et al. 2006; Muscatello and Janz 2009). The toxicity of uranium mine tailings has been shown to be devastating to aquatic life in the Colorado River system (USFWS 1990). Several contaminants, particularly radionuclides and metals, can bioaccumulate in aquatic biota and result in population-level impacts on fish species. Exposure to elevated doses of radiation from radionuclides may affect fish species by affecting fish reproductive organs and decreasing reproductive success (Real et al. 2004). Exposure to elevated concentrations of metals could affect fish by inhibiting growth, tissue damage, reproductive impairment, oxidative stress, and histopathological lesions (Kelly and Janz 2009; Muscatello and Janz 2009). The effects of ammonium include reduced growth rate, reduced gamete production, body deformities and malformations, and degenerative gill and kidney appearance and function. Mining activities may also affect habitat quality for the Colorado River endangered fish by increasing the amount of sediment in the river (Leyda 2011).

Other threats to the Colorado River endangered fish that might be associated with ULP activities include physical stream alteration and the spread of introduced species. Access roads and other structures to support ULP activities may be created to cross stream channels, which could physically alter aquatic environments and reduce the suitability of these habitats for fish populations. Increased human presence near the Dolores and San Miguel Rivers could facilitate the introduction and spread of non-native invasive species, which could negatively affect the endangered fish species through competition and predation.

Measures to avoid or minimize indirect impacts on the Colorado River endangered fish focus on avoiding any additive groundwater withdrawals from the Dolores River Basin, minimizing the potential for contaminants to enter aquatic habitats, and maintaining pre-existing habitat features and biological communities. These measures are listed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Although multiple measures from several categories in Table 4.6-1 that could minimize impacts exist, measures from the following categories would be primarily responsible for reducing or eliminating impacts on the Colorado River endangered fish species:

- M-4: Measures designed to protect soils from erosion, protect local surface water bodies from contamination and sedimentation, and protect local aquifers from contamination; and

- M-7: Measures designed to protect wildlife and wildlife habitats (and grazing animals, if present) from ground disturbance and general site activities.

The ULP would also implement stormwater controls, mine water treatment systems, and other discharge mitigation methods to reduce impacts on the Colorado River endangered fishes. Indirect impacts related to water contamination, physical stream modification, and introduced species are expected to be minimized with the measures identified in Table 4.6-1 to levels that would not adversely affect the species or their habitats. Impacts related to water withdrawal and consumption from the Dolores River Basin are possible (i.e., there are no measures to completely eliminate or offset water withdrawals from the basin). For this reason, DOE determined in its

May 2013 BA that the proposed ULP may affect, and is likely to adversely affect, both the Colorado River endangered fish and their critical habitat. Then, the USFWS, in its August 2013 BO, concluded that water depletions under the preferred alternative (Alternative 4) were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E). Because fewer mines would be operated under Alternative 3 than under Alternative 4, there would be no additional potential for impacts beyond those considered through ESA Section 7 consultation with the USFWS.

Gunnison Sage-Grouse. The Gunnison sage-grouse is a species proposed for listing as endangered under the ESA (USFWS 2013a). Critical habitat for this species is also proposed (USFWS 2013b). This species occurs in sagebrush-dominated habitats in western and southwestern Colorado. Although the species is not known to occur on any of the ULP lease tracts, a portion of the potential proposed critical habitat intersects several lease tracts in the Slick Rock area (Lease Tracts 10, 11, 11A, 12, 15A, 16, and 16A). No occupied or vacant/unknown proposed critical habitat intersects any of the ULP lease tracts. Occupied proposed critical habitat occurs within 1 mi (1.6 km) south of lease tracts in the Paradox area (Lease Tracts 6, 8, and 9) (Figure 3.6-15). Program activities in the above-mentioned lease tracts under Alternative 3 could affect this species through direct effects associated with habitat disturbance, as well as through indirect effects resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure (Table 4.3-8).

Predisturbance surveys would be needed to determine the presence of the Gunnison sage-grouse and its habitat (e.g., sagebrush) on the ULP lease tracts. Program activities would also comply with guidelines set forth in the BLM's *Greater Sage-Grouse Interim Management Policies and Procedures* (BLM 2011e) and *BLM National Greater Sage-Grouse Land Use Planning Strategy* (BLM 2011c). Measures to reduce impacts on this species, including development of a survey protocol, avoidance measures, minimization measures, and, potentially, translocation actions, and compensatory mitigation (if necessary), should be determined following coordination with the USFWS and the CPW. Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). Given the implementation of these measures, ULP activities under Alternative 3 may affect, but are not likely to adversely affect the Gunnison sage-grouse. As a species proposed for listing under the ESA, this species is not required in ESA Section 7 consultation. Should the proposal to list the species become final, all aspects of the ESA (including Section 7 consultation) would apply (USFWS Biological Opinion; Appendix E).

Mexican Spotted Owl. The Mexican spotted owl is listed as threatened under the ESA. This species is considered to be a rare migrant in Montrose and San Miguel Counties, Colorado. It inhabits steep canyons with dense old-growth coniferous forests. This habitat does not occur on the ULP lease tracts, but suitable habitat might occur in the vicinity of the ULP lease tracts. Program activities in all lease tracts under Alternative 3 would not be likely to directly affect this species. However, indirect impacts on suitable habitat resulting from noise, runoff, sedimentation, or fugitive dust deposition might be possible (Table 4.3-8). Programmatic minimization and mitigation measures are discussed in Table 4.6-1 and through formal programmatic ESA Section 7 consultation with the USFWS (Appendix E). The implementation of best reclamation practices should be sufficient to reduce or minimize indirect impacts on this species. Designated critical habitat for this species does not occur in the vicinity of the ULP lease tracts and is not expected to be affected by program activities. Given the implementation of appropriate measures to minimize noise and other indirect impacts, ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the Mexican spotted owl. The USFWS has concurred with this determination under the preferred alternative (Alternative 4) in its programmatic BO (Appendix E). Because fewer mines would be operated under Alternative 3 than under Alternative 4, there would be no additional potential for impacts beyond those considered through ESA Section 7 consultation with the USFWS.

Southwestern Willow Flycatcher. The southwestern willow flycatcher is listed as endangered under the ESA. This species is considered to be an uncommon breeding resident in San Miguel County, Colorado. It inhabits riparian thickets and riparian woodlands. This species is not known to occur on any of the ULP lease tracts. However, according to the SWReGAP habitat suitability model for this species, potentially suitable summer nesting habitat might occur along the Dolores and San Miguel Rivers as well as their tributaries in Mesa, Montrose, and San Miguel Counties. These potentially suitable habitat areas occur in Lease Tracts 13 and 13A, which are being evaluated under Alternative 3. Program activities under Alternative 3 would not be expected to directly affect the southwestern willow flycatcher because direct impacts on this species and its habitat (riparian habitats) would probably be avoided. However, program activities in all lease tracts under Alternative 3 might indirectly affect the southwestern willow flycatcher through impacts resulting from water withdrawals, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure (Table 4.3-8). Critical habitat for the southwestern willow flycatcher does not occur in the vicinity of the lease tracts and is not likely to be affected.

Measures to avoid or minimize groundwater withdrawals to serve ULP activities, along with the implementation of stormwater controls, mine water treatment systems, and other discharge mitigation methods, would reduce impacts of ULP activities on this species. Development of actions to reduce indirect impacts on the southwestern willow flycatcher, including necessary avoidance and minimization measures, would require formal consultation with the USFWS under Section 7 of the ESA. Consultation with the CPW should also occur to determine any state mitigation requirements. Given the implementation of appropriate minimization and mitigation measures, ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the southwestern willow flycatcher. The USFWS has concurred with this determination under the preferred alternative (Alternative 4) in its programmatic BO (Appendix E). Because fewer mines would be operated under Alternative 3 than under Alternative 4, there would be no additional potential for impacts beyond those considered through ESA Section 7 consultation with the USFWS.

Western Yellow-Billed Cuckoo. The western yellow-billed cuckoo is a candidate species for listing under the ESA. It inhabits deciduous riparian woodlands, particularly cottonwood and willow. The western yellow-billed cuckoo is known to occur in Mesa and Montrose Counties as an uncommon summer breeding resident. This species is not known to occur in the vicinity of any of the lease tracts; however, according to the SWReGAP habitat suitability model for the species, potentially suitable summer nesting habitat might occur along the Dolores River in southern Mesa and northern Montrose Counties. These potentially suitable habitat areas do not intersect any of the lease tracts, but they are downslope from Calamity Mesa, Outlaw Mesa, and Uravan lease tracts in Sinbad Valley. Program activities under Alternative 3 are not expected to directly affect the western yellow-billed cuckoo because direct impacts on this species and its habitat (riparian habitats) would probably be avoided. However, program activities at all lease tracts under Alternative 3 might indirectly affect the western yellow-billed cuckoo through impacts resulting from water withdrawals, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure (Table 4.3-8).

Measures to avoid or minimize groundwater withdrawals to serve ULP activities, along with the implementation of stormwater controls, mine water treatment systems, and other discharge mitigation methods, would reduce impacts of ULP activities on the western yellow-billed cuckoo. Development of actions to reduce indirect impacts on this species, including necessary avoidance and minimization measures, should be determined following coordination with the USFWS and the CPW. Given the implementation of appropriate minimization and mitigation measures, ULP activities under Alternative 3 may affect, but are not likely to adversely affect, the western yellow-billed cuckoo. As a candidate species for listing under the ESA, this species is not required in ESA Section 7 consultation. Should the proposal to list the species become final, all aspects of the ESA (including Section 7 consultation) would apply (USFWS Biological Opinion; Appendix E).

Black-Footed Ferret. The black-footed ferret is listed as endangered under the ESA. There are several introduced populations that are listed as experimental and nonessential; however, these populations do not occur in the vicinity of the ULP lease tracts. This species inhabits prairies and shrublands in association with prairie dogs. According to the SWReGAP model, suitable habitat for this species does not occur on or in the vicinity of the ULP lease tracts. The black-footed ferret is presumably extirpated from west central Colorado in the region of the ULP lease tracts, even though block clearance surveys for this species have not been conducted in western Colorado (USFWS 2009b). Prairie dog densities in the region surrounding the ULP lease tracts are not at sufficient densities for supporting the black-footed ferret. Activities associated with Alternative 3 will have no effect on the black-footed ferret. The USFWS has concurred with this determination under the preferred alternative (Alternative 4) in its programmatic BO (Appendix E). Because fewer mines would be operated under Alternative 3 than under Alternative 4, there would be no additional potential for impacts beyond those considered through ESA Section 7 consultation with the USFWS.

Gunnison's Prairie Dog. The Gunnison's prairie dog is a candidate species for listing under the ESA. This species is known to inhabit ULP counties in shrubland habitats at elevations between 6,000 and 12,000 ft (1,800 and 3,700 m). According to CPW, this species is known to occur in at least one lease tract, and suitable habitat may occur in several other lease tracts in Montrose and San Miguel Counties. The overall range for this species intersects several Paradox and Uravan lease tracts. Furthermore, information provided by the CNHP (2011b) indicated recorded quad-level occurrences of this species near Wild Steer Mesa, which is near the lease tracts in Paradox Valley and Dry Creek Basin. Program activities in all lease tracts under Alternative 3 could affect this species through direct effects associated with habitat disturbance, as well as through indirect effects resulting from noise, runoff, sedimentation, dispersion of fugitive dust, and effects related to contaminant exposure (Table 4.3-8).

Predisturbance surveys would be needed to determine the presence of this species and its habitat on the ULP lease tracts. Measures to reduce impacts on this species, including the development of a survey protocol, avoidance measures, minimization measures, and, potentially, translocation actions, and compensatory mitigation (if necessary), should be determined following coordination with the USFWS and the CPW. With the implementation of minimization and mitigation measures, ULP activities under Alternative 3 may affect, but are not likely to adversely affect the Gunnison's prairie dog. As a candidate species for listing under the ESA, this species is not required in ESA Section 7 consultation. Should the proposal to list the species become final, all aspects of the ESA (including Section 7 consultation) would apply (USFWS BO; Appendix E).

4.3.6.4.2 Impacts on Sensitive and State-Listed Species. In addition to species listed under the ESA, there are several other sensitive species that could be affected by ULP activities under Alternative 3. These species include species designated as sensitive by the BLM and USFS, as well as those listed as threatened or endangered by the State of Colorado.

Of the species listed in Table 4.3-8, there are 36 designated as sensitive by the BLM that could be affected by ULP activities under Alternative 3. Of these BLM-designated sensitive species, there are 11 plants, 1 invertebrate, 3 fish, 3 amphibians, 2 reptiles, 9 birds, and 7 mammals. Several of these BLM-designated sensitive species are candidates for listing under the ESA. Impacts on BLM-designated sensitive species are presented in Table 4.3-8.

Of the species listed in Table 4.3-8, there are 20 designated as sensitive by the USFS that could be affected by ULP activities under Alternative 3. Of these USFS-designated sensitive species, there are 2 plants, 3 fish, 1 amphibian, 8 birds, and 6 mammals. Several of these USFS-designated sensitive species are candidates for listing under the ESA or are also designated as BLM sensitive species. Impacts on USFS-designated sensitive species are presented in Table 4.3-8.

Of the species listed in Table 4.3-8, there are 10 that are listed as threatened or endangered by the State of Colorado that could be affected by ULP activities under Alternative 3. Of these state-listed species, there are 4 fish, 1 amphibian, 3 birds, and 2 mammals. Several of these state-listed species are listed under ESA or are also designated by the BLM or USFS as sensitive. Impacts on state-listed species are presented in Table 4.3-8.

4.3.7 Land Use

Under Alternative 3, DOE would continue the ULP as it existed before July 2007—with the 13 then-active leases (now 12 leases)—for the next 10-year period or for another reasonable period. The lands would continue to be closed to mineral entry; however, all other activities within the lease tracts would continue. Mining activities within the lease tracts would likely discourage some land uses, such as recreation or grazing, but because many of the surrounding lands offer opportunities for these activities, impacts due to land use conflicts are considered to be minor. See Section 4.3.8.1 for further discussion of potential impacts on recreation and tourism.

4.3.8 Socioeconomics

The assessment of the socioeconomic impacts of mine exploration, development and operations, and reclamation under Alternative 3 is based on assumptions discussed in Chapter 2 (see Section 2.2.3.1). It is assumed that a total of 8 mines would be in operation in the peak year (2 small, 4 medium, 1 large, and 1 very large mine), producing approximately 1,000 tons of uranium ore per day. Exploration activities would create direct employment of 8 people during the peak year and would create an additional 9 indirect jobs (see Table 4.3-9). Development and operational activities would create direct employment of 123 people during the peak year and would create additional 98 indirect jobs. Mining development and operations activities would constitute 0.3% of total ROI employment. Uranium mining would also produce $4.7 million in direct income and $4.0 million in indirect income. The operational period is assumed to be 10 years or a reasonable longer period of time.

As discussed in Section 3.8, the average unemployment rate in the ROI was 9.6% in 2010; approximately 10,600 people were unemployed. Based on the number of people that could be available from the unemployed workforce and the ROI's distribution of employment by sector, there could be about 2,100 people available for uranium exploration, mining, and reclamation in the ROI. Because of the small number of jobs required for exploration, the current workforce in the ROI could meet the demand for labor; thus, there would be no in-migration of workers. Based on the available labor supply in the ROI as a whole, some of the current workforce could meet the demand for labor needed for mine development and operations. However, some in-migration would occur as a result of uranium mining activities; under this alternative, 63 people would move into the ROI. In-migration of workers would represent an increase in the ROI forecasted population growth rate of 0.04%. The additional workers would increase the annual average employment growth rate by less than 1% in the ROI. The in-migrants would have only a marginal effect on local housing and population and would require less than 1% of vacant owner-occupied housing during mining development and operations. One additional physician, one additional firefighter, and one additional police officer would be required to maintain current levels of service within the ROI as a result of the increased population from in-migrants. No additional teachers would be required to maintain the current student-to-teacher ratio in the ROI.

TABLE 4.3-9 Socioeconomic Impacts of Uranium Mine Development, Operations, and Reclamation in the Region of Influence under Alternative 3

Parameter	Exploration	Development and Operations	Reclamation
Employment (no.)			
Direct	8	123	29
Indirect	9	98	17
Total	17	221	46
Income[a]			
Total	0.7	8.8	1.8
In-migrants (no.)	0	63	0
Vacant housing (no.)	0	37	0
Local community service employment			
Teachers (no.)	0	0	0
Physicians (no.)	0	1	0
Public safety (no.)	0	2	0

[a] Unless indicated otherwise, values are reported in $ million 2009.

Impacts on the ROI would be minor because employment would likely be distributed across all three counties, and the impact would be absorbed across multiple governments and many municipalities. The employment pool would come from a larger population group than if all employment originated from any one county. Mining workers could choose to live in larger population centers within the ROI, such as Grand Junction, Montrose, or Clifton, and commute to mining locations. A report prepared for Sheep Mountain Alliance acknowledged that workers "may choose to live at some distance from the mill and mines to protect the investments they put into their homes. Some businesses serving the mill and mines and their workers may choose to do the same" (Power Consulting 2010). This suggests that the communities in close proximity to the proposed leases might not benefit as greatly from the positive direct and indirect economic impacts from uranium mining, but they could also avoid the conditions under which previous boom and bust periods occurred. Also, the report recognized that despite the decline in uranium and other mining activities following 1980 in the west ends of Montrose, Mesa, and San Miguel Counties, these counties as a whole experienced significant economic expansion after the collapse of the uranium industry in the mid-1980s due to a "growth of a visitor economy including tourists, recreationists, and second homeowners" (Power Consulting 2010). However, individual municipalities in smaller rural communities might experience a temporary increase in population if workers chose to move to communities closer to mining projects rather than commuting from elsewhere in the ROI. Although there might not be a large number of in-migrating workers from outside the three-county ROI and thus little impact on the ROI as a whole, the impact on individual communities could vary.

Reclamation of the 12 lease tracts would occur after operations ceased and the leases were terminated. The reclamation period would likely span 2 to 3 years, although only 1 year of reclamation activities would require a workforce. Reclamation would require a direct workforce of 29 people and would create 17 indirect jobs. During reclamation, the required workforce would generate $1.8 million in income. Because of the small number of jobs required for reclamation, the current workforce in the ROI could meet the demand for labor; thus, there would be no further in-migration of workers.

4.3.8.1 Recreation and Tourism

Under Alternative 3, impacts on recreational opportunities in the area could occur if there was a negative perception of the area due to uranium mining and its potential impacts on air quality, wildlife habitat, water quality, scenic viewsheds, and local roads from increased truck traffic. In addition to economic impacts, there could be social impacts on local communities. Mining activities within the lease tracts would likely discourage land uses for recreation in the specific areas being explored or mined, but much of the lease tract areas would be available for recreation and many of the surrounding lands offer opportunities for these activities. Additional impacts on recreation could occur depending on environmental impacts in other resource areas. DOE ULP lease tracts that are in close proximity to recreation areas and are visible to recreationalists could result in reduced visitation to those areas. The following specially designated areas are within 10 mi (17 km) of the lease tracts and could be in viewing distance from uranium mining activities (visual resources are discussed in Section 4.4.12):

- The Unaweep/Tabeguache Scenic and Historic Byway is located between 2 and 6 mi (3 and 10 km) from lease tracts in Montrose County. Uranium mining activities would be expected to cause minimal to strong contrast levels for views from the byway. Depending on the infrastructure placed within the lease tracts, views of the mine activities and sites would be visible to visitors driving or biking along the byway, primarily in the area within Montrose County.

- The Dolores River Canyon WSA is located between 1 and 6 mi (2 and 10 km) from lease tracts in Montrose County. Uranium mining-related activities in the lease tracts would be expected to cause minimal to weak contrasts for viewpoints in the WSA.

- The Dolores River SRMA is located between 0.25 and 4 mi (0.40 and 6 km) from lease tracts in San Miguel County. Uranium mining-related activities in the lease tracts would be expected to cause minimal to strong contrast levels for views in this SRMA. Portions of the SRMA are contained within the actual lease tracts, including Lease Tracts 13, 13A, and 14.

- The Sewemup WSA is located 4 mi (6 km) from the lease tracts in Montrose County. Uranium mining-related activities in the lease tracts would be expected to cause minimal to weak contrast levels for views from this WSA.

- There would be minimal to no contrast for all other designated areas, including Palisade WSA, which is located 6 mi (10 km) from Mesa County.

Impacts on surface water quality of the Dolores River from mining activities could affect opportunities for fishing and water sports in the ROI. Increased truck traffic on state highways and backcountry roads could lead to potential conflicts with other road users, including recreational cyclists. Noise impacts from mine development would occur to humans and wildlife near the mine sites and along the haul routes, but the impacts would be minor unless these activities occurred near lease tract boundaries adjacent to nearby residences or areas specially designated for wildlife concerns. Section 4.3.5.4 analyzed potential impacts on recreationalists, assuming that a person would camp on top of a waste-rock pile for 2 weeks during each trip, eat wild berries collected in the areas, and hunt wildlife animals for consumption. The total dose associated with exposures would be less than 0.03 mrem/h, although most of the encounters between recreationists and ULP lease tracts are expected to be much shorter than 2 weeks. Wildlife impacts would be localized and would not affect the viability of wildlife populations and therefore should not affect wildlife viewing. Some people visit recreation areas, including specially designated areas, for solitude and to visit undisturbed land. Uranium mining development in the nearby area could negatively impact their perception of the environment surrounding the lease tracts.

Three of the lease tracts included in this alternative are located within the Dolores Canyon SRMA. In recent years, recreation and tourism have become significant components of the local economy in the ROI. According to a report published by the Sonoran Institute (2009), the most significant changes in the economy in the West over the past 40 years have been a rapid growth in the services economy, the rise in nonlabor sources of income (such as investments, Social Security, and Medicare), and the diminished level of jobs and income in the extractive industries (e.g., mining). Increased mining activity in the area could put a strain on local governments from increased road use, traffic safety issues, and potential impacts on public health. Haulage and worker traffic will have an impact on recreationists on state highways without shoulders and roads with bad pavement conditions. Road improvements would be needed for mixed-use roads, and scenic byway status could be dropped, depending on the degree of impact.

Tourism is an important component of local economies because it brings in significant income from outside the area. However, economic impacts from the tourism and recreation sector are difficult to quantify because it is served by a wide-ranging array of industries, including restaurants, hotels, retail shops, second homes, and vacation homes. However, Table 4.3-10 tabulates estimates made for the purpose of providing some perspective on the potential impact. If recreation and outdoor areas are the drivers of an area’s tourism industry, then the condition of the environment is vital to the success of the industry. It is difficult to estimate the impact of uranium mining on recreation because it is not clear how mining development and operations could affect recreational visitation and nonmarket values (i.e., the value of recreational resources for potential or future visits). While it is clear that some land in the ROI would no longer be accessible for recreation, the majority of popular recreational locations would still be available for recreation purposes. Although the impacts of uranium mining on visual impacts is generally minimal, since very few structures are taller than 30 ft

TABLE 4.3-10 Recreation Sector Activity in the Region of Influence in 2012

Type of Activity	Employment	Income ($ million)
Amusement and recreation services	753	15.6
Automotive rental	192	3.4
Eating and drinking places	7,565	132.2
Hotels and lodging places	997	21.9
Museums and historic sites	35	0.86
Recreational vehicle parks and campsites	121	3.4
Scenic tours	531	26.4
Sporting goods retailers	942	19.0
Total ROI	11,136	222.76

Source: MIG (2012)

(9.1 m), it is possible that mining activities in the ROI would be visible from recreational locations and would thus reduce visitation and possibly affect the economy of the ROI.

The Uncompahgre BLM Field Office, which includes Montrose County and parts of San Miguel and Mesa County, currently issues approximately 50 commercial permits for activities such as guided fishing, whitewater rafting, vehicle shuttles, big and small game hunting, mountain lion hunting, horseback trail rides, jeep and motorcycle tours, camping, archery tournaments, and mountain bike rides. Developed recreational sites occur mainly along the San Miguel River SRMA and in the Dolores River SRMA (BLM 2011k). The number of visitors using state and Federal lands for recreational activities is not available from the various administering agencies; consequently, the value of recreational resources in these areas based on the number of recorded visitors is probably underestimated. Because the impact of uranium mining on tourism is not known, this section presents simple scenarios to indicate the magnitude of the economic impact of uranium mining on recreation and tourism; it indicates the impact of a 0.05%, 0.1%, and 0.5% reduction in ROI recreational employment. Impacts include the direct loss of recreation employment in the recreation sectors in each ROI, and the indirect effects, which represent the impact on the remainder of the economy in each ROI as a result of a declining recreation employee wage and salary spending and as a result of expenditures by the recreation sector on materials, equipment, and services. Impacts were estimated by using IMPLAN data for each ROI.

In the ROI, if the impacts of uranium mining caused a 0.05% reduction in recreational employment, there would be a loss of 7 jobs and an income loss of $0.2 million. If there was a 0.1% reduction in recreational employment, there would be a loss of 15 jobs and a corresponding income loss of $0.3 million. If recreational employment declined by 0.5%, 73 jobs would be lost, and there would be a reduction in income of $1.7 million (see Table 4.3-11). Alternately, it is also possible that recreational use could increase if roads close to the ULP lease tracts are improved and if recreationists had easier access to the area.

TABLE 4.3-11 Impacts from Reductions in Recreation Sector Employment Resulting from Uranium Mining Development in the Region of Influence, 2012[a]

	0.05% Employment Reduction		0.1% Employment Reduction		0.5% Employment Reduction	
Area Affected	No. of Jobs Lost	Loss in Income ($ million 2011)	No. of Jobs Lost	Loss in Income ($ million 2011)	No. of Jobs Lost	Loss in Income ($ million 2011)
ROI[b]	7	0.2	15	0.3	73	1.7

[a] The recreation sector includes amusement and recreation services, automotive rental, eating and drinking establishments, hotels and lodging facilities, museums and historic sites, recreational vehicle parks and camp sites, scenic tours, and sporting goods retailers.

[b] The Colorado ROI includes Mesa, Montrose and San Miguel Counties.

4.3.9 Environmental Justice

In the following sections, potential impacts on environmental justice are assessed for the three phases of mining: exploration; development and operation; and reclamation.

4.3.9.1 Exploration

Mine exploration activities would involve some land disturbance activities, such as vegetation clearing, grading, drilling, and building of access roads and drill pads, occurring over relatively small areas. Impacts on minority or low-income populations would be minor and would not be disproportionate, considering the small spatial extent in which exploration activities would occur.

Air emissions from fugitive dust and the operation of construction equipment and mine facility equipment are expected to be minor (see Section 4.3), and chemical exposure during exploration would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. No disproportionate impacts would therefore occur on low-income or minority populations.

Diversion of water from domestic, cultural, religious, or agricultural uses that might disproportionately affect low-income and minority populations is not expected based on water usage for exploration. Potential impacts of exploration on surface water through runoff could occur in some lease tracts, and it has the potential to affect local rivers and aquifers (see Section 4.1.3.1). Short-term soil erosion impacts could occur during exploration (see Section 4.1.3), with longer-term erosion impacts associated with runoff before revegetation would occur. Longer-term surface water runoff and soil erosion impacts could affect wildlife and water quality and, if there was sedimentation, recreational fishing, and they could increase the potential for flooding. Both short-term and long-term surface water runoff and soil erosion impacts could affect subsistence activities, which could have disproportionate impacts on low-income and minority populations.

Exploration would introduce contrasts in form, line, color, and texture, as well as an increasing degree of human activity, into landscapes where activity levels are generally low (see Section 4.1.12). However, dust mitigation would reduce the visual impact of exploration, while revegetation programs would reduce the longer-term visual impacts from mine exploration in local communities and religious and cultural sites and, consequently, reduce any disproportionate impacts on low-income and minority populations. Adverse impacts of exploration on property values would likely be minor, given the existence of mining in the area, the potential small scale of the proposed mining activities, and the opportunity for lucrative uranium exploration employment in local communities where there are low-income and minority populations.

4.3.9.2 Mine Development and Operations

Although there are unique radiological exposure pathways (such as subsistence fish, vegetation, or wildlife consumption or well water use) that could potentially produce adverse health and environmental impacts on low-income and minority populations, no radiological impacts are expected during mine development and operations. Mining facilities would not produce any significant radiological risks to underground or surface mine workers or any radiological or adverse health impacts on the general public during operations (see Section 4.3.5) and therefore would not disproportionately affect low-income and minority populations. Air emissions from fugitive dust and the operation of construction equipment and mine facility equipment are expected to be minor (see Section 4.1.1). Chemical exposure during mine development and operations would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. No disproportionate impacts on low-income or minority populations would therefore be expected.

Diversion of water from domestic, cultural, religious, or agricultural uses that might disproportionately affect low-income and minority populations is not expected based on water usage for operations. Potential impacts from mining operations on surface water through runoff contamination could occur in some lease tracts, and they have the potential to affect local rivers and aquifers (see Section 4.3.3.1). Short-term soil erosion impacts could occur during mine development (see Section 4.3.3). Longer-term erosion impacts associated with runoff before revegetation occurred could affect wildlife and water quality and, with potential sedimentation, recreational fishing. Erosion impacts could also increase the potential for flooding, which could affect subsistence activities, which could have disproportionate impacts on low-income and minority populations.

Mining facilities would introduce contrasts in form, line, color, and texture, as well as an increasing degree of human activity, into landscapes where activity levels are generally (see Section 4.3.12). However, dust mitigation would reduce the visual impact of mine development activity. Attempts could be made to choose construction materials that would minimize scenic contrast, and revegetation programs could reduce the longer-term visual impacts from mining sites in local communities and religious and cultural sites and, consequently, reduce any disproportionate impacts on low-income and minority populations. Adverse impacts of uranium mining on property values would likely be minor, given the existence of mining in the area, the potential small scale and phased schedule of proposed mining activities, the opportunity for lucrative uranium mining employment, and the higher tax revenues and improved local public service provisions in local communities where there are low-income and minority populations.

4.3.9.3 Reclamation

Under Alternative 3, impacts on environmental justice associated with reclamation activities would be the same as those described for Alternative 1 (Section 4.1.9).

Although potential impacts on the general population could result from exploration, mine development and operations, and reclamation of uranium mining facilities under Alternative 3, for the majority of resources evaluated, impacts are likely to be minor and are unlikely to disproportionately affect low-income and minority populations. Specific disproportionate impacts on low-income and minority populations as a result of participation in subsistence or certain cultural and religious activities would also be minor.

4.3.10 Transportation

The transportation risk analysis estimated both radiological and nonradiological impacts associated with the shipment of uranium ore from its point of origin (at one of eight mines) to a uranium mill. Each mine is assumed to be operating on one of the 12 lease tracts considered under Alternative 3. Further details on the risk methodology and input data are provided in Section D.10 of Appendix D. Mitigation measures and BMPs for the safe transportation of uranium ore are provided in Table 4.6-1 (Section 4.6).

4.3.10.1 General Approach and Assumptions

The ULP PEIS transportation assessment evaluated the annual impacts expected during the peak year of operations when the largest potential number of mines could be operating on the 12 lease tracts considered. The shipment of uranium ore is not assumed over the life of the program because of the uncertainty associated with future uranium demand and mine development.

A sample set of 8 of the 12 lease tracts was evaluated in the transportation analysis to represent operations during the peak year of production. To select lease tracts for the transportation analysis, lease tract locations, lessees, and prior mining operations, if any, were considered. In addition, mill distance and capacity were considered when determining which mill would receive a particular mine’s ore shipments. The nearest mill was not always the destination for a given shipment. At the time of actual shipment, various factors, such as existing road conditions due to traffic, weather, and road maintenance and repairs as well as mill capacity and costs, would be among the criteria used to determine which mill would receive a given ore shipment. The intent of the transportation analysis is to provide a reasonable estimate of impacts that could occur. Impacts were also estimated on the basis of the assumption that all shipments would go to a single mill to provide an upper range on what might be expected. Single shipment risks for uranium ore were also determined so that an estimate for any future shipping campaign could be evaluated.

The transportation risk assessment considered human health risks from routine (normal, incident-free) transport of radiological materials and from accidents. The risks associated with the nature of the cargo itself ("cargo-related" impacts) were considered for routine transport. Risks related to the transportation vehicle regardless of type of cargo ("vehicle related" impacts) were considered for routine transport and potential accidents. Radiological-cargo-related accident risks are expected to be negligible and were not assessed as part of this analysis, as discussed in Appendix D, Section D.10.1. Transportation of hazardous chemicals was not part of this analysis because no hazardous chemicals have been identified as being part of uranium mining operations.

4.3.10.1.1 Routine Transportation Risks. The nonradiological routine impacts associated with uranium ore transportation would be vehicle-related as a result of the increase in truck traffic on affected routes. A comparison with existing traffic densities was made, and the potential for traffic delays was considered.

The radiological risk associated with routine transportation would be cargo-related and result from the potential exposure of people to low levels of external radiation near a loaded shipment. No direct physical exposure to radioactive material would occur during routine transport because the uranium ore would be covered by a tarp during transport. No significant unintended releases would occur.

Collective population radiological risks were estimated for persons living or working in the vicinity of a shipment route (off-link population) and persons in all vehicles sharing the transportation route (on-link population). Collective doses were also calculated for the truck drivers involved in the actual shipment of uranium ore. Workers involved in loading or unloading were not considered in the transportation analysis. The doses calculated for the first two population groups were added together to yield the collective dose to the public; the dose calculated for the truck drivers represents the collective dose to workers.

In addition to assessing the routine collective population risk, the radiological risks to individuals were estimated for a number of hypothetical exposure scenarios. Receptors included members of the public exposed standing along the roadside, at a nearby residence, or during traffic delays.

4.3.10.1.2 Transportation Accident Risks. The vehicle-related accident risk refers to the potential for transportation accidents that could result directly in injuries and fatalities not related to the nature of the cargo in the shipment. This risk represents injuries and fatalities from physical trauma. Route-specific or countywide rates for transportation injuries and fatalities were used in the assessment, as discussed in Appendix D, Section D.10.4.1.3. Vehicle-related accident risks were calculated by multiplying the total distance traveled by the rates for transportation injuries and fatalities. In all cases, the vehicle-related accident risks were calculated on the basis of distances for round-trip shipment, since the presence or absence of cargo would not be a factor in accident frequency.

4.3.10.1.3 Transportation Routes. Ore shipments would travel primarily on CO 90 and CO 141, depending on the lease tract, if the Piñon Ridge Mill was used to process the ore. Shipments to the White Mesa Mill would use these roads and also US 491 in Colorado and Utah and US 191 in Utah. Travel on county or BLM roads would also be necessary for those mines without direct access to the state roads. Table 4.3-12 lists the distances to each mill from all lease tracts that could support mining operations under Alternatives 3 through 5.

4.3.10.2 Routine Transportation Risks

4.3.10.2.1 Nonradiological Impacts. The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 3 would be 40 per day, assuming a combined mill processing capability of 1,000 tons per day as discussed in Section 2.2.3.1 and a truck load of 25 tons. Including round-trip travel, 80 trucks per day would be expected to travel the affected routes. As listed in Table 3.10-1, the lowest annual average daily traffic (AADT) along any of the routes would be about 250 vehicles per day near Egnar on CO 141. If all 80 trucks per day passed through Egnar, in the extreme case of all shipments going to the White Mesa Mill, this scenario would represent a 32% increase in traffic in this area but an increase of less than 2% at the most heavily traveled location in Monticello, Utah—again, if all shipments went to the White Mesa Mill. No additional traffic congestion would be expected in any area, and only about two to three additional trucks per hour going in each direction would be expected in that extreme case, assuming a 16-hour workday for transport.

For the example case with operations at 8 mines (1 very large, 1 large, 4 medium, and 2 small, as discussed in Section 2..2.3.1), the total distance traveled by haul trucks during the peak year would be approximately 1.10 million mi (1.77 million km), assuming round-trip travel between the lease tracts and the mills as shown in Table 4.3-13. Using peak-year assumptions of 40 shipments a day and 20 days a month, 9,600 round-trips would be expected. According to the CDOT and UDOT, the estimated total truck distance travelled of 1.10 million mi (1.77 million km) would be about 9% of the total heavy truck miles travelled (12.6 million mi, or 20.3 million km) along the affected highways in 2010 (CDOT 2011; UDOT 2011).In general, actual annual impacts over the course of the ULP could be lower or higher than these impacts, because the shipment numbers are for the estimated peak year and because, for a given lease tract, the ore could be transported to a different mill than that used in the ULP PEIS analysis or because lease tracts other than those used in the sample case would be developed.

TABLE 4.3-12 Distances from Lease Tracts to Ore Processing Mills

	Distance (km)		
Lease Tract	Piñon Ridge	White Mesa	Alternative[a]
5	6.6	195.7	3, 4, 5
5A	7.0	196.1	4, 5
6	8.1	197.2	3, 4, 5
7	7.0	196.1	3, 4, 5
8	9.4	198.5	3, 4, 5
8A	9.4	198.5	4, 5
9	27.4	209.3	3, 4, 5
10	99.8	107.1	4, 5
11	105.5	99.7	3, 4, 5
11A	108.6	102.8	4, 5
12	107.0	103.2	4, 5
13	86.0	114.8	3, 4, 5
13A	87.9	116.8	3, 4, 5
14	87.9	116.1	4, 5
15	91.7	120.5	3, 4, 5
15A	93.9	122.8	4, 5
16	96.0	105.5	4, 5
16A	95.2	104.9	4, 5
17	30.2	172.8	4, 5
18	43.2	204.9	3, 4, 5
19	50.5	212.3	4, 5
19A	47.8	209.6	4, 5
20	47.8	209.6	4, 5
21	21.6	199.7	3, 4, 5
22	24.3	202.3	4, 5
2A	26.0	204.1	4, 5
23	18.4	196.4	4, 5
24	44.0	205.8	4, 5
25	42.8	204.5	3, 4, 5
26	104.5	266.2	4, 5
27	85.6	247.3	4, 5

[a] ULP PEIS alternatives that would mine and produce ore to ship to a mill.

TABLE 4.3-13 Peak-Year Collective Population Transportation Impacts under Alternative 3

Scenario	Total Distance (km)	Radiological Impacts: Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	Accidents per Round Trip: Injuries	Fatalities
Sample case	1,766,000	0.14	8E-05	0.71	0.0004	0.33	0.029
All to Piñon Ridge Mill	751,000	0.058	3E-05	0.30	0.0002	0.14	0.012
All to White Mesa Mill	3,581,000	0.28	0.0002	1.5	0.0009	0.66	0.060

To help put the sample case results in perspective, Table 4.3-13 also lists the total distances that ore would be shipped if all the ore was shipped to one mill or the other. Because of the relative locations of all the lease tracts with respect to the mills, shipping all of the ore to White Mesa Mill (2.22 million mi or 3.58 million km) would represent close to the upper bound for the total distance for all shipments. Shipment of all of the ore to the Piñon Ridge Mill (0.47 million mi or 0.75 million km) would represent close to the lower bound for total distance.

Most of the distance travelled by the haul trucks would occur on state or U.S. highways. To access these roads, the haul trucks might travel distances of up to several miles on county and local roads, depending on the location of the lease tract and the location of the mine within the lease tract. Several residences are located near lease tracts along such roads. In those cases, the number of passing haul trucks could range from about 4 (small mine) to 16 per day (large mine), depending on the size of the nearby mine, as shown in Table 4.3-14. No residences are located along the short distance between the very large mine (JD-7) and the highway. If hauling were to occur 16 hours per day, then up to one haul truck per hour could pass by on the way to or from the main highway in the case of a very large mine. In addition, some of these residences might encounter local truck traffic for the first time should ore production occur on neighboring lease tracts.

Access to the lease tracts from the Colorado state highways is provided by local roads, as discussed in Section 3.10. Improvements to the intersections between the local roads and the state highways (e.g., pave local road surface a prescribed distance back, add turn lanes, improve sight distance) might be necessary, as governed by the State of Colorado State Highway Access Code (pursuant to *Colorado Revised Statutes* [CRS] 43-2-147(4)]), depending on the increased level of traffic from uranium ore production. At this time, it is possible to provide only a general estimate of the potential number of ore shipments and amounts of other related traffic that could be generated and pass through these intersections, regardless of the alternative considered, given the uncertainty regarding which lease tracts would eventually host a mine site, the actual ore production rate associated with each mine, the number of mines operating simultaneously, and the relative locations of the mines and the mills (i.e., whether or not the mines share the use of a common access road).

TABLE 4.3-14 Potential Haul Truck Traffic on Local Roads

Size of Mine	Ore Production Rate (tons/d)	No. of Trucks/d[a]
Small	50	4
Medium	100	8
Large	200	16
Very large	300	24

[a] Assumes 25 tons of uranium ore per truck and round-trip travel.

The transportation analysis conducted for Alternatives 3 through 5 used an assumed mine size, which determines the number of ore shipments, for each lease tract considered, as discussed in Section D.10.4.5. While it is highly unlikely that all lease tracts considered in the ULP PEIS would have mines at the sizes assumed in Table D.10-2 operating simultaneously, it is possible that in isolated cases, two or more lease tracts sharing an access road to a state highway could have mines operating at the same time under Alternative 3, 4, or 5.

Tables 4.3-15 and 4.3-16 present the number of shipments passing through the intersection of each local access road from a lease tract onto a state or U.S. highway, assuming that all shipments would go to either the White Mesa Mill or the Piñon Ridge Mill, respectively. As shown, the number of shipments ranges from 0 to 36 per day, depending on the destination mill and the specific intersection. Note that the value of 36 shipments corresponds to the intersection of DD19 Road with CO 90, with DD19 Road serving the very large mine on JD-7 in addition to six other lease tracts. In each case, the number of haul trucks passing through would be doubled, to account for the return of the empty truck. The number of shipments shown in Tables 4.3-15 and 4.3-16 for each intersection is not necessarily an upper bound, because larger mines than those assumed (or more than one mine) could potentially be sited at each location. However, based on prior mining experience in this region of Colorado, the number of shipments is expected to be at the higher end of the potential range and to provide an indication of the potential impacts on traffic from future mining operations.

In addition to increased traffic flows on the state highways, the associated traffic impacts include the number of vehicle turns (and their direction) from the state highways onto the roads used to access the lease tracts as well as the number of turns in the opposite direction. While the increased traffic flows related to potential mining on the lease tracts are not expected to have any significant effects on traffic congestion, some potential mitigation measures may be necessary. As previously discussed, access to Colorado's state highways is governed by the State of Colorado Access Code. The code contains provisions aimed at maintaining roadway safety that pertain to the intersections between the state highways and other roads that access the highway. Note that mine lessees intending to commence mine operations are expected to discuss their plans with CDOT beforehand. A sample case is provided in the text box as an example to

TABLE 4.3-15 Potential Number of Truck Shipments to the White Mesa Mill Passing through Collector Road Intersections with U.S. and State Highways

Lease Tract	No. of Shipments per Day	DD19 Rd (CO 90)	EE21 Rd (CO 90)	7N Rd (CO 141)	UCOLO Rd (US 491)	S8 Rd (CO 141)	K8 Rd (CO 141)	Unk Rd 1 (CO 141)	Unk Rd 3 (CO 141)
C-JD-5	8	8	0	0	0	0	0	0	0
C-JD-5A	2	2	0	0	0	0	0	0	0
C-JD-6	8	8	0	0	0	0	0	0	0
C-JD-7	12	12	0	0	0	0	0	0	0
C-JD-8	4	4	0	0	0	0	0	0	0
C-JD-8A	2	2	0	0	0	0	0	0	0
C-JD-9	4	0	4	0	0	0	0	0	0
C-SR-10	4	0	0	4	0	0	0	0	0
C-SR-11	4	0	0	0	4	0	0	0	0
C-SR-11A	4	0	0	0	4	0	0	0	0
C-SR-12	2	0	0	0	0	0	2	0	0
C-SR-13	4	0	0	0	0	4	0	0	0
C-SR-13A	4	0	0	0	0	4	0	0	0
C-SR-14	4	0	0	0	0	0	0	4	0
C-SR-15	2	0	0	0	0	2	0	0	0
C-SR-15A	2	0	0	0	0	2	0	0	0
C-SR-16	2	0	0	0	0	0	0	0	0
C-SR-16A	2	0	0	0	0	0	0	0	2
C-WM-17	2	0	0	0	0	0	0	0	0
C-SM-18	4	0	0	0	0	0	0	0	0
C-AM-19	8	0	0	0	0	0	0	0	0
C-AM-19A	4	0	0	0	0	0	0	0	0
C-AM-20	2	0	0	0	0	0	0	0	0
C-LP-21	4	0	0	0	0	0	0	0	0
C-LP-22	2	0	0	0	0	0	0	0	0
C-LP22A	4	0	0	0	0	0	0	0	0
C-LP-23	4	0	0	0	0	0	0	0	0
C-CM-24	2	0	0	0	0	0	0	0	0
C-CM-25	2	0	0	0	0	0	0	0	0
C-G-26	2	0	0	0	0	0	0	0	0
C-G-27	2	0	0	0	0	0	0	0	0
Total shipments	116	36	4	4	8	12	2	4	2
Round-trip trucks	232	72	8	8	16	24	4	8	4

TABLE 4.3-15 (Cont.)

Lease Tract	No. of Shipments per Day	Unk Rd 4 (CO 141)	25R Rd (CO 141	U18 (CO 141)	S17 (CO 141)	EE22 Rd (CO 90))	EE22 Rd (CO 141)	P12 Rd (CO 141)
C-JD-5	8	0	0	0	0	0	0	0
C-JD-5A	2	0	0	0	0	0	0	0
C-JD-6	8	0	0	0	0	0	0	0
C-JD-7	12	0	0	0	0	0	0	0
C-JD-8	4	0	0	0	0	0	0	0
C-JD-8A	2	0	0	0	0	0	0	0
C-JD-9	4	0	0	0	0	0	0	0
C-SR-10	4	0	0	0	0	0	0	0
C-SR-11	4	0	0	0	0	0	0	0
C-SR-11A	4	0	0	0	0	0	0	0
C-SR-12	2	0	0	0	0	0	0	0
C-SR-13	4	0	0	0	0	0	0	0
C-SR-13A	4	0	0	0	0	0	0	0
C-SR-14	4	0	0	0	0	0	0	0
C-SR-15	2	0	0	0	0	0	0	0
C-SR-15A	2	0	0	0	0	0	0	0
C-SR-16	2	2	0	0	0	0	0	0
C-SR-16A	2	0	0	0	0	0	0	0
C-WM-17	2	0	2	0	0	0	0	0
C-SM-18	4	0	0	4	0	0	0	0
C-AM-19	8	0	0	0	8	0	0	0
C-AM-19A	4	0	0	0	4	0	0	0
C-AM-20	2	0	0	0	2	0	0	0
C-LP-21	4	0	0	0	0	4	0	0
C-LP-22	2	0	0	0	0	2	0	0
C-LP22A	4	0	0	0	0	4	0	0
C-LP-23	4	0	0	0	0	4	0	0
C-CM-24	2	0	0	0	0	0	2	0
C-CM-25	2	0	0	0	0	0	2	0
C-G-26	2	0	0	0	0	0	0	2
C-G-27	2	0	0	0	0	0	0	2
Total shipments	116	2	2	4	14	14	4	4
Round-trip trucks	232	4	4	8	28	28	8	8

TABLE 4.3-16 Potential Number of Truck Shipments to the Piñon Ridge Mill Passing through Collector Road Intersections with U.S. and State Highways

Lease Tract	No. of Shipments per Day	DD19 Rd (CO 90)	EE21 Rd (CO 90)	7N Rd (CO 141)	S8 Rd (CO 141)	K8 Rd (CO 141)	Unk Rd 1 (CO 141)	Unk Rd 3 (CO 141)
C-JD-5	8	8	0	0	0	0	0	0
C-JD-5A	2	2	0	0	0	0	0	0
C-JD-6	8	8	0	0	0	0	0	0
C-JD-7	12	12	0	0	0	0	0	0
C-JD-8	4	4	0	0	0	0	0	0
C-JD-8A	2	2	0	0	0	0	0	0
C-JD-9	4	0	4	0	0	0	0	0
C-SR-10	4	0	0	4	0	0	0	0
C-SR-11	4	0	0	0	4	0	0	0
C-SR-11A	4	0	0	0	4	0	0	0
C-SR-12	2	0	0	0	0	2	0	0
C-SR-13	4	0	0	0	4	0	0	0
C-SR-13A	4	0	0	0	4	0	0	0
C-SR-14	4	0	0	0	0	0	4	0
C-SR-15	2	0	0	0	2	0	0	0
C-SR-15A	2	0	0	0	2	0	0	0
C-SR-16	2	0	0	0	0	0	0	0
C-SR-16A	2	0	0	0	0	0	0	2
C-WM-17	2	0	2	0	0	0	0	0
C-SM-18	4	0	0	0	0	0	0	0
C-AM-19	8	0	0	0	0	0	0	0
C-AM-19A	4	0	0	0	0	0	0	0
C-AM-20	2	0	0	0	0	0	0	0
C-LP-21	4	0	0	0	0	0	0	0
C-LP-22	2	0	0	0	0	0	0	0
C-LP22A	4	0	0	0	0	0	0	0
C-LP-23	4	0	0	0	0	0	0	0
C-CM-24	2	0	0	0	0	0	0	0
C-CM-25	2	0	0	0	0	0	0	0
C-G-26	2	0	0	0	0	0	0	0
C-G-27	2	0	0	0	0	0	0	0
Total shipments	116	36	6	4	20	2	4	2
Round-trip trucks	232	72	12	8	40	4	8	4

TABLE 4.3-16 (Cont.)

Lease Tract	No. of Shipments per Day	Unk Rd 4 (CO 141)	U18 (CO 141)	S17 (CO 141)	EE22 Rd (CO 90)	EE22 Rd (CO 141)	P12 Rd (CO 141)
C-JD-5	8	0	0	0	0	0	0
C-JD-5A	2	0	0	0	0	0	0
C-JD-6	8	0	0	0	0	0	0
C-JD-7	12	0	0	0	0	0	0
C-JD-8	4	0	0	0	0	0	0
C-JD-8A	2	0	0	0	0	0	0
C-JD-9	4	0	0	0	0	0	0
C-SR-10	4	0	0	0	0	0	0
C-SR-11	4	0	0	0	0	0	0
C-SR-11A	4	0	0	0	0	0	0
C-SR-12	2	0	0	0	0	0	0
C-SR-13	4	0	0	0	0	0	0
C-SR-13A	4	0	0	0	0	0	0
C-SR-14	4	0	0	0	0	0	0
C-SR-15	2	0	0	0	0	0	0
C-SR-15A	2	0	0	0	0	0	0
C-SR-16	2	2	0	0	0	0	0
C-SR-16A	2	0	0	0	0	0	0
C-WM-17	2	0	0	0	0	0	0
C-SM-18	4	0	4	0	0	0	0
C-AM-19	8	0	0	8	0	0	0
C-AM-19A	4	0	0	4	0	0	0
C-AM-20	2	0	0	2	0	0	0
C-LP-21	4	0	0	0	4	0	0
C-LP-22	2	0	0	0	2	0	0
C-LP22A	4	0	0	0	4	0	0
C-LP-23	4	0	0	0	4	0	0
C-CM-24	2	0	0	0	0	2	0
C-CM-25	2	0	0	0	0	2	0
C-G-26	2	0	0	0	0	0	2
C-G-27	2	0	0	0	0	0	2
Total shipments	116	2	4	14	14	4	4
Round-trip trucks	232	4	8	28	28	8	8

Auxiliary Turn Lane Requirements for State Highways CO 90 and CO 141

Left turn lane: Left ingress turning volume greater than 10 vehicles per hour
Right turn lane: Right ingress turning volume greater than 25 vehicles per hour

Definitions

Passenger car equivalent (PCE): Used to account for vehicles larger than passenger cars/trucks in the access code criteria. A combination truck (e.g., a uranium ore haul truck) 40 ft or longer is considered as 3 PCEs.

Example Assumptions

Two medium mines on the same access road
Number of ore trucks per day (round-trip): 16 (48 PCEs)
Number of workers: 20
All workers arrive and leave over a 1-hour span in the morning and evening in their own cars.

Turn direction from mill onto access road from highway: Left

Turn direction from home onto access road for worker commutes: 40% left, 60% right

Existing traffic: Left turns off highway 12 per day
Right turns off highway 4 per day

Determination

Peak incoming traffic volume would be in the morning when workers arrive and could include a couple of incoming empty haul trucks from the mill. The number of vehicles turning left off the highway during the 1-hour arrival of all workers would include 8 worker vehicles (40% of 20), the haul trucks (6 PCEs), and possibly some of the existing traffic (1 PCE), for total of 15 PCEs; thus, a left-turn lane off the highway to the access road would likely be required. For right-turn access, only 12 worker vehicles and possibly 1 vehicle from existing traffic would amount to a total of only 13 PCEs, below the requirement for a right-turn lane.

illustrate the process used by CDOT to ensure compliance with the code when determining one facet of intersection safety—the need for a left or right turn lane off the state highway.

4.3.10.2.2 Radiological Impacts. Radiological impacts during routine conditions would be a result of human exposure to the low levels of radiation near the shipment. The regulatory limit established in 49 CFR 173.441 (Radiation Level Limitations) and 10 CFR 71.47 (External Radiation Standards for All Packages) to protect the public is 10 mrem/h at 6 ft (2 m) from the outer lateral sides of the transport vehicle. As discussed in Appendix D, Section D.10.4.2, the average external dose rate for uranium ore shipments is approximately 0.1 mrem/h at 6.6 ft (2 m), two orders of magnitude lower than the regulatory maximum.

Collective Population Risk. The collective population risk is a measure of the total risk posed to society as a whole by the actions being considered. For a collective population risk assessment, the persons exposed are considered as a group; no individual receptors are specified. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.14 person-rem for the peak year, assuming about 9,600 shipments for the year for the sample case, as shown in

Table 4.3-13. The total collective population dose of 0.14 person-rem could result in an LCF risk of approximately 8×10^{-5}. Therefore, no latent fatal cancers are expected. These impacts are roughly double the impacts that would occur if all ore shipments went to the Piñon Ridge Mill and roughly half the impacts that would occur if all ore shipments went to the White Mesa Mill, as shown in Table 4.3-13.

Collectively for the sample case, the truck drivers (transportation crew) would receive a dose of about 0.71 person-rem (0.0004 LCF) during the peak year of operations from all shipments. Again, no latent fatal cancers would be expected. For perspective, the collective dose of 0.71 rem (710 mrem) over 9,600 shipments is slightly more than what a single individual would receive in 1 year from natural background radiation (about 310 mrem) and human-made sources of radiation (about 310 mrem/yr).

For scenarios other than those presented in the ULP PEIS, single shipment risks are provided for transporting ore from any of the lease tracts considered in any alternative to the Piñon Ridge Mill (Table 4.3-17) and the White Mesa Mill (Table 4.3-18). In conjunction with Table 4.3-10, all collective population impacts related to any combination and number of ore shipments between lease tracts and uranium mills can be estimated.

Highest-Exposed Individuals during Routine Conditions. In addition to assessing the routine collective population risk, the risks to individuals for a number of hypothetical exposure scenarios were estimated, as described further in Appendix D, Section D.10.2.2. The scenarios were not meant to be exhaustive but were selected to provide a range of potential exposure situations. The estimated doses and associated likelihoods of LCFs are provided in Table 4.3-19.

The highest potential routine radiological exposure to an individual—with an LCF risk of 5×10^{-8}—would be to someone caught in traffic next to a haul truck for up to 30 minutes at a distance of 3.9 ft (1.2 m). There is also the possibility for multiple exposures in some cases. For example, if an individual lived or worked near a uranium mill, the person could receive a combined dose of as much as approximately 0.013 mrem if present for all ore shipments over the course of the peak year (if all of the ore went to a single mill). This dose is extremely low, about 24,000 times lower than the amount an individual receives in a single year from natural background radiation (about 310 mrem/yr).

4.3.10.3 Transportation Accident Risks

The total distance traveled by haul trucks during the peak year would be approximately 1.10 million mi (1.77 million km), including round-trip travel between the lease tracts and the mills, as discussed in Section 4.5.10.2.1 for the sample case. As shown in Table 4.3-13, potential transportation accident impacts for the peak year would not include any expected injuries or fatalities from traffic accidents (risk of <0.5). For perspective, from 2006 through 2010 over the entire area of the affected counties (San Juan County in Utah and Dolores, Mesa, Montrose, and San Miguel Counties in Colorado), a total of 21 heavy-truck-related traffic fatalities occurred (DOT 2010 a–e), representing an average of 4.2 fatalities per year.

TABLE 4.3-17 Single-Shipment Collective Population Impacts from Transporting Ore from Lease Tracts to Piñon Ridge Mill[a]

	Radiological Impacts				Accidents per Round Trip	
Lease Tract	Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	Injuries	Fatalities
5	1.0E-06	6E-10	5.4E-06	3E-09	2.45E-06	2.20E-07
5A	1.1E-06	6E-10	5.6E-06	3E-09	2.57E-06	2.32E-07
6	1.3E-06	8E-10	6.5E-06	4E-09	2.99E-06	2.70E-07
7	1.1E-06	6E-10	5.7E-06	3E-09	2.58E-06	2.33E-07
8	1.5E-06	9E-10	7.6E-06	5E-09	3.49E-06	3.14E-07
8A	1.5E-06	9E-10	7.6E-06	5E-09	3.49E-06	3.14E-07
9	4.2E-06	3E-09	2.2E-05	1E-08	1.01E-05	9.10E-07
10	1.5E-05	9E-09	8.1E-05	5E-08	3.68E-05	3.32E-06
11	1.6E-05	1E-08	8.5E-05	5E-08	3.89E-05	3.51E-06
11A	1.7E-05	1E-08	8.8E-05	5E-08	4.01E-05	3.61E-06
12	1.7E-05	1E-08	8.6E-05	5E-08	3.95E-05	3.56E-06
13	1.3E-05	8E-09	6.9E-05	4E-08	3.17E-05	2.86E-06
13A	1.4E-05	8E-09	7.1E-05	4E-08	3.25E-05	2.92E-06
14	1.4E-05	8E-09	7.1E-05	4E-08	3.24E-05	2.92E-06
15	1.4E-05	8E-09	7.4E-05	4E-08	3.38E-05	3.05E-06
15A	1.5E-05	9E-09	7.6E-05	5E-08	3.47E-05	3.12E-06
16	1.5E-05	9E-09	7.8E-05	5E-08	3.54E-05	3.19E-06
16A	1.5E-05	9E-09	7.7E-05	5E-08	3.51E-05	3.16E-06
17	4.7E-06	3E-09	2.4E-05	1E-08	1.11E-05	1.00E-06
18	6.7E-06	4E-09	3.5E-05	2E-08	1.59E-05	1.44E-06
19	7.8E-06	5E-09	4.1E-05	2E-08	1.86E-05	1.68E-06
19A	7.4E-06	4E-09	3.9E-05	2E-08	1.76E-05	1.59E-06
20	7.4E-06	4E-09	3.9E-05	2E-08	1.76E-05	1.59E-06
21	3.3E-06	2E-09	1.7E-05	1E-08	7.98E-06	7.19E-07
22	3.7E-06	2E-09	2.0E-05	1E-08	8.96E-06	8.07E-07
22A	4.0E-06	2E-09	2.1E-05	1E-08	9.62E-06	8.66E-07
23	2.8E-06	2E-09	1.5E-05	9E-09	6.78E-06	6.10E-07
24	6.8E-06	4E-09	3.6E-05	2E-08	1.63E-05	1.46E-06
25	6.6E-06	4E-09	3.5E-05	2E-08	1.58E-05	1.42E-06
26	1.6E-05	1E-08	8.4E-05	5E-08	3.86E-05	3.47E-06
27	1.3E-05	8E-09	6.9E-05	4E-08	3.16E-05	2.84E-06

[a] See Appendix D, Section D.10.4, for assumptions.

TABLE 4.3-18 Single-Shipment Collective Population Impacts from Transporting Ore from Lease Tracts to White Mesa Mill[a]

	Radiological Impacts				Accidents per Round Trip	
Lease Tract	Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	Injuries	Fatalities
5	3.0E-05	2E-08	1.6E-04	9E-08	7.22E-05	6.51E-06
5A	3.0E-05	2E-08	1.6E-04	1E-07	7.24E-05	6.52E-06
6	3.0E-05	2E-08	1.6E-04	1E-07	7.28E-05	6.56E-06
7	3.0E-05	2E-08	1.6E-04	1E-07	7.24E-05	6.52E-06
8	3.1E-05	2E-08	1.6E-04	1E-07	7.33E-05	6.60E-06
8A	3.1E-05	2E-08	1.6E-04	1E-07	7.33E-05	6.60E-06
9	3.2E-05	2E-08	1.7E-04	1E-07	7.72E-05	6.96E-06
10	1.7E-05	1E-08	8.6E-05	5E-08	3.95E-05	3.56E-06
11	1.5E-05	9E-09	8.0E-05	5E-08	3.68E-05	3.31E-06
11A	1.6E-05	1E-08	8.3E-05	5E-08	3.80E-05	3.42E-06
12	1.6E-05	1E-08	8.3E-05	5E-08	3.81E-05	3.43E-06
13	1.8E-05	1E-08	9.3E-05	6E-08	4.24E-05	3.82E-06
13A	1.8E-05	1E-08	9.4E-05	6E-08	4.31E-05	3.88E-06
14	1.8E-05	1E-08	9.4E-05	6E-08	4.28E-05	3.86E-06
15	1.9E-05	1E-08	9.7E-05	6E-08	4.45E-05	4.01E-06
15A	1.9E-05	1E-08	9.9E-05	6E-08	4.53E-05	4.08E-06
16	1.6E-05	1E-08	8.5E-05	5E-08	3.89E-05	3.51E-06
16A	1.6E-05	1E-08	8.5E-05	5E-08	3.87E-05	3.49E-06
17	2.7E-05	2E-08	1.4E-04	8E-08	6.38E-05	5.75E-06
18	3.2E-05	2E-08	1.7E-04	1E-07	7.56E-05	6.81E-06
19	3.3E-05	2E-08	1.7E-04	1E-07	7.84E-05	7.06E-06
19A	3.2E-05	2E-08	1.7E-04	1E-07	7.74E-05	6.97E-06
20	3.2E-05	2E-08	1.7E-04	1E-07	7.74E-05	6.97E-06
21	3.1E-05	2E-08	1.6E-04	1E-07	7.37E-05	6.64E-06
22	3.1E-05	2E-08	1.6E-04	1E-07	7.47E-05	6.73E-06
22A	3.2E-05	2E-08	1.6E-04	1E-07	7.53E-05	6.79E-06
23	3.0E-05	2E-08	1.6E-04	1E-07	7.25E-05	6.53E-06
24	3.2E-05	2E-08	1.7E-04	1E-07	7.60E-05	6.84E-06
25	3.2E-05	2E-08	1.7E-04	1E-07	7.55E-05	6.80E-06
26	4.1E-05	2E-08	2.1E-04	1E-07	9.82E-05	8.85E-06
27	3.8E-05	2E-08	2.0E-04	1E-07	9.13E-05	8.22E-06

[a] See Appendix D, Section D.10.4, for assumptions.

TABLE 4.3-19 Hypothetical Single-Shipment Radiological Impacts on Individual Receptors

Receptor	Dose (mrem)	LCF Risk
Person at roadside	1.8×10^{-5}	1×10^{-11}
Person in traffic jam	0.089	5×10^{-8}
Resident near route	1.4×10^{-6}	8×10^{-13}

4.3.10.4 Accidental Release of Uranium during Transportation

It is expected that the uranium mine operators and their transportation carriers would maintain an emergency response plan for haul truck accidents. Accidental spills of uranium ore would be cleaned up in the shortest possible time by qualified personnel. Uranium ore being transported is treated by U.S. Department of Transportation regulations as a low-specific-activity material. However, because of the low-grade nature of the uranium ore considered in the ULP PEIS (0.2% as U_3O_8), an ore spill of the entire shipment (25 tons) would not constitute a reportable quantity for uranium as defined in 49 CFR 172.101.

Impacts on the public and the environment from an accident involving a haul truck carrying uranium ore are expected to be minimal and short-term, as related to the reduced use of the affected highway segment during cleanup. If a transportation accident occurred and some or all of the uranium ore spilled on the ground, the ore would be completely recovered, loaded onto a truck, and transported to the mill. Because it is low-grade uranium ore and because the ore is of a stony, aggregate composition that would limit any widespread dispersion, there would be no significant impacts on human health or natural resources. The short-term dose to an individual involved in an accidental spill or the cleanup would be minimal (i.e., a small fraction of that received by a uranium miner, as discussed in Section 4.3.5.1). A miner is estimated to receive an *annual* dose of 430 mrem, primarily from radon inhalation because of the confined nature of the mine. Such confinement would be absent from an accident spill location, and a worker involved in cleanup might therefore be expected to receive a dose on the order of 1 mrem or less. Only local disturbance of soil and vegetation might occur as a consequence of spill cleanup.

If a haul truck accident involved spilling ore into a surface water body, adverse radiological impacts on biota would not be expected. First, the nature of the ore—relatively large, insoluble chunks of material—would make it more amenable to cleanup from the water body. Second, the low concentrations of hazardous constituents in the ore and their relatively low levels of solubility in water would minimize the likelihood of them approaching toxic concentration levels. Third, prompt cleanup of the spill would reduce the time it would take for contaminants to leach into the water. Any finer ore particles would be dispersed by water flow in streams or rivers. In the case of fine particles, more extensive cleanup might be necessary if a sensitive, shallow water body like a pond was involved. The primary impact on water quality from a spill would be a short-term increase in turbidity and total suspended solids (TSP).

4.3.11 Cultural Resources

Under Alternative 3, the full range of uranium mining activities (exploration, development, operations, and reclamation) could occur on 12 lease tracts. As shown in Table 2.4-2, only 10% of the area within the lease tracts has been surveyed for cultural resources; however, it is likely that cultural resources exist in the unsurveyed areas. In each of these phases, cultural resources could be disturbed as a result of activities in which the ground surface was disturbed, historic structures were damaged or destroyed, or pedestrian and vehicle traffic increased on the lease tracts and their access roads. These activities could also have adverse effects on traditional cultural properties, such as plant and animal species traditionally collected by Native Americans for food, medicine, and ritual purposes, and on sacred or culturally significant places and landforms.

DOE ULP procedures require lessees to prepare and submit exploration and mining plans before initiating any surface-disturbing activities or building surface facilities on the lease tracts. These plans must undergo a technical review and a review for compliance with lease provisions. As part of the technical and compliance review process, ULP staff members conduct a field review to identify areas where cultural resources and any additional investigations are required. Per the procedure that has historically been carried out, DOE has addressed consultation through the BLM and the lessees on specific undertakings. If historic properties are identified, BLM, as the surface-managing agency for the lease tracts, would take the lead in notifying the SHPO, Federally recognized tribes, and other concerned parties as required by Section 106 of the NHPA (DOE 2011a). A qualified archaeologist or other cultural resource specialist would evaluate the properties for their eligibility for listing on the NRHP. Upon the recommendation of the cultural resource specialist, a final eligibility determination would be made by BLM in consultation with DOE, the SHPO, tribes, and other concerned parties. If historic properties were discovered to be within the area of potential effects or areas that potentially could be affected by the undertaking proposed in the exploration and mining plans, BLM and DOE would assess the potential for adverse effects. A finding of potential adverse effects would require additional consultation for methods to resolve the effects (DOE 2011a). Per Section 6.3, the final Programmatic Agreement will formalize the process that DOE will use to coordinate these efforts in the future. Potential adverse effects are often resolved by avoiding and/or protecting the threatened cultural resource. It is not always possible to avoid adverse effects. In these cases, data recovery through controlled excavation of an archaeological site, or appropriate recording of historic structures, mitigates but does not eliminate the adverse effects by providing a record of the property. In some cases, it might not be possible to mitigate all adverse effects. For example, Native Americans are likely to oppose the excavation of prehistoric sites, especially if humans are likely to be buried there. Mitigation measures and BMPs to minimize impacts on cultural resources are identified in Table 4.6-1 (Section 4.6).

Even if well-executed cultural resources surveys precede mining activities, since buried cultural remains do not always leave surface indicators, it is possible that unanticipated cultural resources might be encountered during exploration and operations. DOE-LM procedures require that if an in-process project encounters and will affect a previously unidentified cultural resource or will affect a known historic property in an unanticipated manner, that activity must immediately cease in the area of the discovery. The resource must be protected, and DOE must be notified of the discovery. Surface-disturbing activity in the area of the discovery can continue only after DOE has made a decision regarding the disposition of the resource (DOE 2011a).

4.3.11.1 Exploration

The exploration phase is generally limited in time and scope and usually involves minimal surface disturbance. Potential surface disturbance could result from drilling test holes and small pits used to catch cuttings and grading any necessary access roads. Any new roads that would increase access to remote areas would provide easier access to unauthorized artifact collectors. ULP procedures require lessees to prepare and submit exploration plans for review before any surface disturbance takes place. Plans undergo technical review for compliance with lease provisions. As part of the technical and compliance review process, ULP staff members conduct a field review to identify areas where cultural resources inventories and any additional investigations are required. For all proposed new surface disturbances, the lessee is required to perform a cultural resources inventory. The inventory must be conducted to meet the BLM's Class III inventory standards and be provided to both the DOE and the BLM, which is responsible for surface management of the lease tracts (DOE 2011a). Already approved exploration plans for Lease Tracts 13A, 21, and 25 include drilling from one to two test holes.

Because of the very small scale of ground-disturbing activities during the exploration phase and the procedures in place that require pre-exploration cultural resource surveys of the areas to be impacted and mitigation plans for any unavoidable adverse effects, direct impacts on cultural resources in the exploration phase would be limited. Drilling locations are normally about 15 × 50 ft (4.6 × 15 m); a typical cutting pit would be 10 × 10 × 3 ft (3 ×3 × 1 m); and roads are generally less than 20 ft (6 m) in width. Typically, exploration teams use existing access roads when available and drive over land to off-road sites when possible to limit the amount of road cutting necessary. If cultural resources are encountered in the surveys mandated before drilling can occur, the drill site can usually be relocated to avoid the resource. Lessees must consider and plan for reclamation in their exploration and mining plans, and this process encourages them to minimize surface disturbance.

4.3.11.2 Mine Development and Operations

Potential adverse effects on cultural resources from mine development and operations would be similar to those possible during the exploration phase, but on a larger scale. With the exception of a large open-pit mine on Lease Tract 7, which already exists, all of the mining proposed for the lease tracts is expected to be underground. Surface disturbance would include (1) entry portals, inclines, shafts, and adits; (2) associated surface structures, including water and fuel tanks, headframes, hoists, and winches; (3) ventilation equipment and dewatering ponds where necessary; (4) equipment marshaling yards; (5) parking areas; and (6) large cleared areas for storing waste rock and surface soil as well as ore. The area taken up by facilities associated with mine development and operations would vary with the size of the mine. On the ULP lease tracts, it is assumed that a small mine would take up to 10 acres (4.0 ha) and a medium-sized one would take up to 15 acres (6.1 ha). A mine with surface facilities that occupied up to 20 acres (8.1 ha) would be considered large. The open-pit mine in Lease Tract 7 takes up 210 already-disturbed acres (85 ha). The operation of most mines requires large equipment but relatively small crews of five to eight people. Mine operations are assumed for a period of 10 years. Of the lease tracts that would continue under Alternative 3 (5, 6, 7, 8, 9, 11, 13, 13A, 18, 21, and 25), eight have existing permitted mines. There are 11 existing permitted mines in these eight tracts. New surface disturbance would be limited to new mine-related facilities and stockpiling areas. At three lease tracts (13A, 21, and 25), exploratory drilling has been completed and land has been reclaimed. The specific locations of new mines to be developed and operated will not be known until plans are submitted by the lessees to DOE for approval. However, there is likely to be more surface disturbance on these lease tracts as mines are developed and operated. BLM and DOE require that the areas to be developed be surveyed for cultural resources before the ground surface is disturbed. Table 4.3-20 shows the projected number of cultural resources that could be directly affected under the mine development scenario for Alternative 3.

4.3.11.2.1 Roads. As discussed in Section 3.11.1, the Uravan Mineral Belt has been actively mined for more than 100 years. Mining activity has resulted in the construction of a network of mostly dirt roads providing access to the mines, haul routes, maintenance roads, and roads supporting associated structures. The 11 lease tracts with existing permitted mines are already served by access roads. Road construction at these sites would primarily be confined to upgrading existing roads. If new roads either within the lease tracts or providing access to the lease tracts were constructed, cultural resource surveys would first have to be conducted by following BLM regulations and guidelines. Four lease tracts (13A, 15, 21, and 25) have been subjected to exploratory drilling and past mining. There are access roads serving each of these four lease tracts, along with a network of exploration roads. It is likely that these lease tracts could be developed by using mostly existing roads. These might have to be upgraded, and new roads might have to be graded. New roads or road improvements in areas that have not been surveyed would require cultural resource surveys before ground-disturbing activities could begin.

TABLE 4.3-20 Cultural Resource Sites That Could Be Directly Affected under Alternative 3

Mine Size Category under Alternative 3	No. of Mines in Each Category	Expected No. of Sites per Category	Total No. of Sites Affected
Small	2	0.8	2
Medium	4	1.2	5
Large	1	1.7	2
Total			8

Most roads serving the lease tracts are gravel, county roads; most secondary roads serving the lease tracts are dirt. Increased traffic during the mine development and operational phases could lead to secondary impacts on cultural resources. Depending on the weather and the proximity of significant cultural resources, they could be affected by traffic vibration and/or fugitive dust. Fugitive dust can have deleterious effects on rock art panels. Vibration can affect built structures. Traffic noise could have a negative effect on areas used for prayer or areas sacred to traditional cultures where solitude is an essential component. Road improvements might render lease tracts more accessible to hunters and other recreational users. An increased human presence renders cultural resources subject to potential trampling; erosion; vandalism; and illegal, unpermitted collecting.

4.3.11.2.2 Support Facility Construction and Operations. As discussed above, mines already exist in 11 of the lease tracts that would continue under Alternative 3, whereas only exploration and past mining has occurred in the remaining three lease tracts. While it is possible that new facilities would need to be constructed on the lease tracts with existing mines, it is likely that more construction and ground-disturbing activities would occur where development has only reached the exploration stage. On the other hand, existing mines would be more likely to include historic structures or features than would new mining sites. However, since many mines operate for only a few years, it is also possible that existing mines might not include any historic structures. The construction and operations of support facilities could adversely affect buried archaeological sites and historically important features of existing mines and could be visually and acoustically intrusive to traditional cultural properties. As discussed in Section 3.4.11, the pre-construction and excavation reviews required and the cultural resource surveys required prior to construction or ground-disturbing activities should identify significant cultural properties that would be adversely affected by the proposed actions. Plans would then be modified to avoid or mitigate impacts on cultural resources.

Mine construction and operations would also introduce vehicles, equipment, and workers to the mining areas. Impacts from these sources would be similar to those discussed in the section on roads but would be of longer duration. They would include the introduction of vibration, noise, and fugitive dust. These would be confined to areas directly adjacent to mine openings themselves. The introduction of a long-term workforce would increase the possibility of disturbance of cultural resources by human agency.

4.3.11.3 Reclamation

Impacts from the reclamation phase would be the same as those discussed in Section 4.1.11.

4.3.12 Visual Resources

Under Alternative 3, exploration, mine development and operations, and reclamation would occur on the 12 lease tracts.

4.3.12.1 Exploration

Potential visual impacts that could result from this phase include contrasts in form, line, color, and texture resulting from the following activities: (1) vegetation clearing; (2) exploratory drilling; (3) road construction (if needed); and (4) the presence of workers, personal and commercial vehicles, and construction equipment, along with their associated occasional, short-duration road traffic, parking, and dust.

A minimal amount of vegetation clearance might be needed to establish a drilling location, and some roads might need to be constructed or upgraded, resulting in the clearance of some vegetation. The clearing of the vegetation might expose bare soil, creating a change in the color of the ground surface. This impact would be limited, since a typical drilling location is approximately 15 × 50 ft (4.6 × 15 m), and exploratory roadways are generally less than 20 ft (6.1 m) in width. Topsoil from the clearing for both of these features typically would be stockpiled on site for future reclamation, and vegetation clearance would be minimized to the extent possible (DOE 1995).

Exploratory drill rigs are typically 35 ft (11 m) in height. These rigs are used to drill exploratory holes. In some scenarios, small drill rigs that are track- or truck-mounted might be used (DOE 1995). These drill rigs might be visible from within the lease tracts as well as from surrounding lands (Section 4.3.12.4).

If road upgrading or new road construction was necessary, visual contrasts might be introduced due to changes in form, line, color, and texture. The occurrence of visual impacts would depend on the routes selected relative to surface contours and the widths, lengths, and surface treatments of the existing road network. In addition, if improper road maintenance occurred, it could lead to the growth of invasive species or erosion, both of which could introduce visible contrasts in line, color, and texture, primarily with regard to foreground and near-middle-ground views.

Workers, vehicles, and other equipment could be visible in surrounding areas. Depending on site and weather conditions, worker activities (especially those involving vehicles) could result in visible dust. If proper site sanitation practices were not followed, litter could be visible.

Visual impacts associated with exploration are generally minor and of short duration due to the quick time frame in which these activities are conducted. Impacts due to road construction, erosion, or other landform alterations or vegetation clearing in arid environments, however, might be visible for extended periods.

4.3.12.2 Mine Development and Operations

Under Alternative 3, mine development and operations could require up to 10 acres (4 ha) of land for small mines, up to 15 acres (6 ha) for medium-sized mines, and up to 20 acres (8 ha) for large mines. Under this alternative, the largest mine site would be located on Lease Tract 7, at which 210 acres (85 ha) are already disturbed from previous activity. An additional

100 acres (40 ha) of disturbance could occur at this location. Potential visual impacts that could result from mine development and operations would include contrasts in form, line, color, and texture resulting from the following activities: (1) vegetation and ground clearing; (2) road building and upgrading; (3) support facility construction; (4) vehicle, equipment, and worker presence and activity, along with their associated vegetation and ground disturbance, dust, and emissions; and (5) lighting.

Visual impacts resulting from activities associated with mine development and operations would vary in frequency and duration, since this phase can last for 10 years or more.

4.3.12.2.1 Vegetation/Ground Clearing. Mine development for underground and open-pit mines would require clearing of vegetation, large rocks, and other objects that have the potential to interfere with mining activities. The nature and extent of clearing would be affected by the requirements of the project, the types of vegetation, and the characteristics of other objects to be cleared. Vegetation clearing and topographic grading might be required for the construction of access roads, maintenance roads, and roads to support associated structures. The removal of vegetation would result in contrasts in color and texture, because the varied colors and textures of vegetation would be replaced by the more uniform color and texture of bare soil. This activity also could introduce contrasts in form and line, depending on the type of vegetation cleared and nature of the cleared surface. The cleared areas likely would be maintained during operation. At this time, vegetation and ground clearance would be anticipated to result in minimal changes as compared to those activities required for the initial site development.

4.3.12.2.2 Road Building/Upgrading. While not anticipated, some minor construction of new temporary and permanent access roads and/or upgrading of existing roads to support mining activities might be required during mine development. These activities also might occur on off-lease lands (DOE 1995).

Road development might introduce strong visual contrasts to the landscape, depending on the routes selected relative to surface contours and on the widths, lengths, and surface treatments of the roads. Upgrades to roadways generally would consist of widening access roads, if necessary, to accommodate construction equipment. This might consist of additional vegetation or ground clearance, depending on the location and intended use of the roadway.

During mine operations, the roadways would need to be maintained in order to accommodate the transportation of the mined material. These activities might consist of minimal grading or removal of overgrowth. The roads would need to be maintained for the life of the facilities, if required for either the open-pit or underground mining methods.

4.3.12.2.3 Support Facility Construction and Operations. In addition to the use of roadways, mine development would include the construction and placement of surface plant area improvements (i.e., support facility construction).

At some of the mining locations, the structures would not be permanent, and in some cases, they would be positioned on previously disturbed land (Energy Fuels Resources Corp. and Greg Lewicki and Associates 2008). The presence of these structures could potentially create visual impacts as a result of contrasts in form, line, color, and texture, especially if no infrastructure was in place prior to the start of activities. The impacts from placing temporary structures during mine development would be limited due to the short duration of mine development when compared to the time associated with more permanent structures needed for the operational life of the mine.

4.3.12.2.4 Vehicles, Equipment, and Workers. The development of mine sites would require work crews, vehicles, and equipment that could potentially cause visual contrasts in form, line, color, and texture. For instance, traffic associated with workers and large equipment (e.g., trucks, graders, excavators, and cranes) would be expected for constructing roads and buildings. The traffic would produce visible activity and could cause visible dust plumes in dry soils. In addition, temporary parking for vehicles would be needed at or near work locations during construction.

Ground disturbance would produce contrasts of color, form, texture, and line. Any excavating that might be required for building foundations, grading and surfacing roads, clearing and leveling mining areas, and stockpiling soil and ore would damage or remove vegetation, expose bare soil, and suspend dust. Soil scars, exposed slope faces, eroded areas, and areas of compacted soil could result from excavation, leveling, and equipment and vehicle movement. Invasive species might colonize disturbed areas, stockpiles, and compacted areas. These species might be introduced naturally; or in seeds, plants, or soils introduced for intermediate restoration; or by vehicles. In some situations, the presence of invasive species might introduce contrasts with naturally occurring vegetation, primarily in color and texture.

If proper site sanitation practices were not followed, litter and debris could be visible within and around work sites. Site monitoring and restoration activities could reduce many of these impacts. Other activities during this phase could include bracing and cutting existing fences and constructing new fences to limit or prevent access; providing temporary walks, passageways, fences, or other structures to prevent interference with traffic; and providing lighting in areas where work might be conducted at night.

Once surface structures were operating, the nature and extent of visual impacts associated with them would depend in part on the type of mine (i.e., open-pit or underground), the size of the structures, the nature of required clearing and grading, and the types and amounts of materials to be stored for mining activities.

For instance, open-pit mining generally requires larger surface areas for storage of overburden and waste rock than do underground methods (IAEA 2000). Stockpiles could be visible for the duration of operations. Open-pit mining generally utilizes backhoes, front-end loaders, scrapers, bulldozers, and trucks to move mine-rock waste around the site. In addition, for underground mining, vertical and inclined shafts are equipped with hoists and headframes that protrude above the ground surface. Large surface fans also might be used to assist with underground ventilation (National Research Council 2012). If no natural sources of water were available, water may be brought on site by water trucks. These trucks might be visible (DOE 1995). Stockpiles also could be visible for the duration of operations at these types of mines. Underground mines utilize rubber-tired, trackless mobile equipment to transport waste rock (DOE 1995).

The operation of open-pit and underground mines also might create dust, which could be composed of fine particles generated from the mechanical disturbance of rock and soil, bulldozing, blasting, and vehicles traveling on dirt roads. Particles might also be mobilized by wind blowing over ore stockpiles (National Research Council 2012). The suspension and visibility of dust would be influenced by vehicle speeds, road surface materials, and weather conditions (DOE 1995).

4.3.12.2.5 Lighting. It is not anticipated that mine construction would occur at night. However, some outdoor lighting might be necessary for security and safety around the lease tracts. Lighting might be needed around temporary facilities (e.g., construction trailers), parking, and work areas.

During mine operations, exterior lighting might be needed around structures, parking locations, and work areas. Exterior lighting could contribute to light pollution. This type of pollution is caused by outdoor lights that are positioned to face upward or sideways. Any light that escapes upward, unless blocked by an object, will scatter throughout the atmosphere and brighten the night sky. Air pollution particles also might increase the scattering of light at night, just as they affect visibility during the daytime (BLM and DOE 2010b). Light pollution impacts associated with the reclamation of mining sites might include skyglow, light trespass, and glare. Security and other lighting around and on support structures could also contribute to light pollution.

“Skyglow” is a brightening of the night sky caused by both natural and human-related factors. It decreases a person’s ability to see dark night skies and stars, which is an important recreational activity in many parts of the United States, including at BLM and non-BLM lands within the areas that include and surround the lease tracts. These types of effects can be visible for long distances. Outdoor artificial lighting can contribute to this effect by directing light directly upward into the night sky and also through the reflection of light from the ground and other illuminated surfaces.

“Light trespass” is the casting of light into areas where it is unneeded or unwanted. Poorly placed and aimed lighting can cause light to spill into areas outside the location needing illumination. Although few residences are located within the vicinity of the lease tracts, the light spillage might be noticeable to the traveling public, albeit for a brief duration (a few seconds or minutes depending on circumstances), due to the size of the lease tracts.

“Glare” is the visual sensation caused by excessive and uncontrolled brightness, and, in the context of outdoor lighting, it is generally associated with direct views of a strong light source. Poorly placed and aimed lighting can cause glare, as can the use of excessively bright lighting. In general, any degree of lighting would produce some off-site light pollution, which might be particularly noticeable in dark nighttime sky conditions typical of the settings within the lease tracts. Glare also can be produced from unintentional sources, such as vehicle windshields or metal pieces on structures (BLM and DOE 2010b).

4.3.12.3 Reclamation

See Section 4.1.12 for a discussion of the visual impacts associated with reclamation activities.

4.3.12.4 Impacts on Surrounding Lands

The following analysis provides an overview of the potential visual impacts on those SVRAs surrounding the mining locations under Alternative 3. Because of the number of leases and the potential for increased mining activity, lands outside the lease tracts that have views of the lease tracts would be subject to visual impacts. The affected areas and extent of impacts would depend on a number of visibility factors, viewer duration, and viewer distance.

Preliminary viewshed analyses were conducted to identify which lands surrounding the four lease groups identified in Section 3.12 might have views of some portions of the various lease tracts. An additional viewshed analysis was conducted for a subset of these groups that would include all of the lease tracts in which reclamation activities would be conducted under Alternative 3 (see Section 4.3.12.1).

The impact analysis is based on a reverse viewshed analysis for which the methodology is provided in Appendix D. This analysis considers Federal, state, and BLM-designated sensitive visual resources. The intent of the analysis is to determine the potential levels of contrasts (i.e., changes in form, line, color, and texture from the existing condition to that under Alternative 3) that would occur as a result of activities on the lease tracts.

Under Alternative 3, 12 lease tracts would be in operation: Lease Tracts 5; 6; 7; 8; 9; 11; 13; 13A; 15; 18; 21; and 25. The following analysis provides an overview of the potential visual contrasts expected for those SVRAs surrounding the mining locations. Under this alternative, the lease tracts were analyzed in only three of the four groups: the North Central Group; the South Central Group; and the South Group.

Potential mitigation measures and BMPs to minimize lighting to off-site areas and to minimize contrast with surrounding areas are summarized in Table 4.6-1 (Section 4.6).

4.3.12.4.1 North Central Group. Figure 4.3-1 shows the results of the viewshed analysis for lease tracts within the North Central Group, including Lease Tracts 18, 21, and 25. The following SVRAs might have views of the lease tracts:[6]

- Tabeguache Area;
- Sewemup WSA;
- Unaweep/Tabeguache Scenic and Historic Byway;
- Dolores River Canyon WSA;
- Dolores River SRMA;
- San Miguel ACEC; and
- San Miguel River SRMA.

Figure 4.3-1 shows the results of the viewshed analysis for the lease tracts within the North Central Group. The colored segments indicate areas in the SVRAs with clear lines of sight to one or more areas within the lease tracts and from which activities conducted within the lease groups would be expected to be visible, assuming the absence of screening vegetation or structures and assuming there would be adequate lighting and other atmospheric conditions would be suitable.

The lease tracts within the North Central Group would potentially be visible from portions of the Tabeguache Area between 5 and 15 mi (8 and 24 km) from the lease tracts. Views of the North Central Group from the area are partially or fully screened by the intervening mountains and vegetation. The lease tracts would potentially be visible from approximately 49% (4,000 acres or 1,600 ha) of the area. Views of the lease tracts would be possible from elevated viewpoints within the area. Depending on the infrastructure placed within the North Central Group, views of the mine activities and sites might be limited and include the tops of headframes, drill rigs, or other structures, if located on the individual lease tracts. Mine development and operations under Alternative 3 would be expected to cause minimal to weak visual contrast for views from the Tabeguache Area.

From distances between 5 and 15 mi (8 and 24 km) from the lease tracts, views from approximately 32% (6,300 acres or 2,600 ha) of the Sewemup WSA would potentially include the North Central Group. Similar to views from the Tabeguache Area, views of the North Central Group from the WSA are generally partially or fully screened by the intervening mountains. Visibility of the North Central Group is likely from the locations within the WSA that are higher in elevation than the lease tracts. Depending on the infrastructure placed within the lease tracts, views of the mine activities and sites might be limited and include the tops of headframes, drill

[6] For the three groups of lease tracts, the SVRAs are presented in descending order, based on the percentage of the total acreage or mileage that would have a potential view of the lease tracts.

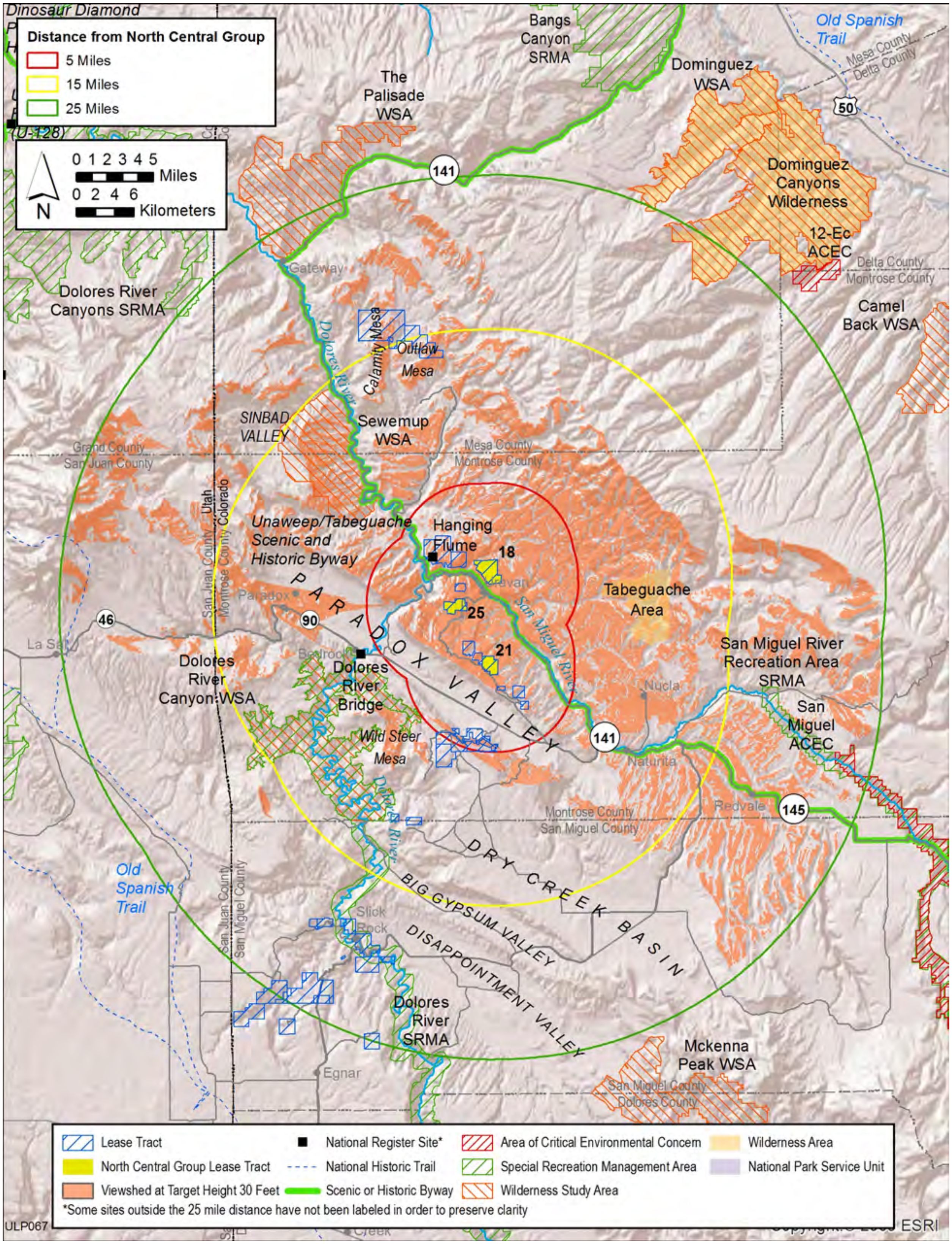


FIGURE 4.3-1 Viewshed Analysis for the North Central Lease Group under Alternative 3

rigs, or other structures. Activities associated with this alternative would be expected to create minimal to weak levels of contrast for views from the WSA.

The Unaweep/Tabeguache Scenic and Historic Byway passes between Lease Tracts 18 and 25. The viewshed analysis indicates that lease tracts within the North Central Group would potentially be visible from approximately 43 mi (69 km) of the byway; however, because of minor mapping inaccuracies that place portions of the roadway outside the narrow canyon it occupies and thereby locate them at higher elevations than they actually are, and because of vegetative screening, the actual number of miles of the byway that has views of the lease tracts is probably much smaller. Actual visibility would be determined as part of a site- and project-specific environmental assessment.

Depending on the infrastructure placed within the lease tracts, the mine activities and sites could be visible to visitors driving along the byway, primarily in the area within Montrose County. Where views were unobstructed, views that were level or looking down onto the lease tracts would likely involve stronger visual contrasts than those that were lower in elevation. Views would include headframes, drill rigs, or other structures, if needed for the mining activities. As such, mine development and operations would be expected to cause minimal to strong visual contrast for views from the byway; however, views from the byway would be of relatively short duration, largely due to the small size of the individual lease tracts within the North Central Group.

The North Central Group lease tracts would be potentially visible from less than 1% (113 acres or 46 ha) of the San Miguel River SRMA, at distances of 18–24 mi (30–39 km) from the SRMA. There could potentially be views of the lease tracts from elevated viewpoints within the SRMA outside the river canyon. Activities conducted within the North Central Group lease tracts would be expected to cause minimal contrasts to no contrasts at all as seen from the SRMA, primarily due to the relatively long distance between the SRMA and the lease tracts and to the very limited amount of acreage within the SRMA that would potentially have views of the lease tracts.

The North Central Group lease tracts would be potentially visible from less than 1% of the Dolores River Canyon WSA (4 acres or 1.6 ha), the Dolores River SRMA (4 acres or 1.6 ha), and the San Miguel ACEC (5 acres or 2.0 ha). Mining-related activities conducted under this alternative would be expected to create minimal levels of contrast to no contrasts at all for views from these SVRAs.

4.3.12.4.2 South Central Group. Figure 4.3-2 shows the results of the viewshed analysis for portions of the South Central Group, including Lease Tracts 5, 6, 7, 8, and 9. The following SVRAs might have views of the South Central Group:

- Tabeguache Area;

- Unaweep/Tabeguache Scenic and Historic Byway;

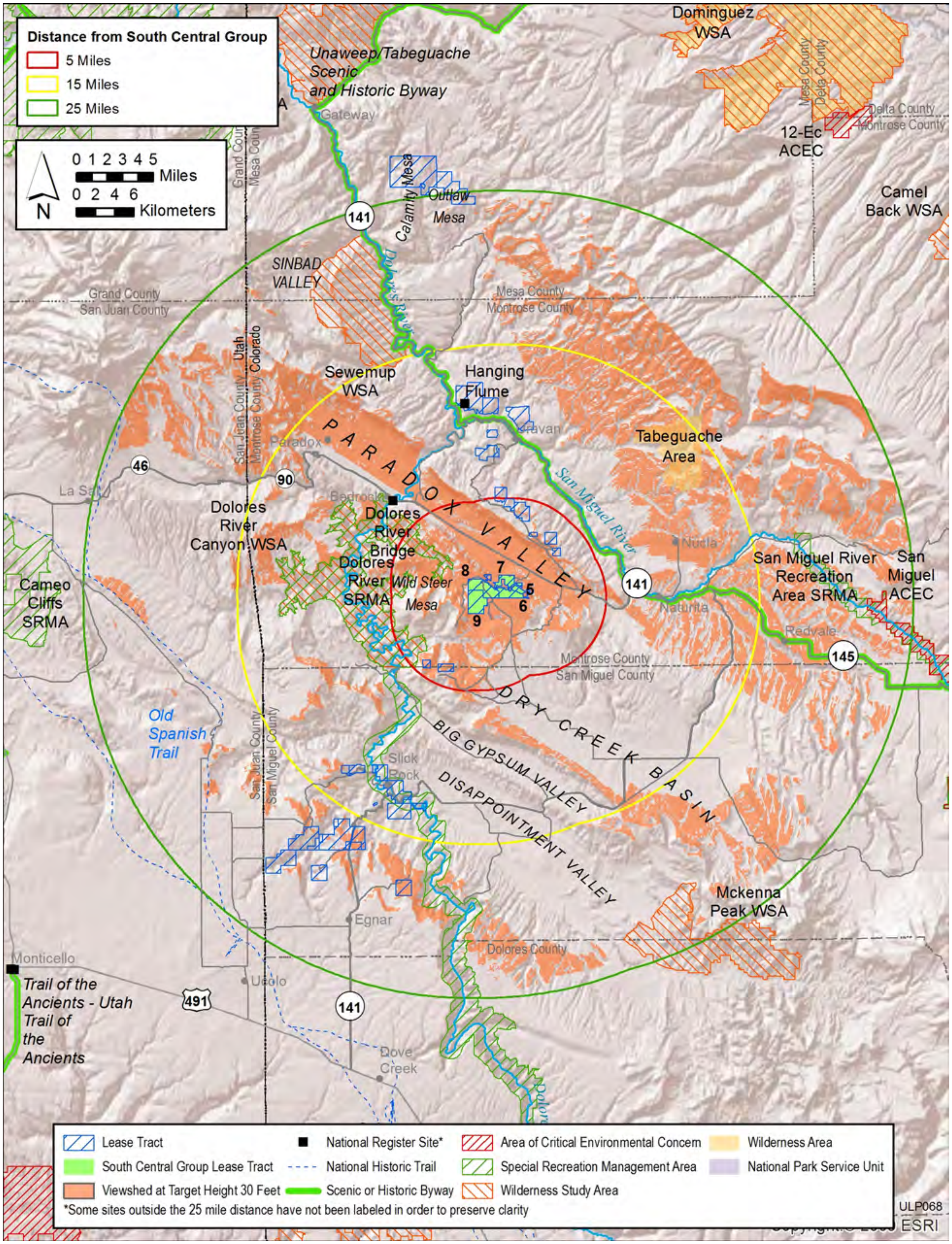


FIGURE 4.3-2 Viewshed Analysis for the South Central Lease Group under Alternative 3

- Dolores River Canyon WSA;

- Sewemup WSA;

- Dolores River SRMA;

- McKenna Peak WSA;

.

- San Miguel ACEC; and

- San Miguel River SRMA.

The South Central Group lease tracts would potentially be visible from approximately 47% (3,800 acres or 1,600 ha) of the Tabeguache Area. Most of this area is located between 5 and 15 mi (8 and 24 km) from this group of lease tracts within Montrose County. Views of the South Central Group are partially or fully screened by the intervening topography and vegetation. Views of the mine activities and sites within the lease tracts contained within this group likely would be limited and would include the tops of headframes, drill rigs, or other structures, if located within the mine sites. Similar to those impacts experienced from views of the North Central Group, mine development and operations under Alternative 3 would be expected to cause minimal to weak visual contrast for views from the Tabeguache Area.

The viewshed analysis indicates that the South Central Group lease tracts could potentially be visible from approximately 19 mi (30 km) of the Unaweep/Tabeguache Scenic and Historic Byway located east–southeast of the lease tracts, and within the background and "seldom seen" distances (i.e., beyond 5 mi or 8 km); however, because of minor mapping inaccuracies that place portions of the roadway outside the narrow canyon it occupies and thereby locate them at higher elevations than they actually are, and because of vegetative screening, the actual mileage of the byway with views of the lease tracts is probably much smaller. Actual visibility would be determined as part of a site- and project-specific environmental assessment. Depending on the infrastructure used at each mine site, views of headframes, drill rigs, or other structures might occur. Activities under Alternative 3 would be expected to cause minimal levels of contrast to no contrasts at all for views from the byway.

The lease tracts within the South Central Group could potentially be visible from approximately 1.7% (500 acres or 800 ha) of the Dolores River Canyon WSA, in areas between 0 and 5 mi (0 and 8 km) from the lease tracts. Between 0 and 25 mi (0 and 40 km), views from approximately 3.6% (1,000 acres or 420 ha) would potentially include the lease tracts. If present, headframes, drill rigs, or other structures might be visible from within the WSA. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Mine development and operations under Alternative 3 would be expected to cause minimal to weak visual contrast for views from the WSA.

The South Central Group lease tracts would be potentially visible from less than 1% (105 acres or 43 ha) of the San Miguel River SRMA, at distances of 18–22 mi (30–35 km) from the SRMA. There could potentially be views of the lease tracts from elevated viewpoints within the SRMA outside the river canyon. Activities conducted within the South Central Group lease tracts would be expected to cause minimal contrasts to no contrasts at all as seen from the SRMA, primarily due to the relatively long distance between the SRMA and the lease tracts and to the very limited amount of acreage within the SRMA that would potentially have views of the lease tracts.

The South Central Group would potentially be visible from approximately 2.1% (410 acres or 170 ha) of the Sewemup WSA, within 15 and 25 mi (24 and 40 km) of the lease tracts. Views of the South Central Group from the WSA are generally partially or fully screened by the intervening mountains. Visibility of this group of lease tracts is likely from the locations along the western edge of the Sewemup Mesa within the WSA that are higher in elevation than the lease tracts. Depending on the infrastructure present on each lease tract, views of the mine activities and sites likely would be limited and could include the tops of headframes, drill rigs, or other structures. Under this alternative, mine development and operations would be expected to create minimal levels of contrast to no contrasts at all for views from this WSA.

The South Central Group lease tracts would potentially be visible from approximately 2.0% (1,300 acres or 530 ha) of the Dolores River SRMA. Views of the mine activities and sites within the lease tracts contained within this group might be limited and likely would include the tops of headframes, drill rigs, or other structures, if located within the mine sites. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Similar to the Dolores River Canyon WSA, mine development and operations would be expected to cause minimal to weak levels of contrast for views from this area.

The South Central Group lease tracts would potentially be visible from approximately 1.1% (220 acres or 88 ha) of the McKenna Peak WSA; areas with potential views of the lease tracts are in the northern portion of the WSA that is in San Miguel County. The South Central Group lease tracts would potentially be visible from portions of the WSA that are located between 15 and 25 mi (24 and 40 km) from the lease tracts. Views of the mine activities and sites within the lease tracts contained within this group would likely be limited and could include the tops of headframes, drill rigs, or other structures, if present. Mine development and operations under Alternative 3 would be expected to cause minimal levels of contrast to no contrasts at all for views from this SVRA.

The South Central Group lease tracts would potentially be visible from less than 1% (3 acres or 1.2 ha) of the San Miguel ACEC. Views of the mine activities and sites within the lease tracts contained within this group would likely be limited. Mine development and operations under Alternative 3 would be expected to cause minimal levels of contrast to no contrasts at all for views from this SVRA.

4.3.12.4.3 South Group. Figure 4.3-3 shows the results of the viewshed analysis of Lease Tracts 11, 13, 13A, and 15 within the South Group. The following SVRAs might have views of the South Group lease tracts:

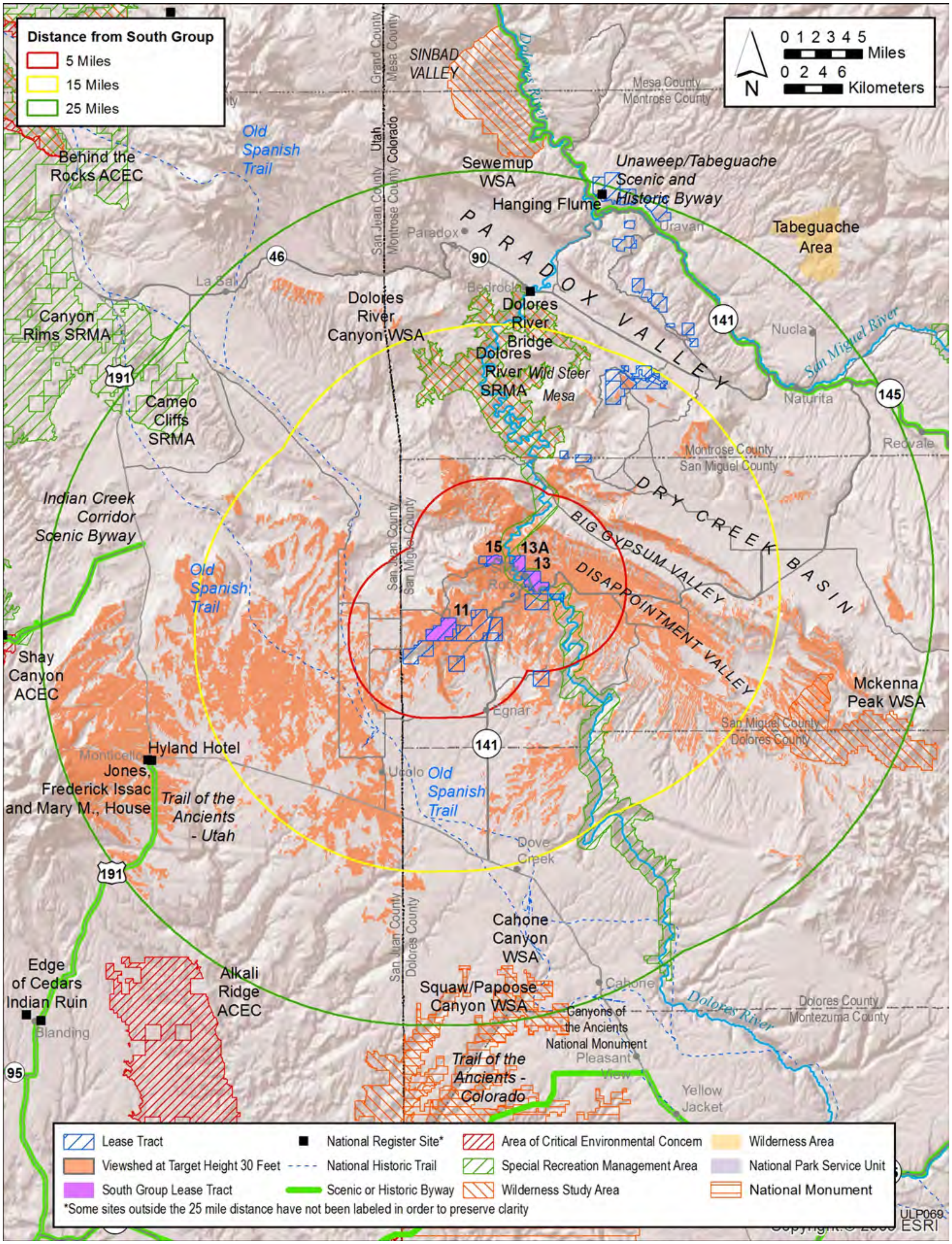


FIGURE 4.3-3 Viewshed Analysis for the South Lease Group under Alternative 3

- McKenna Peak WSA;
- Dolores River SRMA; and
- Trail of the Ancients Byway.

The South Group lease tracts would potentially be visible from approximately 17% (3,400 acres or 1,400 ha) of the McKenna Peak WSA. Areas within the WSA with visibility of the South Group are located between 15 and 25 mi (24 and 40 km) from this group of lease tracts within the western portion of the WSA. Views of the mine activities and sites within the lease tracts contained within this group might be limited and likely would include the tops of headframes, drill rigs, or other structures, if present. Mine development and operations would be expected to cause weak contrast to minimal contrast for views from this SVRA.

Within 5 mi (8 km) of the South Group, the lease tracts would potentially be visible from approximately 9.4% (6,100 acres or 2,500 ha) of the Dolores River Canyon SRMA; portions of the SRMA are within the actual lease tracts (specifically Lease Tracts 13, 13A, and 15). Between 0 and 25 mi (0 and 40 km), views from approximately 9.7% (6,300 acres or 2,600 ha) of the SRMA would potentially include the lease tracts. Depending on the infrastructure placed within the South Group, views of the mine activities and sites would include headframes, drill rigs, or other structures, as well as the actual mining activities. Mine development and operations under Alternative 3 would be expected to cause weak to strong levels of contrast for views from this SRMA. Stronger appearances of contrasts would occur for views from the SRMA, which are located within the South Group, and the contrasts would lessen as the distance from the lease tracts increased.

The South Group lease tracts would be visible from approximately 7.4 mi (12 km) of the Trail of the Ancients Scenic Byway. The byway is located within the “seldom seen” distance zone (i.e., between 15 and 25 mi or 24 and 40 km). The South Group lease tracts would primarily be visible from portions of the byway that are located to the west of the lease tracts in Utah.

Views of the lease tracts would be limited, and the would be of brief duration to byway drivers. The trail’s footprint primarily follows US 191. Mine development and operations would be expected to cause minimal levels of contrast to no contrasts at all for views from along the trail.

4.3.13 Waste Management

Potential impacts on waste management practices (described in Section 3.13) from waste generated during exploration, mine development and operations, and reclamation are expected to be minor. As discussed for Alternative 1, waste that was allowed to remain on the mine sites would be managed accordingly, and disposal capacity at the permitted landfills or licensed facilities would be adequate to accommodate the waste that would need to be transported off site for disposal. Because exploration and mine development and operations would be conducted in addition to reclamation under Alternative 3, the waste generated would be more than that generated under Alternatives 1 and 2. Appendix C presents estimates of waste that could be generated (in addition to the waste-rock piles) for the three phases of mining evaluated under Alternative 3.

4.4 ALTERNATIVE 4

> Alternative 4: This is the preferred alternative, under which DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period.

Under Alternative 4, it is assumed that a total of 19 mines (6 small, 10 medium, 2 large, and 1 very large) with a total disturbed surface area of 460 acres (190 ha) would be in operation in the peak year; however, all of the lease tracts could be developed under this Alternative 4. As they were for Alternative 3, the three phases (exploration, mine development and operations, and reclamation) are evaluated here for Alternative 4.

4.4.1 Air Quality

4.4.1.1 Exploration

Types of potential impacts and emission sources are discussed in Section 4.3.1.1. Under Alternative 4, two, four, and six borehole drillings up to the depth of 600 ft (180 m) would occur at 6 small, 10 medium, and 2 large mines, respectively, in any peak year. As shown in Table 4.4-1, estimated air emissions under Alternative 4 are about two to three times higher than those under Alternative 3 but still negligible compared to three-county total emissions for criteria pollutants and VOCs and Colorado or U.S. GHG emissions.

As a consequence, the types of impacts related to exploration under Alternative 4 are similar to those described for Alternative 3 (Section 4.3.1.1). Exploration activities would occur over relatively small areas, involve little ground disturbance, and require only a small crew and a small fleet of heavy equipment. Thus, potential impacts from this phase on ambient air quality and regional ozone or AQRVs are anticipated to be negligible and temporary. Potential impacts from these activities on climate change would be negligible.

4.4.1.2 Mine Development and Operations

The types of impacts related to mine development and operations under Alternative 4 are similar to those described for Alternative 3 (Section 4.3.1.2).

Air emissions of criteria pollutants, VOCs, and CO_2 from mine development and operations estimated for the peak year are presented in Table 4.4-1 and compared with emission totals for the three counties (Mesa, Montrose, and San Miguel) that encompass the DOE ULP

TABLE 4.4-1 Peak-Year Air Emissions from Mine Development, Operations, and Reclamation under Alternative 4[a]

	Annual Emissions (tons/yr)								
Pollutant[b]	Three-County Total[c]	Exploration		Mine Development		Mine Operations		Reclamation	
CO	65,769	8.0	(0.01%)[d]	165	(0.25%)	128	(0.20%)	11.1	(0.02%)
NO_x	13,806	19.6	(0.14%)	57.4	(0.42%)	275	(2.0%)	23.1	(0.17%)
VOCs	74,113	2.4	(0.003%)	1.7	(0.002%)	26.9	(0.04%)	2.3	(0.003%)
$PM_{2.5}$	5,524	1.9	(0.03%)	73.4	(1.3%)	23.5	(0.43%)	34.8	(0.63%)
PM_{10}	15,377	3.6	(0.02%)	459	(3.0%)	45.1	(0.29%)	171.9	(1.12%)
SO_2	4,246	2.2	(0.05%)	6.9	(0.16%)	35.4	(0.83%)	3.0	(0.07%)
CO_2	142.5×10^6 [e]	2,200	(0.002%)	1,600	(0.001%)	25,000	(0.018%)	2,200	(0.002%)
	$7,311.82 \times 10^6$ [f]		(0.00003%)		(0.00002%)		(0.00034%)		(0.00003%)

[a] Under Alternative 4, it is assumed that 19 mines (6 small, 10 medium, 2 large, and 1 very large) with a total disturbed surface area of 460 acres (190 ha) would be in operation or reclaimed in any peak year.

[b] Notation: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of ≤2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter of ≤10 µm; SO_2 = sulfur dioxide; and VOCs = volatile organic compounds.

[c] Total emissions in 2008 for all three counties encompassing the DOE ULP lease tracts (Mesa, Montrose, and San Miguel Counties), except for CO_2. See Table 3.1-2.

[d] Numbers in parentheses are percentages of three-county total emissions, except for CO_2, which are percentages of Colorado total emissions (top line) and U.S. total emissions (bottom line).

[e] Annual emissions in 2010 for Colorado on a CO_2-equivalent basis.

[f] Annual emissions in 2009 for the United States on a CO_2-equivalent basis.

Sources: CDPHE (2011a); EPA (2011a); Strait et al. (2007)

lease tracts combined. Detailed information on emission factors, assumptions, and emission inventories is available in Appendix C. As shown in the table, total peak-year emission rates are estimated to be rather small when compared with emission totals for all three counties. Typically, PM emissions are highest during mine development, while NO_X emissions are highest during operations. During mine development, non-PM emissions would be relatively small (up to 0.42%), but PM_{10} and $PM_{2.5}$ emissions of 459 and 73 tons/yr would amount to about 3.0% and 1.3%, respectively, of the three-county total emissions. PM_{10} emissions result would from explosive use (47%) and site preparation (43%), followed by wind erosion (9%), but exhaust emissions would contribute only a little to total PM_{10} emissions. Site preparation, explosives use, and wind erosion account for 57%, 33%, and 9%, respectively, of total $PM_{2.5}$ emissions. During operations, NO_X emissions of 275 tons/yr would be highest, amounting to about 2.0% of three-county total emissions. NO_X emissions would come mostly from diesel-fueled heavy equipment (e.g., bulldozers or power generators) and trucks. Mesa, Montrose, and San Miguel Counties encompass 2, 17, and 11 lease tracts, respectively, with one lease tract straddling Montrose and San Miguel Counties. It can be presumed that these emissions would spread over wide areas in three counties (over 50 mi [80 km]). Although site-specific knowledge of some mines and operations are known, future locations are not known at this time where these mines would be developed; thus, the spatial extents of emissions on the various lease tracts as well as which counties are involved are unknown. However, NO_X emission factors of about 44 and 85 tons/yr for the large and very large mine groups, respectively, are relatively high (in Appendix C). In particular, NO_X emissions from a very large open-pit mine (JD-7) would account for about 2.3% of total emissions in Montrose County. There is a potential for near-field exceedances of the 1-hour nitrogen dioxide (NO_2) NAAQS at the lease tract boundary. Thus, detailed air quality impact analysis would be warranted during the air permit application process. These impacts would be minimized by implementation of good industry practices and fugitive dust mitigation measures (such as watering unpaved roads, disturbed surfaces, and temporary stockpiles), as detailed in Table 4.6-1 (Section 4.6). Therefore, potential impacts on ambient air quality would be minor and temporary.

The three counties encompassing DOE ULP lease tracts are currently in attainment for ozone (EPA 2011b), but ozone levels in the area approached the standard (about 90%) (see Table 3.1-3). Recently, wintertime ozone exceedances were often reported at higher elevations in northwestern Colorado, northeastern Utah, and southwestern Wyoming. However, ozone precursor emissions from mine development and operations would be relatively small (less than 2.0% and 0.04% of three-county total NO_X and VOC emissions, respectively) and would be much lower than those for the regional airshed in which emitted precursors are transported and transformed into ozone. In addition, the wintertime high-ozone areas are located more than 100 mi (160 km) from the DOE ULP lease tracts and not located downwind of the prevailing westerlies in the region. Accordingly, the potential impacts of ozone precursor releases from mine development and operations on regional ozone should not be of concern.

As discussed in Section 3.1.4, there are several Class I areas around the DOE ULP lease tracts where AQRVs, such as visibility and acid deposition, might be a concern. Primary pollutants affecting AQRVs include NO_X, SO_2, and PM. NO_X and SO_2 emissions from mine development activities would be relatively small (up to 2.0%) of three-county total emissions, while PM_{10} emissions would be about 3.0% of three-county total emissions. Air emissions from mine development and operations could result in minor impacts on AQRVs at nearby Class I areas. Implementation of good industry practices and fugitive dust mitigation measures could minimize these impacts.

Annual total CO_2 emissions from mine development and operations are estimated as shown in Table 4.4-1. CO_2 emissions during operations would be much higher than those during mine development. During operations, annual total CO_2 emissions would be about 25,000 tons (23,000 metric tons), accounting for about 0.018% of Colorado GHG emissions in 2010 at 140 million tons (130 million metric tons) of CO_2e and 0.00034% of U.S. GHG emissions in 2009 at 7,300 million tons (6,600 million metric tons) of CO_2e (EPA 2011a; Strait et al. 2007). Thus, potential impacts from the mine development and operations phase on global climate change would be negligible.

4.4.1.3 Reclamation

The type of impacts would be similar to those described for Alternative 1 (Section 4.1.1). It is also assumed that reclamation activities under Alternative 4 would occur over about 460 acres (190 ha) in the peak year of reclamation.

Peak-year emissions during the reclamation phase under Alternative 4 are shown in Table 4.4-1. PM_{10} emissions would be highest, accounting for about 1.1% of three-county combined emissions. Among non-PM missions, NO_x emissions from diesel combustion of heavy equipment and trucks would be highest: up to 0.17% of three-county total emissions. Good industry practices and mitigation measures would be implemented to ensure compliance with environmental requirements. Thus, potential impacts on ambient air quality associated with reclamation activities under Alternative 4 are anticipated to be minor and temporary. These low-level emissions are not anticipated to cause any measureable impacts on regional ozone or AQRVs, such as visibility or acid deposition, at nearby Class I areas. In addition, CO_2 emissions during the reclamation phase are about 0.002% and 0.00003% of Colorado GHG emissions in 2010 and U.S. GHG emissions in 2009, respectively (EPA 2011a; Strait et al. 2007). Thus, under Alternative 4, potential impacts from reclamation activities on global climate change would be negligible.

4.4.2 Acoustic Environment

Potential noise-related impacts under Alternative 4 are discussed here.

4.4.2.1 Exploration

The types of impacts related to exploration under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.2.1). Exploration activities occur over relatively small areas, involve little ground disturbance, and require only a small crew and a small fleet of heavy equipment. Accordingly, it is anticipated that potential noise impacts from the exploration phase on neighboring residences or communities, if any, would be minor and intermittent.

4.4.2.2 Mine Development and Operations

The types of impacts related to mine development and operations under Alternative 4 are similar to those under Alternative 3 (Section 4.3.2.2).

As described in Section 4.3.2.2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the construction site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the construction site. In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers caused by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours, would reduce noise levels further. Thus noise attenuation to Colorado limits (as in Colorado revised statutes Title 25, Article 12, Section 103) or EPA limits (EPA 1974) would occur at distances somewhat shorter than the aforementioned distances. In many cases, these limits would not reach any nearby residences or communities. However, when construction would occur near a lease tract boundary, noise levels at four residences around Lease Tracts 13, 13A, 16, and 16A could exceed the Colorado limit. The nearest residence is a cow camp, which abuts Lease Tract 13. A residence is located about 520 ft (160 m) and 1,600 ft (480 m), respectively, from Least Tracts 13 and 13A, and a residence is located about 1,000 ft (310 m) from Lease Tract 13. A store is located about 1,050 ft (320 m) and 1,600 ft (480 m), respectively, from Lease Tracts 16 and 16A.

It is assumed that most mine development and operations would occur during the day, when noise is better tolerated because the masking effects of background noise occur more during daytime than at night. In addition, construction activities for DOE ULP lease tracts would be temporary (typically lasting a few months). Construction within the DOE ULP lease tracts would cause some unavoidable but localized short-term noise impacts on neighboring residences or communities, particularly when mining activities occurred near residences or communities adjacent to the lease tract boundary.

During mine operations, ventilation fans would run continuously at mine sites, for which noise calculations were made separately. The number of fans used for a mine depends on how extensive the mine activities are but typically would be one or two fans for small mines, two or three fans for medium mines, and three or four fans for large mines at an interval of every 366–457 m (1,200–1,500 ft) (Williams 2013). The composite noise level for a ventilation fan, such as that used at JD-9 mine, is about 86 dBA at a distance of 3 m (10 ft) (Spendrup 2013), corresponding to about 70 dBA at a reference distance of 15 m (50 ft), which is far lower than noise levels for typical heavy equipment. For a single fan, noise levels would attenuate to 55 and 50 dBA at distances of about 60 m (200 ft) and 90 m (300 ft) from the fan, respectively, which are the Colorado daytime and nighttime maximum permissible limits of 55 and 50 dBA in a residential zone. The EPA guideline level of 55 dBA L_{dn} for residential areas would occur at about 110 m (360 ft). For four identical fans that are located equidistant from a receptor, these distances would be extended to about 100 m (330 ft), 160 m (530 ft), and 190 m (620 ft), respectively. During daytime hours, beyond some distances, a noise of interest can be overshadowed by relatively high background levels along with skyward refraction caused by temperature lapses (i.e., temperature decreases with increasing height, so sound tends to bend towards the sky). However, on a calm, clear night typical of ULP lease tract settings, the air temperature would likely increase with increasing height (temperature inversion) because of strong radiative cooling. Such a temperature profile tends to focus noise downward toward the ground. Thus, there would be no shadow zone[7] within 1 or 2 mi (2 or 3 km) of the source in the presence of a strong temperature inversion (Beranek 1988). In particular, such conditions add to the effect of noise being more discernible during nighttime hours, when the background levels are the lowest. Considering these facts, potential impact distances would be extended further, to several hundred meters. Accordingly, noise control measures (e.g., the installation of front and rear silencers, which can reduce noise levels from 5 to 10 dBA [Spendrup 2013]) would be warranted if any residences were located within these distances from ventilation fans. Also, the outlet could have a 45 degree or 90 degree elbow pointed away from the sensitive receptors (Williams 2013).

During operations, over-the-road heavy haul trucks would transport uranium ores from DOE ULP lease tracts to either the proposed Piñon Ridge Mill or White Mesa Mill in Utah. These shipments could produce noise along the haul routes. Under Alternative 4, about 2,000 tons per day of uranium ores would be produced. Assuming 25 tons of uranium ore per truck and round-trip travel, the traffic volume would be 160 truck trips per day (80 round trips per day) and 20 trucks per hour (for 8-hour operation). At distances of 180 ft (55 m) and 350 ft (110 m) from the route, noise levels would attenuate to 55 and 50 dBA, respectively, which are the Colorado daytime and nighttime maximum permissible limits in a residential zone. Noise levels above the EPA guideline levels of 55 dBA L_{dn} for residential areas could reach up to a distance of 94 ft (29 m) from the route. Accordingly, Colorado limits or EPA guideline levels could be exceeded within 350 ft (110 m) from the haul route, and any residences within this distance might be affected; however, mitigation measures described in Section 4.6 are expected to bring these activities into compliance with applicable limits.

Depending on local geological conditions, explosive blasting during mine development and operations might be needed. Blasting would generate a stress wave in the surrounding rock, causing vibration of the ground and structures on the ground surface. The blasting also would create a compressional wave in the air (air blast overpressure), the audible portion of which would be manifested as noise. Potential impacts of ground vibration would include damage to structures, such as window breakage. Potential impacts of blast noise would include effects on humans and animals. The estimation of potential increases in ambient noise levels, ground vibration, and air blast overpressure and evaluation of possible environmental impacts associated with such increases would be required at the project-specific phase if potential impacts at nearby residences or structures were anticipated.

Blasting techniques would be designed and controlled by blasting and vibration control specialists to prevent damage to structures or equipment. These controls would attenuate blasting

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[7] A shadow zone is defined as the region where direct sound does not penetrate because of upward refraction.

noise as well. For the 31 lease tracts evaluated under Alternative 4, there are several residences within 1.0 mi (1.6 km) from the boundaries of the lease tracts to be developed. The further distances of other off-site residences make additional mitigation unnecessary. However, given the impulsive nature of blasting noise, it is critical that blasting activities be avoided at night and on weekends and that affected neighborhoods be notified in advance of scheduled blasts.

There are several specially designated areas (e.g., Dolores River SRMA, Dolores River Canyon WSA) and other nearby wildlife habitats around the DOE ULP lease tracts and haul routes where noise might be a concern. Negative impacts on wildlife begin at 55–60 dBA, which corresponds to the onset of adverse physiological impacts (Barber et al. 2010). As discussed above, these levels would be limited up to distances of 1,650 ft (500 m) from the mine sites and 180 ft (55 m) from the haul routes. However, there is the potential for other effects to occur at lower noise levels (Barber et al. 2011). When these impacts and the potential for impacts at lower noise levels are taken into account, impacts on terrestrial wildlife from construction noise and mitigation measures would have to be considered on a project-specific basis. Such a consideration should incorporate site-specific background levels and hearing sensitivity for site-specific terrestrial wildlife of concern.

In summary, potential noise impacts from mine development on humans and wildlife would be anticipated near the mine sites and along the haul routes, but the impacts would be minor and limited to proximate areas unless these activities occurred near lease tract boundaries adjacent to nearby residences or communities or areas specially designated for wildlife concerns, if any. Implementation of measures (i.e., compliance measures, mitigation measures, and BMPs) and coherent noise management plans could minimize these impacts (see Table 4.6-1 in Section 4.6).

4.4.2.3 Reclamation

The type of impacts would be similar to those described for Alternative 1 (Section 4.2.2). It is also assumed that reclamation activities under Alternative 4 would occur over about 460 acres (190 ha) during the peak year of reclamation.

As detailed in Section 4.1.2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the reclamation site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the construction site. Most residences are located beyond these distances but, if reclamation activities occurred near the boundary of Lease Tracts 13, 13A, 16, or 16A, noise levels at four residences could exceed the Colorado limit.

It is assumed that most reclamation activities would occur during the day, when noise is better tolerated, because of the masking effects of background noise that occurs more during daytime than at night. In addition, reclamation activities at DOE ULP lease tracts would be temporary (typically lasting a few weeks to months, depending on the size of the area to be reclaimed). Accordingly, reclamation within the DOE ULP lease tracts would cause some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities. The same mitigation measures adopted during the mine development and operations phase could also be implemented during the reclamation phase.

4.4.3 Geology and Soil Resources

4.4.3.1 Exploration

The types of impacts related to exploration under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.3.1). Because exploration activities would occur over relatively small areas and involve little or no ground disturbance, impacts associated with this phase are expected to be minor.

4.4.3.2 Mine Development and Operations

The types of impacts related to mine development and operations under Alternative 4 are similar to those under Alternative 3 (Section 4.3.3.2). Under Alternative 4, ground disturbance during the peak production year would occur on an assumed 460 acres (190 ha), mainly during mine development. Impacts associated with this phase are expected to be minor to moderate. The degree of impact would vary among the lease tracts, depending on the activities needed to prepare and develop each mine site (because some sites are more developed than others) and depending on site-specific factors, such as soil properties, slope, vegetation, weather, and distance to surface water. Implementing the mitigation measures and BMPs listed in Table 4.6-1 (Section 4.6) would reduce the potential for adverse impacts associated with these activities.

4.4.3.3 Reclamation

The types of impacts related to reclamation under Alternative 4 would be similar to those under Alternatives 1, 2, and 3 (Sections 4.1.3.2, 4.2.3, and 4.3.3.3, respectively). However, ground disturbance would occur over a larger area (assumed to be 460 acres, or 190 ha) than that assumed for Alternatives 1, 2, and 3.

4.4.3.4 Paleontological Resources

4.4.3.4.1 Exploration. The types of impacts related to exploration under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.3.4.1). Because exploration activities would occur over relatively small areas and involve little or no ground disturbance, impacts associated with this phase are expected to be minor.

4.4.3.4.2 Mine Development and Operations. The types of impacts related to mine development and operations under Alternative 4 are similar to those under Alternative 3 (Section 4.3.3.4.2). However, under Alternative 4, ground disturbance during the peak production year would occur on an assumed 460 acres (190 ha), a larger area than that assumed for Alternative 3, mainly during mine development.

4.4.3.4.3 Reclamation. The types of impacts related to reclamation under Alternative 4 would be similar to those under Alternatives 1, 2, and 3 (Sections 4.1.3.3, 4.2.3.1, and 4.3.3.4.3, respectively). However, ground disturbance would occur over a larger area (assumed to be 460 acres, or 190 ha) than that assumed for Alternatives 1, 2, and 3.

4.4.4 Water Resources

4.4.4.1 Exploration

Exploration activities are expected to increase significantly under an assumption that the number of mines and production rate would be double (Table 2.2-4) what they are under Alternative 3. While the types of impacts related to exploration under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.4.1), an increase in exploration activities would have the potential to increase those impacts.

The number of exploratory drill holes is anticipated to increase in order to develop the up to 19 mines assumed. There would be the potential in this phase to increase impacts of groundwater leaching, mixing water with varying geochemical characteristics, and cross-contamination via an increased number of drill boreholes and wells. However, groundwater seepage from shallow aquifers (alluvial and perched sandstone aquifers) is still a key factor governing impacts. The number of wet mines would be similar to those under Alternative 3 and possibly limited to lease tracts in Paradox and Lease Tract 13 along the Dolores River in Slick Rock.

The increased exploration activities would occur over relatively small areas and involve only a small amount of ground disturbance. Impacts associated with runoff generation and erosion in this phase are expected to be minor.

4.4.4.2 Mine Development and Operations

Under Alternative 4, there would be a total of 19 mines operating across the 31 DOE ULP lease tracts, involving a total land disturbance of 460 acres (190 ha) and an annual water use of 6,300,000 gal (19 ac-ft) (Section 2.2.4.1). The types of impacts related to mine development and operations under Alternative 4 would be similar to those described for Alternative 3 (Section 4.3.4.2).

The increase in area of surface disturbed under Alternative 4 has the potential to increase impacts associated with erosion; however, the proximity of the lease tract to the Dolores River and the San Miguel River would still be the primary factor governing impacts. The additional 18 lease tracts included under Alternative 4 are not located along the reaches of perennial rivers. The overall magnitude of impacts would be expected to be similar to the magnitude under Alternative 3.

The increase in mining operations may also have the potential to increase dewatering effects and groundwater contamination.

The underground working areas are expected to increase significantly in order to achieve the assumed production of up to 3,000 tons/d (2,700 metric tons/d). However, groundwater seepage from alluvial, perched, and uranium-containing aquifers is the primary driver that could cause dewatering, groundwater leaching, and cross-contamination. The underground mines in the 18 additional lease tracts under Alternative 4 are anticipated to be relatively dry except for Lease Tract 8A, which has not been leased before and is close to Lease Tract 7, which has wet mines near Paradox Valley. Two domestic wells were identified as being associated with some of the 18 additional lease tracts. One is located within 1,000 ft (300 m) from Lease Tract 8A, and the other is located on a potential migration pathway from Lease Tract 16 to the Dolores River. The nature and magnitude of impacts would be expected to be similar to those under Alternative 3. Those impacts could be minimized through mitigation measures, permitting, and BMPs, as discussed in Section 4.3.4.2 and listed in Table 4.6-1. The site-specific requirements and plans for drainage design, stormwater management, and spill prevention and control would be expected to be evaluated and incorporated in the future project-specific action.

The estimated annual water use under Alternative 4 would be two times higher than that under Alternative 3. However, the potential impacts are still minor compared to regional water use in three counties for mining (2.9%) and for the public water supply (0.1%). The consumptive water use is a fraction of the estimated water use. This part of water use will be returned to the hydrologic system in the region (potable water, etc.). The further specific evaluation would be included in future project-specific NEPA documents.

4.4.4.3 Reclamation

The potential impacts on water resources associated with the reclamation activities under Alternatives 1–3 are described in Sections 4.1.4., 4.2.4, and 4.3.4. Under Alternative 4, the type of impacts would be the same as those under Alternatives 1–3. However, the area of land disturbance would be 1.5 times higher and the size of underground mines would be about 2 times higher than those under Alternative 3. The increased scale of reclamation might have the potential to increase impacts associated with reclamation activities.

The increase in the area of surface land disturbance in this phase could increase impacts associated with erosion; however, the proximity of the lease tract to the Dolores River and the San Miguel River would still be the primary factor governing the impact. The additional 18 lease tracts included under Alternative 4 are not located along the reaches of perennial rivers. The overall magnitude of impacts would be expected to be similar to those under Alternative 3.

The increased level of active prospecting across up to 31 lease tracts during the previous operations phase would require more underground working areas to be backfilled and more boreholes to be plugged in this phase than under Alternative 3. The potential could be higher than it is under Alternative 3 for impacts on groundwater quality that would result from leaching via backfills and poor sealing of drill holes. However, groundwater seepage from shallow aquifers is the primary driver that could cause groundwater leaching and cross-contamination via drill holes and open mine portals and vent holes. Under Alternative 4, the underground mines in the 18 additional lease tracts are expected to be relatively dry except for Lease Tract 8A, as just discussed. Potential impacts on groundwater quality would be minor and could be avoided if the reclamation is performed by appropriate backfilling of mine portal and vent holes, complete sealing of drill holes that intercept multiple aquifers, and adequate water reclamation in accordance with reclamation performance measures by CDRMS.

4.4.5 Human Health

Exploration for uranium ores would involve drilling small holes (a few inches in diameter) in the ground and bringing up small amounts of mineralized cuttings, most of which would be placed back to fill the holes. Because potential human health impacts during mine exploration are expected to be minimal and limited to only a few workers, the analysis of human health impacts in this section focuses on the consequences caused by development and operations of the uranium mines and the reclamation of lease tracts. Nevertheless, to provide a perspective of the potential dose associated with mine exploration, an analysis with the RESRAD code was conducted (see Section 4.3.5 for more descriptions). The analysis assumed that the mineralized cuttings brought up from drilling would be spread over an area of about 100 ft^2 (3 m × 3 m), and an exploration worker would stand on the cuttings and be exposed to radiation. According to the analysis, the radiation dose rate would be much lower than 0.3 mrem per day. Therefore, it is considered reasonable to expect that the total dose that an exploration worker would receive from mine exploration would be less than 5 mrem.

4.4.5.1 Worker Exposure – Uranium Miners

Like many other occupations, uranium mining can result in physical injuries or fatalities. Based on data published by the U.S. Department of Labor, Bureau of Labor Statistics, in 2010, the fatal occupational injury rate for the mining industry was 19.8 per 100,000 full-time workers (FTWs) (BLS 2011a), and the nonfatal occupational injury and illness rate was 2.3 per 100 FTWs (BLS 2011b). Assuming the injury and fatality rates for uranium mining are similar to those for other types of mining, during the year of peak operations, there could be five nonfatal injuries and illnesses among the 218 workers assumed for Alternative 4. However, no mining-related fatality is predicted among the workers. The above estimated numbers of injury and fatality were made on the basis of statistical data and should be interpreted from a statistical perspective as well. The actual injury and fatality rates among individual mines could be different. Proper worker training and extensive experience in uranium mining would reduce mining accidents, thereby reducing the potential of injury and fatality.

In addition to being exposed to physical hazards, uranium miners could receive radiation exposure from mining activities. The radiation exposure to individual miners under Alternative 4 would be similar to that under Alternative 3. Monitoring data over the period 1985 to 1989 indicated that the average radiation exposure for uranium mine workers in the United States ranged from 350 to 433 mrem/yr (UNSCEAR 2010), excluding the background radiation dose, which is estimated to be about 430 mrem/yr in the ULP lease tracts. In general, underground miners receive higher radiation exposure than open-pit miners, because underground cavities accumulate higher radon concentrations and airborne uranium ore dust concentrations than does aboveground open space. According to UNSCEAR (1993), external exposure accounts for 28% of the total dose for underground miners and 60% for open-pit miners; the inhalation of radon accounts for 69% and 34% of the total dose for underground miners and open-pit miners, respectively; and inhalation of uranium ore dust accounts for 3% and 6% of the total dose for underground miners and open-pit miners, respectively. Based on the assumption that the average dose for underground miners is 433 mrem/yr and based on the distribution of the total dose among different pathways, an LCF risk of 4×0^{-4}/yr is calculated for an average miner (see Table 4.3-2). This translates to a probability of about 1 in 2,500 of developing a latent fatal cancer from 1 year of radiation exposure. If a worker would work for 10 years as a uranium miner, the total cumulative dose he would receive would be 4,330 mrem, with a corresponding cumulative LCF risk of 4×10^{-3}; i.e., the probability of developing a fatal cancer would be about 1 in 250.

An attempt was also made to infer potential chemical exposures associated with underground uranium mining. This inference was detailed in Section 4.3.5.1. Potential air concentrations of uranium and vanadium, assumed in the form of V_2O_5, were estimated using the radiation dose associated with the inhalation of particulate pathway that an average miner would receive. The estimated chemical concentrations were then used to estimate the potential hazard index associated with uranium and vanadium exposures. A hazard index of 1.06 was estimated, contributed primarily by vanadium exposure. Because the hazard index slightly exceeds the threshold value of 1, it is concluded that potential adverse health effect might result from working in underground uranium mines.

4.4.5.2 Worker Exposure – Reclamation Workers

During the reclamation phase, the largest source of radiation exposure would be the aboveground waste-rock piles accumulated over the operational period. The potential radiation dose incurred by reclamation workers would depend on the size of the waste-rock pile and its uranium content. The potential radiation exposure of a reclamation worker was estimated on the basis of four assumed waste-rock pile dimensions corresponding to the four mine sizes assumed. Detailed discussions on the development of the four waste-rock piles evaluated are provided in Section 4.1.5.

The radiation exposure of an individual worker that would result from performing reclamation activities is expected to be about the same as that analyzed in Section 4.1.5 for Alternative 1. Based on the RESRAD (Yu et al. 2001) analysis, the total radiation dose incurred by a reclamation worker would range from 14.3 to 34.2 mrem, depending on the radionuclide concentrations assumed for waste rocks. The lower end of the estimate corresponds to the maximum concentration reported for waste rock samples taken from the JD-6 and JD-8 lease tracts (Whetstone Association 2011, 2012), which was reported to have a concentration for Ra-226 of 70 pCi/g. Section 4.1.5 provides more discussions on the determination of radionuclide concentrations in waste-rock piles. The total dose is estimated on the basis of the assumption that the worker would work 8 hours per day for 20 days on top of a waste-rock pile. The radiation exposure would be dominated by the external radiation pathway, which would contribute about 94–96% of the total dose, followed by the incidental soil ingestion pathway, which accounts for about 3% of the total dose. The remaining dose would be contributed by exposures from inhalation of radioactive particulates and radon gas. The potential LCF risk associated with this radiation exposure is estimated to 1×10^{-5}; i.e., the probability of developing a latent fatal cancer ranges from about 1 in 100,000 based on the 70 pCi/g concentration. The estimates for the 168 pCi/g concentration would be less than 3 times as much.

Reclamation workers may be required to work underground to reclaim mine workings; however, the time spent underground is expected to be much shorter than the time spent above the ground. Based on past monitoring data for uranium miners (433 mrem/yr on average, see Section 4.3.5.1), it is estimated that a reclamation worker would need to spend 66–158 hours at underground workings to receive the same dose (6.1–14.3 mrem) as he would from working on top of a waste-rock pile for 160 hours (i.e., 20 workdays).

In addition to the radiation that would be emitted by the uranium isotopes and their decay products in the waste rocks, the chemical toxicity of the uranium and vanadium minerals in the waste rocks could also affect the health of a reclamation worker. The potential chemical risk that a reclamation worker could incur under Alternative 4 is expected to be about the same as that under Alternative 1 (Section 4.1.5.1). The chemical exposure would be well below the threshold values, the reclamation worker is not expected to experience adverse health effects.

4.4.5.3 General Public Exposure – Residential Scenario

The maximum potential radiation exposure for a member of the general public was estimated as a function of distance from the release point of radionuclides, which can be used to estimate the potential exposure of an individual living close to the ULP lease tracts, given the location and size of the uranium mine being operated. The maximum doses were estimated for the four mine sizes assumed.

4.4.5.3.1 Uranium Mine Development and Operations.

Exposure to an Individual Receptor. Based on the discussions in Section 4.3.5.3.1 (for Alternative 3), the primary source of potential human health impacts on the residents who lived near the ULP lease tracts during the operational phase would be the radon gas emitted from mining activities. The analysis of potential radiation exposures to the residents focused on the consequences associated with the release of radon.

For human health impact analysis, the radon emission rates for the three sizes of underground uranium mines assumed were developed by using the equation developed by the EPA (EPA 1985) that correlates the radon emission rate with cumulative uranium ore production. An operational period of 10 years was assumed when developing the radon emission rates. The radon emission rates based on a 10-year operational period were considered to be the upper-bound estimates for underground mines. The radon emission rate for a very large mine (i.e., the existing open-pit mine on Lease Tract 7) was estimated on the basis of the data compiled by the EPA (Table 12-7 in EPA 1989a) for surface mines. The estimated value is also expected to be greater than the actual emission rate. The emission rates developed for the four sizes of uranium mines assumed under Alternative 4 would have the same values as those developed under Alternative 3. Therefore, the potential maximum doses would be the same as those listed in Table 4.3-4.

Based on the results in Table 4.3-4, the radiation exposures would decrease with increasing distance because of greater dilution in the radon concentrations. The maximum exposure at a fixed distance from the emission point of an underground mine or from the center of the open-pit mine would always occur in a specific sector that coincides with at dominant wind direction. In any other sector, the potential exposure would be less than the maximum values.

As presented in Table 4.3-4 with the CAP88-PC results, if the resident lived at a distance of 3,300 ft (1,000 m) from the emission point of a uranium mine, the potential maximum radiation dose he could incur would range from 5.6 to 22.5 mrem/yr, depending on the scale of the uranium mine. If the distance increased to 6,600 ft (2,000 m), then the maximum exposure would be reduced to range from 2.7 to 10.7 mrem/yr. Beyond a distance of 8,200 ft (2,500 m), the maximum exposures would be less than 10 mrem/yr, which is the NESHAP dose limit (40 CFR Part 61) for airborne emissions of radionuclides. It should be noted that the maximum doses listed in Table 4.3-4 are for a resident living in a dominant wind direction and that they were obtained by using radon emission rates corresponding to an operational period of 10 years. The emission rates for uranium mines that have been developed and operated for fewer than 10 years would be less. However, if two or more uranium mines located close to a given residence were being operated at the same time, the potential dose to the resident would be the sum of the doses contributed by each mine.

The maximum LCF risk for a resident living close to a uranium mine was estimated to range from 1×10^{-6}/yr to 5×10^{-6}/yr at a distance of 16,000 ft (5,000 m) and to range from 7×10^{-6}/yr to 3×10^{-5}/yr at a distance of 3,300 ft (1,000 m). That is, the probability of developing a latent fatal cancer ranges from 1 in 1,000,000 to 1 in 200,000 at a distance of 16,000 ft (5,000 m), and it ranges from 1 in 140,000 to 1 in 33,000 at a distance of 3,300 ft (1,000 m), for each year of exposure.

Due to the large dilution in air concentrations after the uranium- and vanadium-contained dust particles were released from the emission stacks, potential chemical exposures of nearby residents are expected to be much lower than those of underground uranium miners. The hazard index estimated for an underground miner is 1.06 (from Section 4.3.5.1); therefore, for a nearby resident, the hazard index should be much lower than 1. On the basis of this inference, a nearby resident is not expected to experience any adverse health effect from the chemical exposures.

Because potential radon exposures of the general public living near the ULP lease tracts could exceed the NESHAP dose limit of 10 mrem/yr, mitigation measures would be required for (1) obtaining actual radon emission rates to refine the dose estimates associated with radon exposures and (2) reducing the impact to the general public, if the refined estimates would exceed the 10-mrem/yr dose limit. See Section 4.3.5.3.1 for the suggested mitigation measures.

Exposure to a Collective Population. Collective exposures of the general public living within 50 mi (80 km) of the ULP lease tracts were evaluated by using the same method described in Section 4.3.5.3.1. The range of the potential collective dose in the peak year of operations can be estimated by summing all the radon emissions from active uranium mines and placing the total emission at the center of each lease tract group.

Table 4.4-2 lists the estimated Rn-222 emission rates during the peak year of operations under Alternative 4. It was assumed that the active mines would have been developed and operated for 10 years at the peak year of operations. The total Rn-222 emission rate from underground mining was estimated to be about 18,000 Ci/yr, and the estimated Rn-222 emission rate from the very large open-pit mine was 600 Ci/yr.

Table 4.4-3 presents the collective doses to the general public living within 3.1 to 50 mi (5 to 80 km) of the assumed emission points during the peak year of operations under Alternative 4 obtained by using the CAP88-PC code. The estimated collective dose associated with underground mining ranges from 16 to 93.3 person-rem. The estimated collective dose associated with open-pit mining is about 0.88 person-rem. Combined, the underground and open-pit mining would result in a total collective dose ranging from 16.9 to 94.1 person-rem during the peak year of operations. This collective exposure would cause a collective LCF risk of 0.022 to 0.12. Therefore, no cancer fatality is expected among the population resulting from exposure to the radon gas emitted from 19 uranium mines that would be operated simultaneously during the peak year of operations under Alternative 4. The total populations involved in these estimates would range from 27,062 to 178,473. If the collective dose was evenly distributed among the affected population, the average individual dose would range from 0.51 to 0.97 mrem (LCF risk of 7×10^{-7} to 1×10^{-6}; i.e., 1 in 1,400,000 to 1 in 1,000,000) during the peak year of operations. In reality, because the active lease tracts (the lease tracts with mining operations) would be scattered among the four lease tract groups rather than being concentrated in one single group (as they were assumed to be in the calculations), the size of the population within 3.1 to 50 mi (5 to

TABLE 4.4-2 Radon Emission Rates per Type of Mine during Mine Operations Assumed for Alternative 4

Parameters	Small[a]	Medium[a]	Large[a]	Very Large[b]	Total
Uranium ore production per mine (tons/d)	50	100	200	300	
Cumulative uranium ore production per mine (tons)	1.20E+05	2.40E+05	4.80E+05	7.20E+05	
Rn-222 emission rate per mine (Ci/yr)[c]	5.28E+02	1.06E+03	2.11E+03	6.00E+02	
Alternative 4 (peak year of operations)					
No. of active mines	6	10	2	1	19
Total Rn-222 emission rate (Ci/yr)	3.17E+03	1.06E+04	4.22E+03	6.00E+02	1.86E+04

[a] Underground mine.

[b] Open-pit mine.

[c] The emission rates of radon from underground mines were estimated by using the correlation developed by the EPA in 1985: Rn-222 emission (Ci/yr) = 0.0044 × cumulative uranium ore production (tons) (EPA 1985). A cumulative period of 10 years was assumed for this calculation. The emission rate from the very large open-pit mine was determined based on data compiled by the EPA for surface uranium mines (EPA 1989a).

80 km) of the lease tracts should be larger than 178,473. Therefore, the actual average individual dose should be just a fraction of the calculated values.

4.4.5.3.2 Reclamation. Residents living close to a uranium mine could be exposed to radiation as a result of emissions of radioactive particulates and radon gas from the waste-rock piles left aboveground. The potential radiation dose would depend on the direction and distance between the residence and the waste-rock piles and the emission rates of the particulates and radon. The potential range of radiation dose a resident would incur under Alternative 4 is expected to be similar to that estimated for Alternatives 1 and 2, because the exposures would be dominated by the emissions from the waste-rock pile(s) that were closest to this resident.

Based on the calculation results presented in Section 4.1.5.2, if a resident lived 3,300 ft (1,000 m) from a waste-rock pile, the radiation dose he could receive would be less than 3.5 mrem/yr; if the distance was increased to 6,600 ft (2,000 m), then his exposure would drop to less than 1.3 mrem/yr. If there were two waste-rock piles nearby, the potential dose that this resident would incur would be the sum of the doses contributed by each waste-rock pile. Based on the listed maximum doses in Table 4.1-8, the potential dose incurred by any resident living at a distance of more than 1,600 ft (500 m) from the center of a waste-rock pile is expected to be smaller than the NESHAP dose limit of 10 mrem/yr for airborne emissions (40 CFR Part 61). The potential LCF risk would be less than 9×10^{-6}/yr, which means the probability of developing a latent fatal cancer from living close to the ULP lease tracts for 1 year during or

TABLE 4.4-3 Collective Doses and LCF Risks to the General Public from Radon Emissions from Uranium Mines during the Peak Year of Operations under Alternative 4

Radon Source	Collective Dose (person-rem/yr)	Collective LCF (1/yr)[a]
From underground mining[b]		
Based on the center of Group 1[c]	9.33E+01	1E-01
Based on the center of Group 2[d]	4.98E+01	6E-02
Based on the center of Group 3[e]	2.53E+01	3E-02
Based on the center of Group 4[f]	1.60E+01	2E-02
From open-pit mining[g]		
Based on the center of Group 3[e]	8.80E-01	1E-03
Total		
Minimum	1.69E+01	2E-02
Maximum	9.41E+01	1E-01

[a] Denotes the number of latent lung cancers that could result from radiation exposure.

[b] The total radon emission rate from underground mining during the peak year of operations is 17,990 Ci/yr.

[c] If the emission is from the center of lease tract Group 1, the total population between 3 and 50 mi (5 and 80 km) is 178,473.

[d] If the emission is from the center of lease tract Group 2, the total population between 3and 50 mi (5 and 80 km) is 86,657.

[e] If the emission is from the center of lease tract Group 3, the total population between 3 and 50 mi (5 and 80 km) is 27,062.

[f] If the emission is from the center of lease tract Group 4, the total population between 3 and 50 mi (5 and 80 km) is 33,166.

[g] The total radon emission rate from open-pit mining during the peak year of operations is 600 Ci/yr.

after reclamation would be 1 in 110,000. If a resident lived in the same location for 30 years, the cumulative LCF risk would be less than 3×10^{-4} (i.e., 1 in 3,300). The above estimates were obtained by using the base concentration of 70 pCi/g for Ra-226. Should the higher 168 pCi/g concentration be used, the potential radiation doses and LCF risks would increase by a factor of less than 3.

The waste-rock piles would be covered by a layer of soil or top cover materials during reclamation to facilitate vegetation growth. Because of this cover, emissions of radioactive particulates would be greatly reduced, if not eliminated completely. Emissions of radon from waste-rock piles could continue, although the emission rates would be reduced. However, because the uranium isotopes and their decay products have long decay half-lives, the potential of radon emissions from waste-rock piles could persist for millions of years after reclamation was completed.

In addition to radiation exposure, the residents living close to the ULP lease tracts could incur chemical exposures due to the chemical toxicity of uranium and vanadium minerals contained in the waste rocks. Potential chemical exposures would be associated with the emissions of particulates and come through the inhalation and incidental dust ingestion pathways. By using the same exposure parameters as those used for radiation dose modeling, potential chemical risks to the nearby residents were evaluated. The total hazard index would be well below the threshold value of one, with inhalation being the dominant pathway. Therefore, nearby residents are not expected to experience any adverse health effects with the potential exposures.

A less likely exposure scenario after the reclamation phase is for a nearby resident to raise livestock in the lease tract and consume the meat and milk produced. According to the RESRAD calculation results, the potential dose would be less than 5.5 mrem/yr, which is a small fraction of the DOE dose limit of 100 mrem/yr for the general public from all applicable exposure pathways (DOE Order 458.1). The corresponding LCF risk would be 3×10^{-6}/yr; i.e., the probability of developing a latent fatal cancer would be less than 1 in 330,000 per year. Section 4.1.5.2 provides detailed discussions on this analysis.

4.4.5.4 General Public Exposure – Recreationist Scenario

A recreationist who unknowingly entered the lease tracts could also be exposed to radiation. To model this potential radiation exposure, it is assumed that the recreationist would camp on top of a waste-rock pile for 2 weeks, eat wild berries collected in the areas, and hunt wildlife animals for consumption. This recreationist could receive radiation exposure through the direct external radiation, inhalation of radon, inhalation of particulates, and incidental soil ingestion pathways while camping on waste rocks. The potential exposures would vary with the thickness of soil cover placed on top of waste rocks during reclamation. In the analysis, the thickness was assumed to range from 0 to 1 ft (0 to 0.3 m).

The potential dose that could be incurred by a recreationist under Alternative 4 would be similar to that under Alternatives 1 and 2. The estimated radiation dose incurred by the recreationist from camping on waste rocks for 2 weeks would range from 0.88 mrem with a cover thickness of 1 ft (0.3 m) to 30 mrem with no cover. The corresponding LCF risk would range from 1×10^{-6} to 2×10^{-5}; i.e., the probability of developing a latent fatal cancer would be about 1 in 1,000,000 to 1 in 50,000. The majority of the radiation dose would result from direct external radiation. These dose estimates were made by using the base concentrations (70 pCi/g for Ra-226) assumed for waste rocks. If the concentrations were increased to 168 pCi/g, the potential doses and LCF risks would increase by a factor of less than 3.

The potential radiation dose associated with eating wild berries and wildlife animals was calculated by using assumed ingestion rates of 1 lb (0.45 kg) and 100 lb (45.4 kg), respectively. The potential dose was estimated to range from 1.08 to 1.66 mrem, depending on the depth of plant roots assumed for the estimate. The corresponding LCF risk was estimated to be less than 8×10^{-7}; i.e., the probability of developing a latent cancer fatality would be less than 1 in 1,250,000.

No chemical risks would result from camping on a waste-rock pile if the waste rock pile was covered by a few inches of soil materials. In the worst situation in which there would be no soil cover, a hazard index of 0.039 was calculated. The potential chemical risk associated with ingesting contaminated wild berries would be small, with a hazard index of less than 0.003. The hazard index associated with eating wildlife animals would be more than 100 times greater than that associated with eating wild berries, because of the potential accumulation of vanadium in animal tissues. The hazard index calculated was 0.39. However, because the sum of all these hazard indexes was much less than 1, the recreationist is not expected to experience any adverse health effect from these two ingestion pathways.

Most of the encounters between recreationists and ULP lease tracts are expected to be much shorter than 2 weeks. When the total dose associated with exposures to waste rocks from camping was used, a dose rate of less than 0.09 mrem/h (LCF risk of 7×10^{-8}; i.e., 1 in 14,000,000) was estimated.

A discussion of a detailed analysis of the potential exposure to an individual receptor under post-reclamation conditions at the mine sites is provided in Section 4.1.5.3.

4.4.6 Ecological Resources

4.4.6.1 Vegetation

Exploration and development activities could occur on each of the 31 lease tracts included under Alternative 4. Previous disturbance from exploration or mine development has occurred in each of these lease tracts except Lease Tract 8A. However, new exploration and development could occur in either disturbed or undisturbed areas of the lease tracts. Exploration and development on Lease Tract 8A would occur in undisturbed habitats.

The types of impacts from exploration, development and operations, and reclamation under Alternative 4 would be similar to those under Alternative 3, except that during the peak year of operations a greater area would be disturbed. Up to 19 mines could be in operation (6 small, 10 medium, 2 large, and 1 very large); in addition, the mines could be located on any of the 31 lease tracts rather than on just 12 of them. Ground disturbance would range from 10 acres (4.0 ha) for small mines, to 15 acres (6.1 ha) for medium mines, to 20 acres (8.1 ha) for large mines, with the total being 250 acres (100 ha). In addition, the 210-acre (85-ha) open-pit mine (Lease Tract 7) would resume operations, resulting in a total of 460 acres (190 ha) of disturbance under Alternative 4. Direct impacts associated with the development of mines would include the destruction of habitats during site clearing and excavation as well as the loss of habitats at the waste-rock disposal area, various storage areas, project facilities, and access roads. The lease tracts included in Alternative 4 support a wide variety of vegetation types. The predominant types are piñon-juniper woodland and shrubland and big sagebrush shrubland. Some of the areas affected might include high-quality mature habitats, resulting in greater impact levels than those that would occur in previously degraded areas. Indirect impacts of mining would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or water quality.

4.4.6.1.1 Wetlands and Floodplains. Wetlands occur in most of the lease tracts and might be directly or indirectly affected. Indirect impacts of mining would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or water quality.

4.4.6.2 Wildlife

Impacts on wildlife from exploration, mine development and operations, and reclamation under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.6.2) except that (1) during the peak years of operation, up to 19 mines could be in operation at the same time, and (2) the mines could be located on any of the 31 lease tracts. The 19 mines would include 6 small mines (10 acres or 4.0 ha disturbed per mine), 10 medium mines (15 acres or 6.1 ha disturbed per mine), 2 large mines (20 acres or 8.1 ha disturbed per mine), and 1 very large mine (210 acres or 85 ha disturbed), for a total of 460 acres (190 ha). The 210 acres (85 ha) for the very large mine (JD-7) have already been disturbed (as were 80 acres [32 ha] for topsoil storage). Therefore, areas of existing and new disturbances could occur at the other mine locations, and they would involve a total of 250 acres (100 ha) of land containing various amounts of upland vegetation. Including the existing area disturbed for JD-7, this area of disturbance represents 1.8% of the total acreage of DOE's lease program. The remainder of the lease tracts (excluding areas where access roads and utility corridors could be required) would be undisturbed by mining activities under Alternative 4.

The differences in impacts under Alternative 4 compared with the impacts under Alternative 3 would be limited (Section 4.3.6.2). However, the potential impacts on wildlife would occur at additional mine sites and affect an additional 150 acres (61 ha) of land on any of the 31 lease tracts rather than on any of just the 13 pre-July 2007 then-active lease tracts. Although exploration, mine development and operations, and reclamation activities are expected to be incrementally greater under Alternative 4 than under Alternative 3, impacts on wildlife are still expected to be negligible during site exploration and minor to moderate during mine development, operations, and reclamation. While impacts on wildlife could be long term (e.g., last for decades), they would be scattered temporally and, especially, spatially. In general, impacts would be localized and would not affect the viability of wildlife populations, especially if mitigation measures are implemented (see Section 4.6).

Impacts on wildlife following reclamation of the mine sites would be negligible if no development or other use of the sites (other than that of natural resource protection) occurred.

4.4.6.3 Aquatic Biota

Impacts on aquatic biota from mine exploration, development, operations, and reclamation under Alternative 4 would be similar to those under Alternative 3 (Section 4.3.6.3) except that (1) during the peak year of operations, up to 19 mines could be in operation, and (2) the mines could be located on any of the 31 lease tracts. Overall, impacts on aquatic biota are expected to be negligible during site exploration and negligible to minor during mine development, operations, and reclamation. Moderate impacts would only be expected if mines were located near perennial water bodies. In general, any impacts on aquatic biota would be localized and would not affect the viability of affected resources, especially if mitigation measures are implemented (see Section 4.6).

4.4.6.4 Threatened, Endangered, and Sensitive Species

Under Alternative 4, impacts on threatened, endangered, or sensitive species could result from exploration, mine development and operational, and reclamation activities. The threatened, endangered, and sensitive species evaluated under Alternative 3 (Section 4.3.6.4) would still be considered under Alternative 4. The only difference is that the potential for impacts on these species might be greater because more lease tracts could be developed, representing a greater potential for direct and indirect effects on these species.

All species evaluated under Alternative 3 have the potential to be affected by program activities under Alternative 4. Potential impacts on these species, as well as potentially applicable avoidance, minimization, and mitigation measures, are identified in Section 4.3.6.4 (see Table 4.3-8). In addition to these species, Table 4.4-4 shows there is the potential for impacts on other sensitive species that might be affected by ULP activities on the expanded number of lease tracts under Alternative 4. In total, 52 threatened, endangered, or sensitive species might be affected by ULP activities under Alternative 4. (This includes all species listed back in Table 4.3-8 and listed here in Table 4.4-4.) Of these 52, 5 sensitive species that might be affected by ULP activities under Alternative 4 would not be affected under Alternative 3 (Table 4.3-8). These 5 species are all BLM-designated sensitive plant species. Impacts on these additional species are described in Table 4.4-4. DOE consulted with the USFWS on potential impacts on federally listed species under this alternative as part of its obligations under Section 7 of the ESA. The BA and BO prepared for this consultation is provided in Appendix E.

4.4.7 Land Use

Under Alternative 4, DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period. A total of 19 mines are assumed to be in operation during the peak year of ore production. The lands would continue to be closed to mineral entry; however, all other activities within the lease tracts would continue. Mining activities within the lease tracts would likely preclude some land uses such as recreation or grazing, but because many of the surrounding lands offer opportunities for these activities,

TABLE 4.4-4 Potential Effects of the Uranium Leasing Program under Alternative 4 on Threatened, Endangered, and Sensitive Species That Would Not Be Affected under Alternative 3[a]

Common Name	Scientific Name	Status[b]	Potential to Occur on or near the Following Lease Tracts[c]	Potential for Effect[d]
Plants				
Canyonlands biscuitroot	*Aletes latilobus*	BLM-S	26, 27	Potential for negative impact—direct and indirect effects. ULP activities could affect this species. Impacts could occur through direct effects such as mortality and habitat disturbance resulting from exploration, development, and reclamation activities, as well as indirect impacts such as runoff, sedimentation, dispersion of fugitive dust, and effects related to radiation exposure.
Fisher milkvetch	*Astragalus piscator*	BLM-S	26, 27	Same as above.
Grand Junction suncup	*Camissonia eastwoodiae*	BLM-S	26, 27	Same as above.
Horseshoe milkvetch	*Astragalus equisolensis*	BLM-S	26, 27	Same as above.
Osterhout's cryptantha	*Cryptantha osterhoutii*	BLM-S	26, 27	Same as above.

[a] Threatened, endangered, and sensitive species that might be affected under Alternative 4 include all species that might be affected under Alternative 3, as well as all species presented in this table. See Section 4.3.6.4 and Table 4.3-6 for a discussion and presentation of potential impacts on threatened, endangered, and sensitive species under Alternative 3.

[b] BLM-S = BLM-designated sensitive species.

[c] Refer to Table 3.6-20 (Section 3.6.4) for a description of species' habitat requirements and potential to occur on or near lease tracts.

[d] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 1 lease tracts. Impacts on species might occur as either direct or indirect effects. Direct effects are considered to be physical impacts resulting from ground-disturbing activities; these include impacts such as direct mortality and habitat disturbance. The impact zone for direct effects does not extend beyond the lease tract boundaries. Indirect effects result from factors including, but not limited to, noise, runoff, dust, accidental spills, and radiation exposure. The impact zone for indirect effects might extend beyond the lease tract boundaries, but the potential degree of indirect effects would decrease with increasing distance from the lease tracts.

impacts due to land use conflicts are considered to be minor (but greater than those under Alternative 3 because they involve more lands). See Section 4.4.8.1 for further discussion of potential impacts on recreation and tourism.

4.4.8 Socioeconomics

Exploration activities would create 20 jobs during the peak year and would create 16 additional indirect jobs (see Table 4.4-5). Because of the small number of jobs required for exploration, the current workforce in the ROI could meet the demand for labor; thus, there would be no in-migration of workers. Mining development and operational activities would create direct employment of 229 people during the peak year and would create 152 additional indirect jobs. Development and operational activities would constitute 0.6% of total ROI employment. Uranium mining would also produce $14.8 million in income. Mine operation is assumed to be 10 years.

As discussed in Section 3.8, the average unemployment rate in the ROI was 9.6% in 2010; approximately 10,600 people were unemployed. Based on the number of people that could be available from the unemployed workforce and the ROI's distribution of employment by sector, there could be approximately 2,100 people available for uranium mining and reclamation in the ROI. Based on the available labor supply in the ROI as a whole, some of the current

TABLE 4.4-5 Socioeconomic Impacts from Uranium Mine Development, Operations, and Reclamation in the Region of Influence under Alternative 4

Parameter	Exploration	Development and Operations	Reclamation
Employment (no.)			
Direct	20	229	39
Indirect	16	152	21
Total	36	381	60
Income[a]			
Total	1.7	14.8	2.4
In-migrants (no.)	0	115	0
Vacant housing (no.)	0	69	0
Local community service employment			
Teachers (no.)	0	0	0
Physicians (no.)	0	1	0
Public safety (no.)	0	2	0

[a] Unless indicated otherwise, values are reported in $ million 2009.

workforce could meet the demand for labor necessary for mine development and operations and reclamation of the 19 assumed mines.

However, some in-migration would occur as a result of uranium mining activities; under Alternative 4, 115 people would move into the ROI. In-migration of workers would represent an 0.08% increase in the ROI forecasted population growth rate. The additional workers would increase the annual average employment growth rate by less than 1% in the ROI. The in-migrants would have only a marginal effect on local housing and population and would require less than 1% of vacant owner-occupied housing during mine development and operations. One additional physician, one additional firefighter, and one additional police officer would be required to maintain current levels of service within the ROI as a result of the increased population from in-migrants. No additional teachers would be required to maintain the current student-to-teacher ratio in the ROI.

Impacts in the ROI would be small because (a) employment would likely be distributed across all three counties, (b) the impacts would be absorbed across multiple governments and many municipalities, and the (c) employment pool would come from a larger population group than if all employment originated from any one county. Mining workers could live in larger population centers in the ROI and close vicinity, such as Grand Junction, Montrose, or Telluride, and commute to mining locations. A report prepared for Sheep Mountain Alliance acknowledged that workers "may choose to live at some distance from the mill and mines to protect the investments they put into their homes. Some businesses serving the mill and mines and their workers may choose to do the same" (Power Consulting 2010). This suggests that the communities in close proximity to the proposed leases might not benefit as greatly from the positive direct and indirect economic impacts from uranium mining, but they could also avoid the conditions under which previous boom-and-bust periods occurred. Also, the report recognized that despite the decline in uranium and other mining activities following 1980 in the west ends of Montrose, Mesa, and San Miguel Counties, these counties as a whole experienced significant economic expansion after the collapse of the uranium industry in the mid-1980s due to a "growth of a visitor economy including tourists, recreationists, and second homeowners" (Power Consulting 2010). However, individual municipalities in smaller rural communities might experience a temporary increase in population from workers if they chose to move to communities closer to mining projects rather than commuting longer distances. Although there might not be a large number of in-migrating workers from outside the three-county ROI and thus minor impact on the ROI as a whole, the impact on individual communities could vary.

Potential impacts during reclamation would be minor. The reclamation period would likely span 2 to 3 years, although only 1 year of reclamation activities would require a workforce. Reclamation would require 39 direct jobs and 21 indirect jobs during the peak year for field work and revegetation (see Table 4.4-5). Reclamation would use the existing workforce in the ROI, so there would be no further in-migration of workers.

4.4.8.1 Recreation and Tourism

Potential impacts on recreation and tourism under Alternative 4 would be the same as those under Alternative 3 (see Section 4.3.8.1).

4.4.9 Environmental Justice

4.4.9.1 Exploration

The types of impacts related to exploration under Alternative 4 are similar to those under Alternative 3 (Section 4.3.9.1). Because exploration activities would occur over relatively small areas and involve little or no ground disturbance, impacts associated with this phase are expected to be minor.

4.4.9.2 Mine Development and Operations

Under Alternative 4, there would be a total of 19 mines operating across the 31 DOE ULP lease tracts. The types of impacts related to mine development and operations under Alternative 4 would be similar to those described under Alternative 3 (Section 4.3.9.2), but the increase in the disturbed area under Alternative 4 could potentially increase the impacts.

4.4.9.3 Reclamation

Under Alternative 4, impacts on environmental justice associated with the reclamation activities would be the same as those under Alternative 1 (Section 4.1.9).

Although impacts on the general population could be incurred as a result of exploration, mine development and operations, and reclamation of uranium mining facilities under Alternative 4, for the majority of resources evaluated, impacts are likely to be minor. Specific impacts on low-income and minority populations as a result of participation in subsistence or certain cultural and religious activities would also be minor and would not disproportionately affect minority populations.

4.4.10 Transportation

The transportation risk analysis estimated both radiological and nonradiological impacts associated with the shipment of uranium ore from its points of origin at one of the 31 lease tracts to a uranium mill. Further details on the risk methodology and input data are provided in Section 4.3.10.1 and Section D.10 of Appendix D.

The Alternative 4 transportation assessment evaluates the annual impacts expected during the peak year of operations when 19 of the 31 lease tracts could have operating mines. The shipment of uranium ore over the life of the program is not discussed because of the uncertainty associated with future uranium demand and mine development.

A sample set of 19 of the 31 lease tracts were evaluated in the transportation analysis to represent operations during the peak year of production. As was done for Alternative 3, lease tract selection for the transportation analysis considered the lease tract locations, lessees, and prior mining operations, if any. In addition to a mill's distance, its capacity was also considered when determining which mill would receive a particular mine's ore shipments. Thus, the nearest mill was not always the destination for a given shipment. At the time of actual shipment, various factors, such as existing road conditions due to traffic, weather, and road maintenance or repair, as well as mill capacity and costs, would be among the criteria used to determine which mill should receive a given ore shipment. The intent of the transportation analysis is to provide a reasonable estimate of impacts that could occur. Impacts were also estimated on the basis of the assumption that all shipments would go to a single mill in order to provide an upper range on what might be expected. Single shipment risks for uranium ore shipments are also provided so that an estimate for any future shipping campaign can be evaluated.

The transportation risk assessment considered human health risks from routine (normal, incident-free) transport of radiological materials and from accidents. The risks associated with the nature of the cargo itself ("cargo-related" impacts) were considered for routine transport. Risks related to the transportation vehicle, regardless of type of cargo ("vehicle related" impacts), were considered for routine transport and potential accidents. Radiological-cargo-related accident risks are expected to be negligible and were not assessed as part of this analysis, as discussed in Appendix E, Section E.10.1. Transportation of hazardous chemicals was not part of this analysis because no hazardous chemicals have been identified as being part of uranium mining operations.

4.4.10.1 Routine Transportation Risks

4.4.10.1.1 Nonradiological Impacts. The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 4 would be 80 per day, assuming an ore production rate of 2,000 tons per day, as discussed in Section 2.2.4.1, and a truck load of 25 tons. Including round-trip travel, 160 trucks per day would be expected to travel the affected routes. As listed in Table 3.10-1, the lowest AADT along the route would be about 250 vehicles per day near Egnar on CO 141. If all 160 trucks per day passed through Egnar, in the extreme case of all shipments going to the White Mesa Mill, there would be a 64% increase in traffic in this area, but only a 3% increase at the most heavily traveled location in Monticello, Utah. No additional traffic congestion would be expected in any area, and only about five additional trucks per hour would be expected in each direction, assuming a 16-hour workday for transport.

For the example case with operations at 19 mines (1 very large, 2 large, 10 medium, and 6 small, as discussed in Section 2.2.4.1), the total distance travelled by haul trucks during the peak year would be approximately 2.22 million mi (3.57 million km), assuming round-trip travel between the lease tracts and the mills as shown in Table 4.4-6. Using peak year assumptions of 80 shipments a day and 20 days a month, 19,200 round trips would be expected. The estimated total truck distance traveled of approximately 2.22 million mi or 3.57 million km would be about 18% of the total heavy-truck miles travelled (12.6 million mi or 20.3 million km) along the affected highways in 2010 (CDOT 2011; UDOT 2011). In general, actual annual impacts over the course of the ULP could be lower or higher than these impacts, because the shipment numbers are for the estimated peak year; because for a given lease tract, the ore could be transported to a different mill than that used in the ULP PEIS analysis; or because lease tracts other than those used in the sample case could be developed.

To put the sample case results in perspective, Table 4.4-6 also lists the total distances that ore would be shipped if all of the ore was shipped to one mill or the other. Because of the relative locations of all of the lease tracts with respect to the mills, shipping all of the ore to the White Mesa Mill (4.26 million mi or 6.86 million km) would represent close to the upper bound for the total distance for all shipments. Conversely, shipment of all of the ore to the Piñon Ridge Mill (1.14 million mi or 1.84 million km) would represent close to the lower bound for total distance.

As previously discussed in Section 4.3.10.2.1, most of the distance traveled by the haul trucks would occur on state or U.S. highways. To access these roads, the haul trucks might have to travel distances of up to several miles on county and local roads, depending on the location of the lease tract and the location of the mine within the lease tract. Several residences are located near lease tracts along such roads. In those cases, the number of passing haul trucks could range from about 4 (small mine) to 16 (large mine) trucks per day, depending on the size of the nearby mine, as shown in Table 4.3-14. No residences are located along the short distance between the very large mine (JD-7) and the highway.

4.4.10.1.2 Radiological Impacts. Radiological impacts during routine conditions would be a result of human exposure to the low levels of radiation near the shipment. The regulatory

TABLE 4.4-6 Peak-Year Collective Population Transportation Impacts under Alternative 4

		Radiological Impacts				Accidents per Round Trip	
Scenario	Total Distance (km)	Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	Injuries	Fatalities
Sample case	3,565,000	0.28	0.0002	1.4	0.0009	0.66	0.059
All to Piñon Ridge Mill	1,835,000	0.14	9E-05	0.74	0.0004	0.34	0.031
All to White Mesa Mill	6,861,000	0.53	0.0003	2.8	0.002	1.3	0.11

limit established in 49 CFR 173.441 (Radiation Level Limitations) and 10 CFR 71.47 (External Radiation Standards for All Packages) to protect the public is 10 mrem/h at 6 ft (2 m) from the outer lateral sides of the transport vehicle. As discussed in Appendix D, Section D.10.4.2, the average external dose rate for uranium ore shipments is approximately 0.1 mrem/h at 6.6 ft (2 m), two orders of magnitude lower than the Federal regulatory maximum.

Collective Population Risk. The collective population risk is a measure of the total risk posed to society as a whole by the actions being considered. For a collective population risk assessment, the persons exposed are considered as a group; no individual receptors are specified. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.28 person-rem for the peak year, assuming about 19,200 shipments for the sample case, as shown in Table 4.4-6. The total collective population dose of 0.28 person-rem could result in approximately 0.0002 LCF. Therefore, no LCFs are expected. These impacts are intermediate between the impacts estimated if all ore shipments went to the Piñon Ridge Mill and the impacts estimated if all went to the White Mesa Mill, as shown in Table 4.4-6.

Collectively for the sample case, the truck drivers (transportation crew) would receive a dose of about 1.4 person-rem (0.0009 LCF) during the peak year of operations from all shipments. Again, no LCFs would be expected. For perspective, the collective dose of 1.4 rem (1,400 mrem) over 19,200 shipments is slightly more than double the dose that a single individual would receive in 1 year from natural background radiation and human-made sources of radiation (about 620 mrem/yr).

For scenarios other than those presented in the ULP PEIS, single shipment risks are provided for transporting ore from any of the lease tracts considered under any alternative to the Piñon Ridge Mill (Table 4.3-15) and to the White Mesa Mill (Table 4.3-16). In conjunction with Table 4.3-12, all collective population impacts related to any combination and number of ore shipments between lease tracts and uranium mills could be estimated.

Highest-Exposed Individuals during Routine Conditions. In addition to assessing the routine collective population risk, the risks to individuals under a number of hypothetical exposure scenarios were estimated, as described further in Appendix D, Section D.10.2.2. The scenarios were not meant to be exhaustive but were selected to provide a range of potential exposure situations. The estimated doses and associated likelihood of LCFs are discussed in Section 4.3.10.2.2.

4.4.10.2 Transportation Accident Risks

The total distance traveled by haul trucks during the peak year would be approximately 2.22 million mi (3.57 million km), including round-trip travel between the lease tracts and the mills, as discussed in Section 4.4.10.1.1 for the sample case. As shown in Table 4.4-6, potential transportation accident impacts for the peak year would not include any expected fatalities and would include possibly one injury from traffic accidents. For perspective, over the entire area of the affected counties (San Juan County in Utah and Dolores, Mesa, Montrose, and San Miguel Counties in Colorado), from 2006 through 2010, a total of 21 heavy-truck-related traffic fatalities occurred (DOT 2010a–e), representing an average of 4.2 fatalities per year.

4.4.11 Cultural Resources

Under Alternative 4, the DOE ULP would continue at all 31 lease tracts for the next 10-year period or for another reasonable period. All phases of uranium mining activities (exploration, development and operations, and reclamation) would be expected to occur. Impacts would be similar to those discussed in previous cultural resources sections, except they would occur on a larger scale, since they could occur on all lease tracts.

Impacts from exploration would be expected to be the same as those described in Section 4.3.11.1. They would accrue mostly from exploration test borings and would be minimal within any lease tract. Drill pads are generally small (15 × 50 ft or 4.6 × 75 m), and boring can usually be accomplished with minimal surface disruption. Drilling sites and the proposed locations for any new road construction would have to undergo cultural surveys before any dirt could be moved, and cultural resources would generally be avoided. Secondary impacts from increased access, traffic, and human presence would be similar, but on a larger scale, since three times as many lease tracts would be in play. As listed in Table 2.4-3, 221 known cultural resource sites could be exposed to secondary impacts under Alternative 4.

Impacts from mine development and operations would be similar in nature to those described in Section 4.3.11.2, but once again, on a larger scale. They would include disturbance of archaeological sites, damage or demolition of historic structures, damage or destruction of plant or animal resources that are important to Native Americans, and damage to or disruption of sites that are sacred or culturally important to traditional cultures. The agents of disturbance would likely include earth-moving activities, the demolition or significant alteration of existing structures for mine development, increased human presence, increased access, increased noise, and increased traffic. Based on the average site frequency across all lease tracts and the proposed numbers and sizes of new mines, an estimate of direct impacts was generated and is shown in Table 4.4-7. An estimated 21 cultural resource sites would be likely to be affected by the development of mining activities under Alternative 4.

Impacts from reclamation activities would be the same as those discussed in Section 4.1.11. They include adverse impacts on historically important mining structures and features, ground-disturbing activities if borrowing from undisturbed areas or road construction and improvement occurred, and temporary increases in traffic and human presence. Potential positive impacts from reclamation could include the restoration of habitat for plant and animal resources that are important to Native Americans, the restoration of solitude, and the elimination of some visual intrusions in places that are important to traditional cultures.

TABLE 4.4-7 Cultural Resource Sites That Could Be Directly Affected under Alternative 4

Mine Size Categories under Alternative 4	No. of Mines in Category	Expected No. of Sites per Category	Total No. of Sites Expected
Small	6	0.8	5
Medium	10	1.2	12
Large	2	1.7	3
Total			21

4.4.12 Visual Resources

Under this alternative, exploration, mine development and operations, and reclamation activities would occur on all of the lease tracts considered in the ULP PEIS. Mitigation measures and BMPs for reducing impacts related to off-site lighting and contrast with surrounding areas are summarized in Table 4.6-1 (Section 4.6).

4.4.12.1 Exploration, Mine Development and Operations, and Reclamation

Visual impacts generally would be the same under this alternative as those under Alternatives 1 and 3 (see Sections 4.1.12 and 4.3.12). The primary difference would be that activities would occur on all lease tracts. Impacts could result from a range of direct and indirect actions or activities occurring on the lands contained within the lease areas. These types of impacts include the following: (1) vegetation and landform alterations; (2) removal and addition of structures and materials; (3) changes to existing roadways; (4) vehicular and worker activity; and (5) light pollution.

Visual impacts associated with exploration and mine development and operations were discussed further in Sections 4.3.12.1 and 4.3.12.2. Impacts associated with reclamation activities were discussed further in Sections 4.1.12.1 through 4.1.12.5.

4.4.12.2 Impacts on Surrounding Lands

Under Alternative 4, DOE would continue the ULP at all 31 of the lease tracts for the next 10-year period or for another reasonable period. The following analysis provides an overview of the potential visual impacts on the SVRAs surrounding the mining locations. Because of the number of leases and the potential for increased mining activity, lands outside the lease tracts that have views of the lease tracts would be subject to visual impacts. The affected areas and extent of impacts would depend on a number of visibility factors, view duration, and view distance.

Preliminary viewshed analyses were conducted to identify which lands surrounding the lease tracts could have views of the mining activities in at least some portion of the four groups. This analysis was based on a reverse viewshed analysis. Appendix E provides an overview of the methodology used to determine which locations are visible within a 25-mi (40 km) distance surrounding the lease tracts. For the purposes of this analysis, the lease tracts were analyzed in four groups, as described in Section 4.12: the North; North Central; South Central; and South Groups. The intent of the analysis was to determine the potential levels of contrasts (i.e., changes in form, line, color, and texture from the existing conditions to those under Alternative 4) that would be present.

4.4.12.2.1 North Group. Views from the following SVRAs would potentially include the lease tracts from the North Group:[8]

- Sewemup WSA;
- The Palisade ONA (an ACEC);
- The Palisade WSA;
- Unaweep/Tabeguache Scenic and Historic Byway;
- Tabeguache Area;
- Dolores River SRMA; and
- Dolores River Canyon WSA.

Figure 4.4-1 shows the results of the viewshed analysis for lease tracts within the North Group. The colored segments indicate areas in the SVRAs with clear lines of sight to one or more areas within the lease tracts and from which mining activities within the lease tracts would be expected to be visible, assuming the absence of screening vegetation or structures, and assuming there would be adequate lighting and other atmospheric conditions.

Within 5 mi (8 km) of the North Group, views from approximately 3% (640 acres or 260 ha) of the Sewemup WSA would potentially include the lease tracts. This WSA is located to the southwest of the North Group. As the distance from the lease tracts increases, views from approximately 38% (7,500 acres or 3,000 ha) of the WSA would potentially include the lease tracts. Views of the North Group from the WSA are generally partially or fully screened by the intervening mountains. The visible areas generally are located to the west of the Dolores River. Visibility of the North Group is most likely from the locations within the WSA that are higher in elevation than the lease tracts. Depending on the infrastructure placed within the two lease tracts,

[8] For the four groups of lease tracts, the SVRAs are presented in descending order, based on the percentage of the total acreage or mileage that would have potential views of the lease tracts.

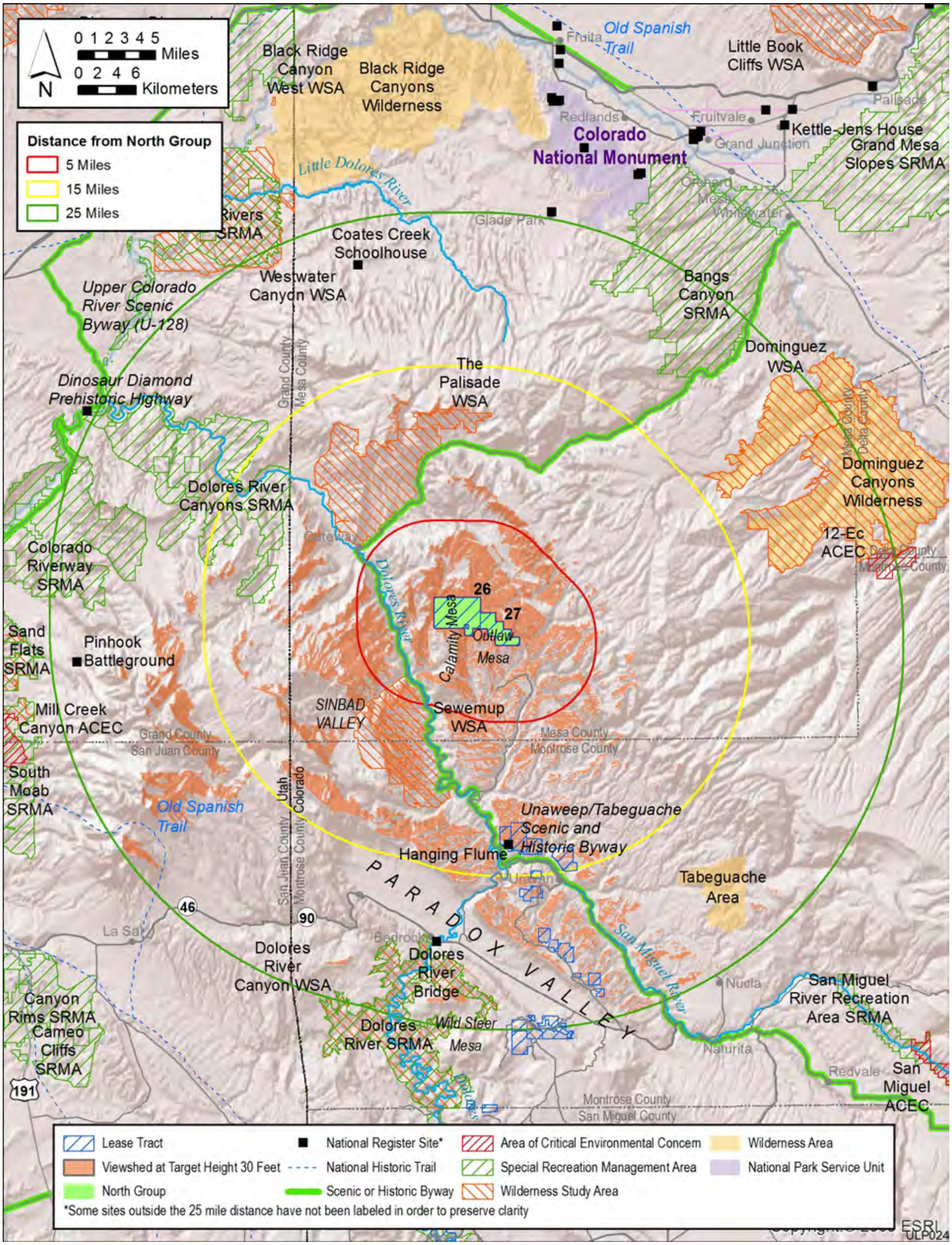

FIGURE 4.4-1 Viewshed Analysis for the North Lease Group under Alternative 4

views of the mine activities and sites might be limited and include the tops of headframes, drill rigs, or other structures, if present. Activities conducted under Alternative 4 would be expected to cause minimal to weak contrast levels for views from this WSA.

Portions of the Palisade ONA ACEC that would potentially have visibility of the North Group lease tracts are located between 5 and 25 mi (8 and 40 km) of the lease tracts. The ACEC is located to the north of these two lease tracts. Within this distance, views from approximately 560 acres (220 ha), or 2.3% of the total ACEC, could potentially include the lease tracts. Views of the North Group from the ACEC are generally partially or fully screened by the intervening mountains. Only views from the northernmost portions of the ACEC would potentially include the lease tracts, such as from portions of the ACEC located along the Piñon Mesa. Depending on the infrastructure placed within the two lease tracts, views of the mine activities and sites might be limited and include the tops of headframes, drill rigs, or other structures, if present. As such, activities conducted under Alternative 4 would be expected to cause minimal contrast levels to no contrasts at all for views from this area.

Between 5 and 15 mi (8 and 24 km) from the North Group, the lease tracts would potentially be visible from approximately 1.5% (390 acres or 60 ha) of the Palisade WSA. The Palisade WSA is contained almost entirely within the Palisade ONA ACEC. As a result, contrast levels for this area would be similar to those described for the ACEC.

The lease tracts would potentially be visible from less than 1% of the Unaweep/ Tabeguache Scenic and Historic Byway, the Tabeguache Area, the Dolores River SRMA, and the Dolores River WSA. Under Alternative 4, mining-related activities in the lease tracts would be expected to cause minimal contrast levels to no contrasts at all for views from these SVRAs.

Views from portions of the North and South Central Groups also would potentially include lease tracts within the North Group. These locations are within 5 and 25 mi (8 and 40 km) of the group.

4.4.12.2.2 North Central Group. Figure 4.4-2 shows the results of the viewshed analysis for lease tracts within the North Central Group. Views from the following SVRAs would potentially include the North Central Group:

- Tabeguache Area;
- Sewemup WSA;
- Unaweep/Tabeguache Scenic and Historic Byway;
- Dolores River Canyon WSA;
- Dolores River SRMA;

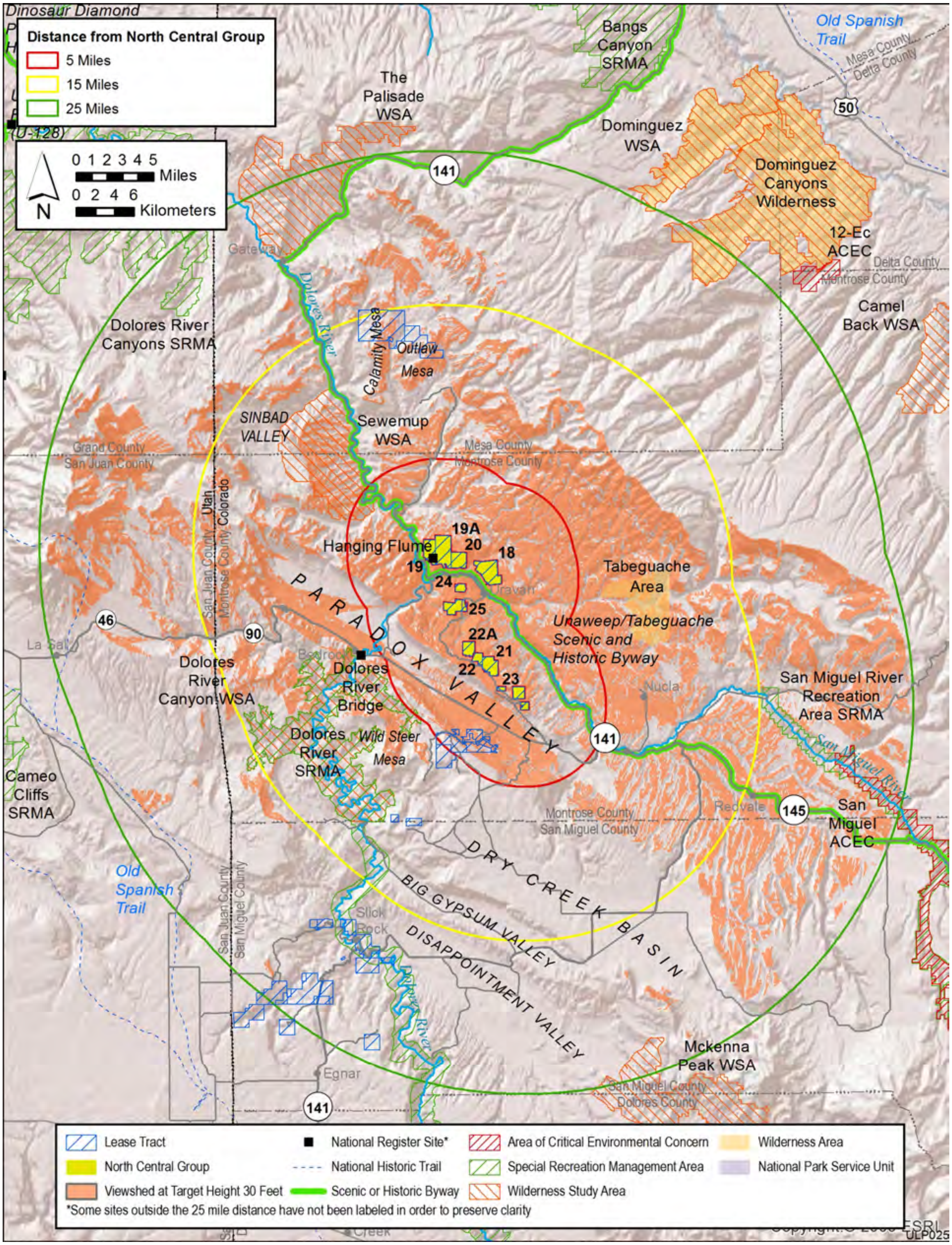

FIGURE 4.4-2 Viewshed Analysis for the North Central Lease Group under Alternative 4

- San Miguel ACEC; and

- San Miguel River SRMA.

The North Central Group lease tracts would be visible from portions of the Tabeguache Area. The entire area is located between 5 and 15 mi (8 and 40 km) of this group of lease tracts within Montrose County. Views of the North Central Group from the area are partially or fully screened by the intervening mountains and vegetation. The lease tracts would be visible from approximately 59% (4,800 acres or 1,700 ha) of the area. Views of the lease tracts would be possible from elevated viewpoints within the area. Depending on the infrastructure placed within the North Central Group, views of the mine activities and sites might be limited and include the tops of headframes, drill rigs, or other structures, if located on the individual lease tracts. Activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this area.

The North Central Group lease tracts would be visible from approximately 1.6% (310 acres or 130 ha) of the Sewemup WSA. As the distance from the lease tracts increases, views from approximately 35% (6,900 acres or 2,800 ha) of the WSA would potentially include the lease tracts. Similar to views from the Tabeguache Area, views of the North Central Group from the WSA are generally partially or fully screened by the intervening mountains. Visibility of the North Central Group is likely from the locations within the WSA that are higher in elevation than the lease tracts. Depending on the infrastructure placed within the lease tracts, views of the mine activities and sites might be limited and include the tops of headframes, drill rigs, or other structures. Activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this WSA.

Drivers along the Unaweep/Tabeguache Scenic and Historic Byway would have views of the North Central Group from locations within the BLM foreground distance of 3 to 5 mi (5 to 8 km). Within this distance, views from approximately 22 mi (35 km) of the byway would potentially include the lease tracts. Between 0 and 15 mi (0 and 24 km), views from approximately 36 mi (58 km) would potentially include the lease tracts, and between 0 and 25 mi (0 and 40 km), views from approximately 43 mi (69 mi) would potentially include the lease tracts. The byway passes between Lease Tracts 18, 19, 19A, 20, 24, and 25. Depending on the infrastructure placed within the lease tracts, views of the mine activities and sites would be visible to visitors driving along the byway, primarily in the area within Montrose County. Views that are level or looking down onto the lease tracts would involve stronger contrasts than views that are lower in elevation. Views would include headframes, drill rigs, or other structures, if needed for the mining activities. As such, activities conducted under this alternative would be expected to cause minimal to strong contrast levels for views from the byway. However, views from the byway would be relatively short in duration, largely due to the small size of the individual lease tracts within the North Central Group.

Between 5 and 25 mi (8 and 40 km) from the North Central Group, the North Central Group lease tracts would be visible from approximately 2.9% (860 acres or 350 km) of the Dolores River Canyon WSA. Views of the North Central Group from the WSA are generally partially or fully screened. Scattered portions of the WSA are visible largely as a result of the intervening mesa tops and Paradox Valley. Views of the mine activities and sites within the lease tracts contained within this group might be limited and include the tops of headframes, drill rigs, or other structures, if present. Under Alternative 4, activities would be expected to cause minimal to weak contrast levels for views from the Dolores River Canyon WSA.

The North Central Group lease tracts would be visible from approximately 1.3% (880 acres or 360 ha) of the Dolores River SRMA. Portions of the SRMA with views of the lease tracts are located to the west of Paradox Valley and to the northwest of Lease Tracts 8, 8A, and 9. These locations are near Bedrock, Colorado. Similar to other SVRAs located within 25 mi (40 km) of the North Central Group, views from elevated locations would likely include the tops of headframes, drill rigs, and other structures, if present. Activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this SRMA.

The North Central Group lease tracts would be visible from less than 1% (51 acres or 21 ha) of the San Miguel ACEC. Portions of the ACEC with views of the lease tracts are located between 15 and 25 mi (24 and 40 km) of the North Central Group north of Norwood, Colorado, and Route 145. Views of the lease tracts from the San Miguel ACEC would likely be limited. Activities conducted under this alternative would be expected to cause minimal contrast levels to no contrasts at all for views from this ACEC.

The North Central Group lease tracts would be potentially visible from less than 1% (280 acres or 120 ha) of the San Miguel River SRMA. Locations within the SRMA with potential views of the lease tracts are between 15–25 mi (24–40 km) southeast of the North Central Group. There could potentially be views of the lease tracts from elevated viewpoints within the SRMA outside the river canyon. Activities conducted within the North Central Group lease tracts would be expected to cause minimal to no contrasts at all as seen from the SRMA, primarily due to the relatively long distance between the SRMA and the lease tracts and to the very limited amount of acreage within the SRMA that would potentially have views of the lease tracts.

Views from portions of the North and South Central Groups also would potentially include the North Central Group. These viewing locations are within 5 and 25 mi (8 and 40 km) of the North Central Group.

4.4.12.2.3 South Central Group. Figure 4.4-3 shows the results of the viewshed analysis for lease tracts within the South Central Group. The following SVRAs might have views of the South Central Group:

- Tabeguache Area;
- Dolores River Canyon WSA;
- Dolores River SRMA;

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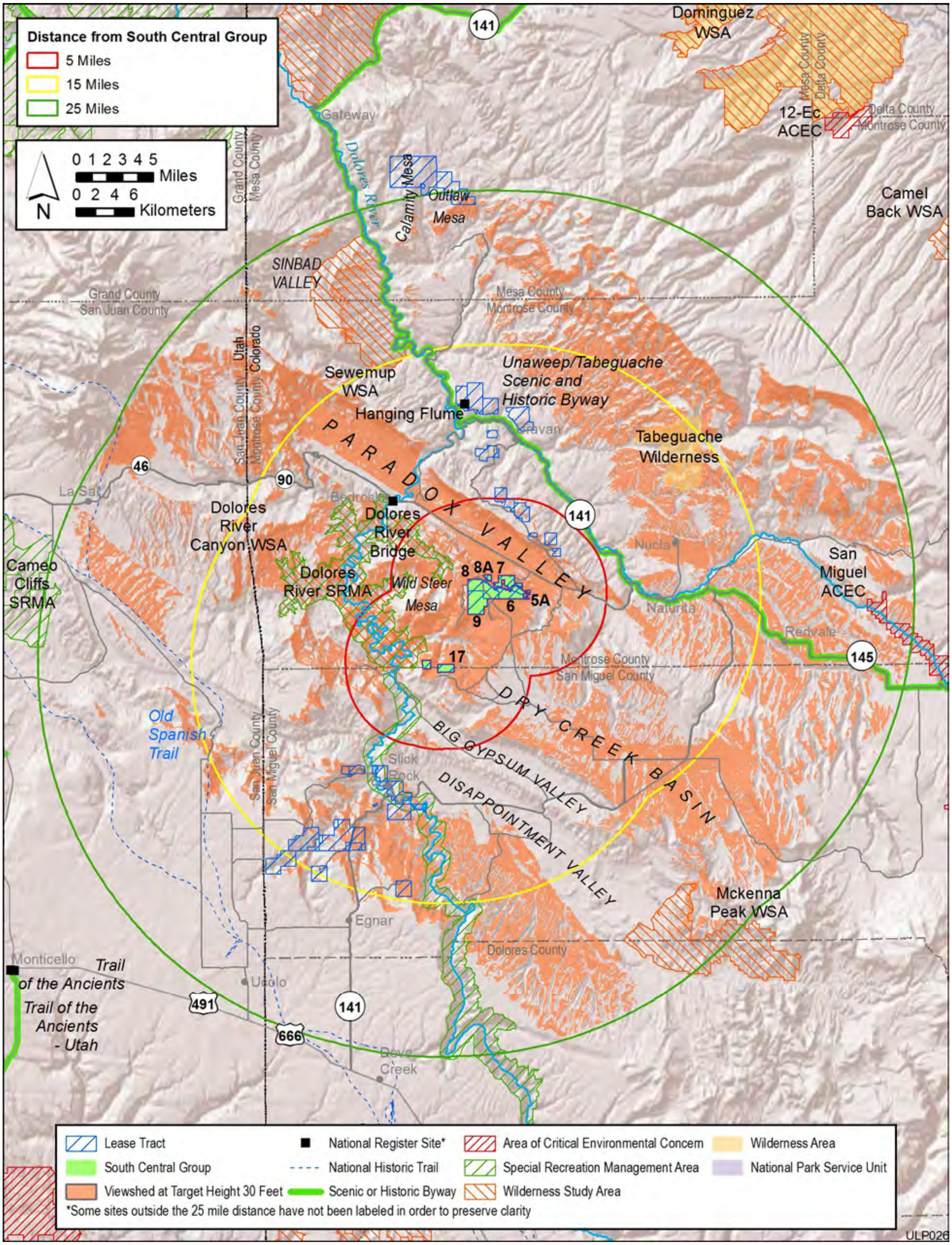

2 **FIGURE 4.4-3 Viewshed Analysis for the South Central Lease Group under Alternative 4**

- Unaweep/Tabeguache Scenic and Historic Byway;
- Sewemup WSA;
- McKenna Peak WSA;
- San Miguel ACEC; and
- San Miguel River SRMA.

Of these SVRAs, only the Dolores River SRMA and the Dolores River Canyon WSA include lands within 5 mi (8 km) of the South Central Group with potential views of the lease tracts.

The South Central Group lease tracts are potentially visible from approximately 46% (3,700 acres or 1,500 ha) of the Tabeguache Area. Most of this area is located between 5 and 15 mi (8 and 24 km) of this group of lease tracts within Montrose County. Views of the South Central Group are partially or fully screened by the intervening topography and vegetation. Views of the mine activities and sites within the lease tracts contained within this group might be limited and likely would include the tops of headframes, drill rigs, or other structures, if located within the mine sites. Similar to those impacts experienced from views to the North Central Group, activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this area.

Between 0 and 15 mi (24 km) from the lease tracts, the South Central Group lease tracts could potentially be visible from approximately 22% (6,500 acres or 2,600 ha) of the Dolores River Canyon WSA. These viewing locations are south of Bedrock, Colorado. If present, headframes, drill rigs, or other structures might be visible from within the WSA. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this WSA.

The South Central Group lease tracts are potentially visible from approximately 14% (8,900 acres or 3,600 ha) of the Dolores River Canyon SRMA. These viewing locations are in those portions of the SRMA within Montrose County, south of the Bedrock, Colorado. Views of the mine activities and sites within the lease tracts contained within this group might be limited and likely would include the tops of headframes, drill rigs, or other structures, if located within the mine sites. Views of the lease tracts are more likely to occur from elevated locations than from within the canyon. Similar to the Dolores River Canyon WSA, activities conducted under Alternative 4 would be expected to cause minimal to weak contrast levels for views from this SRMA.

The viewshed analysis indicates that drivers along the Unaweep/Tabeguache Scenic and Historic Byway would potentially have views of the South Central Group in locations within the background and “seldom seen” distances, along approximately 19 mi (30 km) of the byway. However, because of minor mapping inaccuracies that place portions of the roadway outside the narrow canyon it occupies and thereby locate them at higher elevations than they actually are, and because of vegetative screening, the actual mileage of the byway with views of the lease tracts is likely much smaller. Actual visibility would be determined as part of a site- and project-specific environmental assessment. Views from the byway near the towns of Redvale and Naturita also could include the lease tracts within the South Central Group. Depending on the infrastructure used at each mine site, views of headframes, drill rigs, or other structures might occur. Minimal contrast levels to no contrasts at all would be expected to occur for users of the byway.

The South Central Group lease tracts are potentially visible from approximately 8.0% (1,580 acres or 640 ha) of the Sewemup WSA. These viewing locations are within 15 and 25 mi (24 and 40 km) of the South Central Group. Views of the South Central Group from the WSA are generally partially or fully screened by the intervening mountains. This group of lease tracts is likely to be visible from the western edge of Sewemup Mesa within the WSA areas that are higher in elevation than the lease tracts. Depending on the infrastructure present on each lease tract, views of the mine activities and sites might be limited, and they could include the tops of headframes, drill rigs, or other structures. Activities conducted under this alternative would be expected to cause minimal contrast levels to no contrasts for all for views from this area.

The South Central Group lease tracts are potentially visible from approximately 3.6% (720 acres or 290 ha) of the McKenna Peak WSA. These locations within the WSA are between 15 and 25 mi (24 and 40 km) from the South Central Group. These viewing areas primarily are located within San Miguel County, with only a small portion being within Dolores County. Views of the mine activities and sites within the lease tracts contained within this group might be limited, and they would be likely to include the tops of headframes, drill rigs, or other structures, if present. Activities conducted under this alternative would be expected to cause minimal contrast levels to no contrasts at all for views from this SVRA.

The South Central Group lease tracts are potentially visible from less than 1% (21 acres or 8.5 ha) of the San Miguel ACEC. These viewing locations are within Montrose County, north of Norwood, Colorado, along an elevated mountain ridge in the north part of the ACEC. Views of the lease tracts form the ACEC are likely to be limited. Activities conducted under Alternative 4 would be expected to cause minimal (barely discernible) contrast levels to no contrasts at all for views from this SVRA.

The South Central Group lease tracts would be potentially visible from less than 1% (280 acres or 120 ha) of the San Miguel River SRMA, at distances from 18–24 mi (29–39 km) from the SRMA. There could potentially be views of the lease tracts from elevated viewpoints within the SRMA outside the river canyon. Activities conducted within the South Central Group lease tracts would be expected to cause minimal to no contrasts at all as seen from the SRMA, primarily due to the relatively long distance between the SRMA and the lease tracts and to the very limited amount of acreage within the SRMA that would potentially have views of the lease tracts.

Portions of the North Central and South Groups also would potentially include the lease tracts within the South Central Group. These viewing locations are within 5 and 15 mi (8 and 24 km) of the group.

4.4.12.2.4 South Group. Figure 4.4-4 shows the results of the viewshed analysis for lease tracts within the South Group. The following SVRAs might have views of the South Group:

- McKenna Peak WSA;
- Dolores River SRMA;
- Cahone Canyon WSA;
- Dolores River Canyon WSA;
- Trail of the Ancients Byway;
- Squaw/Papoose Canyon WSA; and
- Canyons of the Ancients National Monument.

Of these SVRAs, only the Dolores River Canyon WSA includes lands within 5 mi (8 km) of the South Group with potential views of the lease tracts.

The South Group lease tracts are potentially visible from approximately 27% (5,400 acres or 2,200 ha) of the McKenna Peak WSA. Portions of the WSA with potential views of the lease tracts are between 15 and 25 mi (24 and 40 km) of the lease tracts. Views of the mine activities and sites within the lease tracts contained within this group might be limited and likely would include the tops of headframes, drill rigs, or other structures, if present. Activities conducted under this alternative would be expected to cause minimal to weak contrast levels for views from this SVRA.

From within 5 mi (8 km) of the South Group, the lease tracts are potentially visible from approximately 13% (8,400 acres or 3,400 ha) of the Dolores River Canyon SRMA. In fact, portions of the SRMA are contained within the actual lease tracts, including Lease Tracts 13, 13A, and 14. Depending on the infrastructure placed within the South Group, views of the mine activities and sites would include headframes, drill rigs, or other structures, as well as actual mining activities. Activities under this alternative would be expected to create weak to strong contrast levels for views from this SRMA. The stronger contrast levels would occur for views from those areas of the SRMA that were located within the contrast South Group, and the levels would lessen as the distance from the lease tracts increased.

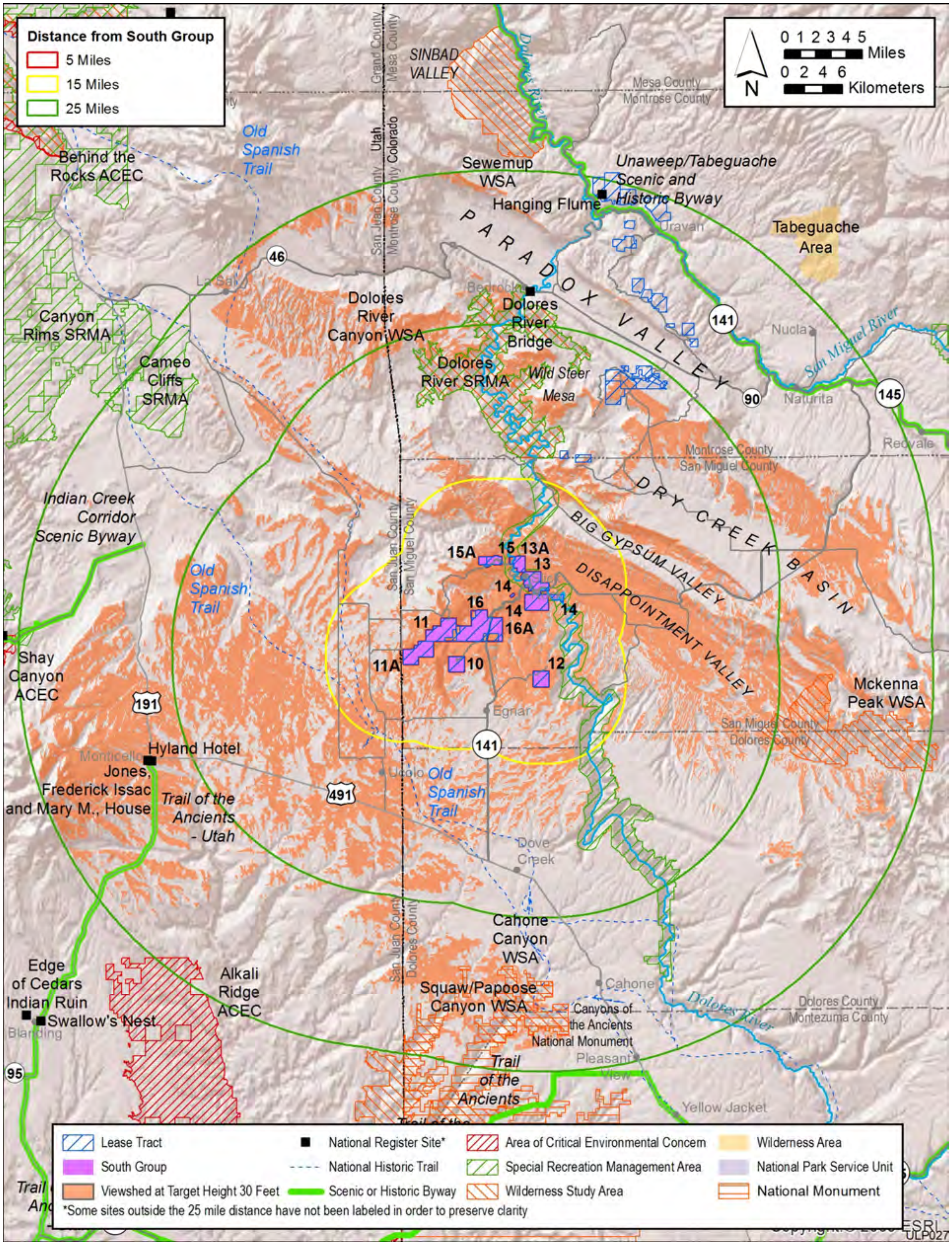

FIGURE 4.4-4 Viewshed Analysis for the South Lease Group under Alternative 4

Within the "seldom seen" distance zone (i.e., between 15 and 25 mi or 24 and 40 km), a small portion of the South Group lease tracts are potentially visible from approximately 790 acres or 320 ha (8.7%) of the Cahone Canyon WSA. Views of the lease tracts from the WSA are likely to be very limited. Depending on the infrastructure placed within the lease tracts, views might include headframes, drill rigs, or other structures. Activities conducted under this alternative would be expected to cause minimal contrasts levels to no contrasts at all for views from the WSA.

Between 5 and 25 mi (8 and 40 km) from the South Group, the lease tracts are potentially visible from approximately 4.1% of the Dolores River Canyon WSA. Views of the South Group from the WSA are generally partially or fully screened; they are located primarily within elevated portions of the WSA, near the Slick Rock Canyon. Views of the mine activities and sites might be limited and include only the tops of headframes, drill rigs, or other structures, if present. Activities conducted under this alternative would be expected to cause minimal contrast levels to no contrasts at all for views from the Dolores River Canyon WSA.

Views from approximately 9.5 mi (15 km) of the Trail of the Ancients would potentially include the South Group. This trail is located within the "seldom seen" distance zone (i.e., between 15 and 25 mi or 24 and 40 km). Viewing locations from the trail that would include views of the lease tracts are mainly to the west of the South Group in Utah. The trail's footprint primarily follows US 191. Views of the lease tracts would be limited, and the views would be of brief duration to byway drivers. Activities conducted under Alternative 4 would be expected to cause minimal contrast levels to no contrasts at all for views from along the trail.

A small portion of the South Group lease tracts is potentially visible from less than 1% of the Squaw/Papoose Canyon WSA and the Canyons of the Ancients National Monument. Portions of these SVRAs with potential views of the lease tracts are between 15 and 25 mi (24 and 40 km) from the South Group. Views of the lease tracts from the WSA are likely to be very limited. Activities conducted under this alternative would be expected to cause minimal contrast levels to no contrasts at all for views from these SVRAs.

Portions of the South Central Group also would potentially include views of the lease tracts within the South Group, including Lease Tracts 8, 9, and 17. Viewing locations with this potential are within 5 and 15 mi (8 and 24 km) from the group.

4.4.13 Waste Management

Potential impacts on waste management practices under Alternative 4 would be small and similar to those under Alternatives 1, 2, and 3. The quantity of waste to be managed under Alternative 4 would be slightly larger than the quantity under Alternative 3 for the peak year of mine development and operations.

4.5 ALTERNATIVE 5

Under Alternative 5, it is assumed that a total of 19 mines (16 medium, 2 large, and 1 very large) with a total area of 490 acres (200 ha) would be in operation in the peak year. The same three phases of mining evaluated for Alternatives 3 and 4 were also evaluated for Alternative 5.

> Alternative 5: This is the No Action Alternative, under which DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period, and the leases would continue exactly as they were issued in 2008.

4.5.1 Air Quality

4.5.1.1 Exploration

Types of potential impacts and emission sources are discussed in Section 4.3.1.1. Under Alternative 5, four and six borehole drillings up to a depth of 600 ft (180 m) would occur at 16 medium and 2 large mines, respectively, in any peak year. As shown in Table 4.5-1, estimated air emissions under Alternative 5 are about three to four times higher than those under Alternative 3, but they are still negligible when compared to three-county total emissions for criteria pollutants and VOCs and Colorado or U.S. GHG emissions.

In consequence, similar to Alternatives 3 and 4 discussed previously, exploration activities occur over relatively small areas and involve little ground disturbance, a small crew, and a small fleet of heavy equipment. Thus, it is anticipated that potential impacts from this phase on ambient air quality and regional ozone or AQRVs would be negligible and temporary. Potential impacts from these activities on climate change would be negligible.

4.5.1.2 Mine Development and Operations

Air emissions of criteria pollutants, VOCs, and CO_2 from mine development and operations estimated for the peak year are presented in Table 4.5-1 and compared to emission totals for a combination of the three counties (Mesa, Montrose, and San Miguel) that encompass the DOE ULP lease tracts. As shown in the table, total peak-year emission rates are estimated to be rather small compared to emission totals for all three counties. Typically, PM emissions are highest during mine development, while NO_x emissions are highest during operations. During mine development, non-PM emissions would be relatively small (up to 0.45%), and PM_{10} and $PM_{2.5}$ emissions would be about 3.2% and 1.4%, respectively, of the three-county total emissions. PM_{10} emissions would result from explosives use (47%) and site preparation (43%), followed by wind erosion (9%). Exhaust emissions would contribute only a little to total PM_{10} emissions. During operations, NO_x emissions of 313 tons/yr are highest, amounting to about 2.3% of three-county total emissions. NO_x emissions would mostly come from diesel-fueled heavy equipment (e.g., bulldozers or power generators) and trucks. These impacts would be minimized by implementing good industry practices and fugitive dust mitigation measures (such

TABLE 4.5-1 Peak-Year Air Emissions from Mine Development, Operations, and Reclamation under Alternative 5[a]

	Annual Emissions (tons/yr)								
Pollutant[b]	Three-County Total[c]	Exploration		Mine Development		Mine Operations		Reclamation	
CO	65,769	9.5	(0.01%)[d]	176	(0.27%)	145	(0.22%)	12.0	(0.02%)
NO_x	13,806	23.3	(0.17%)	61.8	(0.45%)	313	(2.3%)	24.8	(0.18%)
VOCs	74,113	2.8	(0.004%)	1.9	(0.003%)	30.4	(0.04%)	2.5	(0.003%)
$PM_{2.5}$	5,524	2.3	(0.04%)	78.3	(1.4%)	26.7	(0.48%)	35.3	(0.64%)
PM_{10}	15,377	4.5	(0.03%)	489	(3.2%)	51.4	(0.33%)	174.7	(1.14%)
SO_2	4,246	2.6	(0.06%)	7.5	(0.18%)	40.1	(0.95%)	3.3	(0.08%)
CO_2	142.5×10^6 [e]	2,600	(0.002%)	1,800	(0.001%)	29,000	(0.020%)	2,400	(0.002%)
	$7,311.8\times10^6$ [f]		(0.00004%)		(0.00002%)		(0.00040%)		(0.00003%)

[a] Under Alternative 5, it is assumed that 19 mines (16 medium, 2 large, and 1 very large) with a total area of 490 acres (200 ha) would be in operation or reclaimed in any peak year.

[b] Notation: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of ≤2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter of ≤10 µm; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

[c] Total emissions in 2008 for all three counties encompassing the DOE ULP lease tracts (Mesa, Montrose, and San Miguel Counties), except for CO_2 emissions. See Table 3.1-2.

[d] Numbers in parentheses are percentages of three-county total emissions, except for CO_2, which are percentages of Colorado total emissions (top line) and U.S. total emissions (bottom line).

[e] Annual emissions in 2010 for Colorado on a CO_2-equivalent basis.

[f] Annual emissions in 2009 for the United States on a CO_2-equivalent basis.

Sources: CDPHE (2011a); EPA (2011a); Strait et al. (2007)

as watering unpaved roads, disturbed surfaces, and temporary stockpiles). Therefore, potential impacts on ambient air quality would be minor and temporary.

The three counties encompassing the lease tracts are currently in attainment for ozone (EPA 2011b), but ozone levels in the area approached the standard (about 90%) (see Table 3.1-3). Recently, wintertime ozone exceedances have been frequently reported at higher elevations in northwestern Colorado, northeastern Utah, and southwestern Wyoming. However, ozone precursor emissions from mine development and operations would be relatively small—less than 2.3% and 0.04%, respectively, of three-county total NO_x and VOC emissions, and they would be much lower than those for the regional airshed in which emitted precursors are transported and transformed into ozone. In addition, the wintertime high-ozone areas are located more than 100 mi (160 km) from the lease tracts and are not located downwind of the prevailing westerlies in the region. Accordingly, potential impacts of O_3 precursor releases from mine development and operations on regional ozone would not be of concern.

As discussed in Section 4.1.4, there are several Class I areas around the lease tracts where AQRVs, such as visibility and acid deposition, might be a concern. Primary pollutants affecting AQRVs include NO_x, SO_2, and PM. NO_x and SO_2 emissions from mine development and operations would be relatively small, accounting for up to 2.3% of three-county total emissions, while PM_{10} emissions would be about 3.2% of three-county total emissions. Air emissions from mine development and operations could result in minor impacts on AQRVs at nearby Class I areas. The implementation of good industry practices and fugitive dust mitigation measures could minimize these impacts.

Annual total CO_2 emissions from mine development and operations were estimated as shown in Table 4.5-1. CO emissions during operations would be much higher than those during mine development. During operations, annual total CO_2 emissions would be about 29,000 tons (26,000 metric tons). They accounted for about 0.020% of Colorado GHG emissions in 2010 at 140 million tons (130 million metric tons) of CO_2e and for about 0.00040% of U.S. GHG emissions in 2009 at 7,300 million tons (6,600 million metric tons) of CO_2e (EPA 2011a; Strait et al. 2007). Thus, potential impacts from mine development and operations on global climate change would be negligible.

4.5.1.3 Reclamation

Peak-year emissions during the reclamation phase under Alternative 5 are included in Table 4.5-1. PM_{10} emissions are highest, accounting for about 1.1% of three-county combined emissions. Among non-PM emissions, NO_x emissions from diesel combustion of heavy equipment and trucks are highest, up to 0.18% of three-county total emissions. Good industry practices and mitigation measures would be implemented to ensure compliance with environmental requirements. Thus, potential impacts on ambient air quality associated with reclamation activities under Alternative 5 are anticipated to be minor and temporary in nature. These low-level emissions are not anticipated to cause any measurable impacts on regional ozone or AQRVs, such as visibility or acid deposition, at nearby Class I areas. In addition, CO_2 emissions during the reclamation phase were about 0.002% of Colorado GHG emissions in 2010 and 0.00003% of U.S. GHG emissions in 2009 (EPA 2011a; Strait et al. 2007). Thus, under Alternative 5, potential impacts from reclamation activities on global climate change would be negligible.

4.5.2 Acoustic Environment

4.5.2.1 Exploration

Details on activities during the exploration phase are presented in Section 4.3.1.1. The types of impacts related to exploration under Alternative 5 would be similar to those under Alternative 3 (Section 4.3.1.1). Exploration activities would occur over relatively small areas and involve little ground disturbance, a small crew, and a small fleet of heavy equipment. Accordingly, it is anticipated that noise impacts from the exploration phase on neighboring residences or communities, if any, would be minor and intermittent.

4.5.2.2 Mine Development and Operations

As described in Section 4.3.2.2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the mine development site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the mine development site. In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers caused by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours, would reduce noise levels further. Thus, noise attenuation to Colorado or EPA limits would occur at distances somewhat shorter than the aforementioned distances. In many cases, these limits would not reach any nearby residences or communities. However, if mine development occurred near the lease tract boundary, noise levels at residences around Lease Tracts 13, 13A, 16, and 16A would exceed the Colorado limit.

It is assumed that most mine development and operational activities would occur during the day, when noise is better tolerated because of the masking effects of background noise, which occurs more during daytime than at night. In addition, mine development activities for lease tracts are temporary in nature (typically a few months). Mine development within the lease tracts would cause some unavoidable but localized short-term noise impacts on neighboring residences or communities, particularly when mine development occurred near the residences or communities adjacent to the lease tract boundary.

During mine operations, ventilation fans would run continuously at mine sites, for which noise calculations were made separately. The number of fans used for a mine depends on how extensive the mine activities are but typically would be one or two fans for small mines, two or three fans for medium mines, and three or four fans for large mines at an interval of every 366–457 m (1,200–1,500 ft) (Williams 2013). The composite noise level for a ventilation fan, such as that used at JD-9 mine, is about 86 dBA at a distance of 3 m (10 ft) (Spendrup 2013), corresponding to about 70 dBA at a reference distance of 15 m (50 ft), which is far lower than noise levels for typical heavy equipment. For a single fan, noise levels would attenuate to 55 and 50 dBA at distances of about 60 m (200 ft) and 90 m (300 ft) from the fan, respectively, which are the Colorado daytime and nighttime maximum permissible limits of 55 and 50 dBA in a residential zone. The EPA guideline level of 55 dBA L_{dn} for residential areas would occur at about 110 m (360 ft). For four identical fans that are located equidistant from a receptor, these distances would be extended to about 100 m (330 ft), 160 m (530 ft), and 190 m (620 ft), respectively. During daytime hours, beyond some distances, a noise of interest can be overshadowed by relatively high background levels along with skyward refraction caused by temperature lapses (i.e., temperature decreases with increasing height, so sound tends to bend towards the sky). However, on a calm, clear night typical of ULP lease tract settings, the air temperature would likely increase with increasing height (temperature inversion) because of strong radiative cooling. Such a temperature profile tends to focus noise downward toward the ground. Thus, there would be no shadow zone[9] within 1 or 2 mi (2 or 3 km) of the source in the presence of a strong temperature inversion (Beranek 1988). In particular, such conditions add to the effect of noise being more discernible during nighttime hours, when the background levels are the lowest. Considering these facts, potential impact distances would be extended further, to several hundred meters. Accordingly, noise control measures (e.g., the installation of front and rear silencers, which can reduce noise levels from 5 to 10 dBA [Spendrup 2013]) would be warranted if any residences were located within these distances from ventilation fans. Also, the outlet could have a 45 degree or 90 degree elbow pointed away from the sensitive receptors (Williams 2013).

During operations, over-the-road heavy haul trucks would transport uranium ores from lease tracts to either the proposed Piñon Ridge Mill or White Mesa Mill in Utah. These shipments could generate noise along the haul routes. Under Alternative 5, about 2,300 tons per day of uranium ore would be generated. Based on the assumptions that there would be 25 tons of uranium ore per truck and round-trip travel, the traffic volume would be 184 truck trips per day (92 round trips per day) and 23 trucks per hour (for 8-hour operation). At distances of 200 ft (61 m) and 380 ft (120 m) from the route, noise levels would attenuate to 55 and 50 dBA, respectively, which are Colorado daytime and nighttime maximum permissible limits in a residential zone. Noise levels above the EPA guideline level of 55 dBA L_{dn} for residential areas would be reached at a distance of up to 100 ft (31 m) from the route. Accordingly, Colorado limits or EPA guideline levels would be exceeded within 380 ft (120 m) from the haul route, and any residences within this distance might be affected.

Depending on local geological conditions, explosive blasting during mine development and operations might be required. Blasting would generate a stress wave in the surrounding rock, causing the ground and the structures on the ground surface to vibrate. The blasting would also create a compressional wave in the air (air blast overpressure), the audible portion of which would be manifested as noise. Potential impacts of ground vibration would include damage to structures, such as broken windows. Potential impacts of blast noise would include effects on humans and animals. The estimation of potential increases in ambient noise levels, ground vibration, and air blast overpressure, as well as the evaluation of any environmental impacts

[9] A shadow zone is defined as the region where direct sound does not penetrate because of upward refraction.

associated with such increases, would be required at the site-specific project phase, if potential impacts were anticipated at nearby residences or structures.

Blasting techniques are designed and controlled by blasting and vibration control specialists to prevent damage to structures or equipment. The controls attenuate blasting noise as well. Under Alternative 5, several residences are within 1.0 mi (1.6 km) of the boundaries of the lease tracts to be developed. Residences at further distances would not require additional mitigation. However, given the impulsive nature of blasting noise, it is critical that blasting activities be avoided at night and on weekends and that affected neighborhoods be notified in advance of scheduled blasts.

There are several specially designated areas (e.g., Dolores River SRMA and Dolores River Canyon SRA) and other nearby wildlife habitats around the DOE ULP lease tracts and haul routes where noise might be a concern. Negative impacts on wildlife (specifically, onset of adverse physiological impacts) begin between 55 and 60 dBA (Barber et al. 2010). As discussed above, these levels would be limited up to distances of 1,650 ft (500 m) from the mine sites and 200 ft (61 m) from the haul routes. However, there is the potential for other effects to occur at lower noise levels (Barber et al. 2011). To adequately account for these impacts and the potential for impacts at lower noise levels, impacts on terrestrial wildlife from mine development noise and mitigation measures would have to be determined on a site-specific basis, including the consideration of site-specific background levels and the hearing sensitivities of site-specific terrestrial wildlife of concern.

In summary, potential noise impacts from mine development on humans and wildlife would be anticipated near the mine sites and along the haul routes, but their impacts would be minor and limited to proximate areas unless these activities occurred near the lease tract boundaries adjacent to nearby residences or communities or areas specially designated for wildlife concerns, if any. Implementation of good industry practices and coherent noise management plans could minimize these impacts.

4.5.2.3 Reclamation

As detailed in Section 4.1.2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the reclamation site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur about 1,200 ft (360 m) from the mine development site. Most residences are located beyond these distances, but if reclamation activities occurred near the boundaries of Lease Tracts 13, 13A, 16, or 16A, noise levels at nearby residences could exceed the Colorado limit.

It is assumed that most reclamation activities would occur during the day, when noise is better tolerated because of the masking effects of background noise, which is more prominent in daytime than at night. In addition, reclamation activities at lease tracts would be temporary (typically lasting a few weeks to months, depending on the size of the area to be reclaimed). Accordingly, reclamation within the lease tracts would cause some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities. The same mitigation measures adopted during the mine development phase could also be implemented during the reclamation phase (see Table 4.6-1 in Section 4.6).

4.5.3 Geology and Soil Resources

Soil impacts under Alternative 5 for the exploration, mine development and operations, and reclamation phases would be the same as those described under Alternative 4 because DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period. The number of mines assumed to be operating at the peak year of ore production would be the same as the number under Alternative 4, except that a slightly larger surface area would be used for mine development.

4.5.3.1 Paleontological Resources

Impacts on paleontological resources (if present) under Alternative 5 for the exploration, mine development and operations, and reclamation phases would be the same as those described under Alternative 4 because DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period. The number of mines assumed to be operating at the peak year of ore production would be the same as the number under Alternative 4, except that a slightly larger surface area would be used for mine development.

4.5.4 Water Resources

4.5.4.1 Exploration

The types of impacts related to exploration under Alternative 5 would be similar to those under Alternative 3 (Section 4.3.4.1). Because exploration activities would occur over relatively small areas and involve a little disturbance, impacts associated with runoff generation and erosion in this phase are expected to be minor.

The exploratory drill holes are expected to run through alluvial aquifers along the rivers and Paradox Valley or Dakota Sandstone and Burro Canyon aquifers (or perched aquifers) at mesas to reach Saltwash Member, the uranium-containing unit. Historically, most of the underground mines in the ULP lease tracts are dry. The potential for groundwater mixing and leaching via exploratory drill holes is minimal. In Paradox and Slick Rock, some groundwater accumulation at a low rate has been found in underground mines in Lease Tracts 7 and 9 near Paradox Valley and Lease Tract 13 along the Dolores River (Slick Rock) (DOE 2007). Lease Tract 8A has not been leased before and is close to Lease Tract 7, which has wet mines near Paradox Valley. During exploration at these lease tracts, impacts associated with the drilling of exploratory boreholes and wells would be considered minor and minimized if BMPs, mitigation measures, and standards set forth by the CDWR (2005) (see also Table 4.6-1 in Section 4.6) are implemented.

4.5.4.2 Mine Development and Operations

Under Alternative 5, there would be a total of 19 mines operating across the 31 DOE ULP lease tracts, with a total land disturbance of 490 acres (200 ha) and an annual water use of 8,000,000 gal (25 ac-ft) (Section 2.2.5.1). The types of impacts related to mine development and operations under Alternative 5 would be similar to those under Alternative 3 (Section 4.3.4.2).

The increase in disturbed area under Alternative 5 might increase the impacts associated with erosion; however, the proximity of the lease tract to the Dolores River and the San Miguel River would be still be the primary factor governing impacts. The additional lease tracts added under Alternative 5 are not located along the reaches of perennial rivers. The overall magnitude of impacts would be expected to be similar to that under Alternative 3.

The increase in mining operations could also increase dewatering effects and groundwater contamination. The potential increase in underground working areas could also increase the potential for backfills and poor sealing of drill holes. However, groundwater seepage from shallow aquifers is the primary driver that could cause groundwater leaching and cross-contamination via drill holes and open mine portal and vent holes. Under Alternative 5, the underground mines in the 18 additional lease tracts are expected to be relatively dry, except at Lease Tract 8A as discussed above. Potential impacts on groundwater quality would be minor and could be avoided if the reclamation is performed by the appropriate backfilling of mine portal and vent holes, complete sealing of drill holes that intercept multiple aquifers, and adequate water reclamation in accordance with reclamation performance measures by CDRMS. (However, the number of domestic wells that might be affected is similar to that under Alternative 3, and it only increases by one well associated with Lease Tract 16. The increase in consumptive water use would be negligible because it is assumed that the water would be trucked in from off site.)

4.5.4.3 Reclamation

Under Alternative 5, impacts on water resources associated with reclamation activities would be the same as those under Alternative 1 (Section 4.1.4).

4.5.5 Human Health

Similar to Alternatives 3 and 4, for Alternative 5, because the exploration drilling would disturb only small areas and the drill holes would be backfilled in a short period of time (less than a few weeks), potential human health impacts are expected to be minimal and limited to only a few workers. Therefore, the analysis of human health impacts under Alternative 5 focuses on the consequences caused by the development and operations of uranium mines and the reclamation of lease tracts. Nevertheless, the potential exposure associated with exploration drilling was estimated and is discussed in Section 4.3.5. According to that estimate, the total dose that an exploration worker would receive would be less than 5 mrem (LCF risk of about 4×10^{-6} or 1 in 250,000).

4.5.5.1 Worker Exposure – Uranium Miners

On the basis of the data published by the U.S. Department of Labor, Bureau of Labor Statistics, in 2010, the fatal occupational injury rate for the mining industry was 19.8 per 100,000 full-time workers (BLS 2011a), and the nonfatal occupational injury and illness rate was 2.3 per 100 full-time workers (BLS 2011b). Based on the assumption that the injury and fatality rates for uranium mining are similar to those for other types of mining, during the peak year of operations, there could be six nonfatal injuries and illnesses among the 242 workers assumed for mining development under Alternative 5. However, no mining-related fatality is predicted among the workers. The above estimates of injury and fatality were made on the basis of statistical data and should be interpreted from a statistical perspective as well. The actual injury and fatality rates among individual mines could be different. Proper worker training and extensive experience in uranium mining would reduce mining accidents, thereby reducing the potential of injury and fatality.

In addition to being exposed to physical hazards, uranium miners could be exposed to radiation from mining activities. The radiation exposure of individual miners under Alternative 5 would be similar to those under Alternative 3. On the basis of monitoring data for the period 1985 to 1989, the average radiation exposure for uranium mine workers in the United States ranged from 350 to 433 mrem/yr (UNSCEAR 2010), excluding the background radiation dose, which is estimated to be about 430 mrem/yr in the ULP lease tract. In general, underground miners are exposed to higher radiation levels than are open-pit miners, because underground cavities accumulate higher radon concentrations and airborne uranium ore dust concentrations than do aboveground open spaces. According to UNSCEAR (1993), external exposure accounts for 28% of the total dose to underground miners and for 60% of the total dose to open-pit miners; inhalation of radon accounts for 69% of the total dose to underground miners and for 34% of the total dose to open-pit miners; and inhalation of uranium ore dust accounts for 3% of the total dose for underground miners and for 6% of the total dose to open-pit miners. Based on assumptions that the average dose for underground miners is 433 mrem/yr and that the total dose is distributed among different pathways, an LCF of 4×10^{-4}/yr was calculated for an average miner (see Table 4.3-2). This translates to a probability of about 1 in 2,500 for a worker to develop a latent fatal cancer through 1 year of radiation exposure. If a miner worked for 10 years in uranium mines, the total cumulative dose received would be 4,330 mrem, with a corresponding cumulative LCF risk of 4×10^{-3}; i.e., the probability of developing a fatal cancer would be about 1 in 250.

An inference was made in order to estimate potential chemical exposures associated with underground uranium mining. This inference was detailed in Section 4.3.5.1. Potential air concentrations of uranium and vanadium, assumed in the form of V_2O_5, were estimated by using the radiation dose associated with the inhalation of particulates pathway that an average miner would receive. The estimated chemical concentrations were then used to estimate the potential hazard index associated with uranium and vanadium exposures. A hazard index of 1.06 was estimated, primarily due to vanadium exposure. Because the hazard index slightly exceeds the threshold value of 1, potential adverse health effects might result from working in underground uranium mines.

4.5.5.2 Worker Exposure – Reclamation Workers

After mining operations were completed, the disturbed land would be reclaimed. During the reclamation phase, the largest sources for radiation exposure would be the aboveground waste-rock piles accumulated over the operational period. The potential radiation dose incurred by reclamation workers would depend on the size of the waste-rock pile and its uranium content. As it was under Alternatives 3 and 4, the potential radiation exposure of a reclamation worker was estimated on the basis of three waste-rock pile dimensions corresponding to the three mine sizes (medium, large, and very large) assumed. A detailed discussion on the development of the three waste-rock piles evaluated is provided in Section 4.1.5.

The radiation exposure of an individual worker that would result from performing reclamation activities is expected to be about the same as that analyzed in Section 4.1.5 for Alternative 1. Based on the RESRAD analysis, the total radiation dose incurred by a reclamation worker would range from 14.3 to 34.2 mrem, depending on whether the radionuclide concentration assumed for waste rocks is 70 pCi/g or 168 pCi/g. The radiation exposure would be about the same regardless of the size of waste-rock pile, because external radiation dose (which is the dominant pathway contributing to the total dose) would not vary much among the three sizes of waste-rock pile considered. The total dose was estimated based on the assumption that the worker would work 8 hours per day for 20 days on top of a waste-rock pile. The radiation exposure would be dominated by the external radiation pathway, which would contribute about 94–96% to the total dose, followed by the incidental soil ingestion pathway, which would account for about 3% of the total dose. The remaining dose would be from the inhalation of radioactive particulates and radon gas. The potential LCF risk associated with this radiation exposure is estimated to range from 1×10^{-5} to 3×10^{-5}; i.e., the probability of developing a latent fatal cancer ranges from about 1 in 100,000 to 1 in 33,000.

Reclamation workers may be required to work underground to reclaim mine workings; however, the time spent underground is expected to be much shorter than the time spent above the ground. Based on past monitoring data for uranium miners (433 mrem/yr on average, see Section 4.3.5.1), it is estimated that a reclamation worker would need to spend 66–158 hours at underground workings to receive the same dose (14.3 to 34.2 mrem) as he would from working on top of a waste-rock pile for 160 hours (i.e., 20 workdays).

Similar to Alternatives 1, 3, and 4, the total hazard index associated with potential chemical exposure is estimated to be well below the threshold value of 1 (See Section 4.1.5.1 for detailed discussions); therefore, it is expected that the reclamation worker would not experience adverse health effects resulting from the exposures.

4.5.5.3 General Public Exposure – Residential Scenario

Members of the general public who live in or around the ULP lease tracts could be exposed to radiation as a result of the release of radon gas and radioactive particulates that contain uranium isotopes and their decay products from mining-related activities. The potential maximum radiation exposure was estimated as a function of distance from the release point of radionuclides. It could be used to estimate the potential exposure of an individual living close to the ULP lease tracts once the locations and scales of uranium mines are known. The maximum doses were estimated for three uranium mine sizes.

4.5.5.3.1 Uranium Mine Development and Operations.

Exposure to an Individual Receptor. Based on the discussion provided in Section 4.3.5.3.1 under Alternative 3, the primary source of human health impacts on the residents living close to the ULP lease tracts during the operational phase would be the radon gas emitted from mining activities. Therefore, the analysis of potential radiation exposures to the residents focused on the consequences associated with the release of radon.

For the human health impacts analysis, the radon emission rates for underground uranium mines were developed based the equation developed by the EPA (EPA 1985), which correlates the radon emission rate with cumulative uranium ore production. An operational period of 10 years was assumed when developing the radon emission rates. The radon emission rates calculated based on this assumption are considered to be the upper bound for underground mines under Alternative 5. The radon emission rate for a very large mine (i.e., the existing open-pit mine on Lease Tract 7) was estimated on the basis of the data compiled in EPA (1989a, Table 12-7) for surface mines. The estimated value is expected to be greater than the actual emission rate. The emission rates developed for the three hypothetical mines under Alternative 5 are listed in Table 4.5-2. The total Rn-222 emission rate from underground mining was estimated to be about 21,120 Ci/yr, and the estimated Rn-222 emission rate from the very large open-pit mine was 600 Ci/yr.

Table 4.5-3 lists the maximum radiation doses calculated with CAP88-PC at different exposure distances for the three assumed uranium mine sizes. Based on the calculation results, the radiation exposures would decrease with increasing distance because of greater dilution in the radon concentrations. The maximum exposure at a fixed distance from the emission point of an underground mine or from the center of the open-pit mine would always occur in the sector that coincides with a dominant wind direction. In any other sector, the potential exposure would be less than the maximum values.

Based on Table 4.5-3, if the resident lived at a distance of 3,300 ft (1,000 m) from the emission point of an underground mine, then the maximum radiation dose he could incur would range from 9.1 to 22.5 mrem/yr. If the distance increased to 8,000 ft (2,500 m), then the maximum exposure would be reduced and range from 2.7 to 8.2 mrem/yr, below the NESHAP dose limit (40 CFR Part 61) of 10 mrem/yr for airborne emissions of radionuclides. Note that the

TABLE 4.5-2 Radon Emission Rates per Type of Mine during Mine Operations Assumed for Alternative 5

Parameters	Medium[a]	Large[a]	Very Large[b]	Total
Uranium ore production per mine (tons/d)	100	200	300	
Cumulative uranium ore production per mine (tons)	2.40E+05	4.80E+05	7.20E+05	
Rn-222 emission rate per mine (Ci/yr)[c]	1.06E+03	2.11E+03	6.00E+02	
Alternative 5 in peak year of operations				
No. of active mines	16	2	1	19
Total Rn-222 emission rate (Ci/yr)	1.69E+04	4.22E+03	6.00E+02	2.17E+04

[a] Underground mine.

[b] Open-pit mine.

[c] The emission rates of radon from underground mines were estimated by using the correlation developed as indicated by the EPA in 1985 (EPA 1985): Rn-222 emissions (Ci/yr) = 0.0044 × cumulative uranium ore production (tons). A cumulative period of 10 years was assumed for this calculation. The emission rate from the very large open-pit mine was determined based on data from surface uranium mines compiled by the EPA in 1989 (EPA 1989a).

maximum doses listed in Table 4.5-3 are estimated for a resident living in a dominant wind direction and were obtained by using the radon emission rates corresponding to an operational period of 10 years. The emission rates for uranium mines that have been developed and operated for less than 10 years would be less; therefore, the potential radon exposures associated with mining would be smaller than those listed in the table. On the other hand, if there was more than one uranium mine located close to the resident and if the mines were being operated at the same time, the potential dose to the resident would be the sum of the doses contributed by each mine.

The maximum LCF for a resident living close to a medium-sized underground uranium mine was estimated to range from 3×10^{-6}/yr to 5×10^{-6}/yr at a distance of 16,400 ft (5,000 m), and from 1×10^{-5}/yr to 3×10^{-5}/yr at a distance of 3,300 ft (1,000 m). That is, the probability of developing a latent fatal cancer would range from about 1 in 330,000 to 1 in 200,000 at a distance of 16,400 ft (5,000 m) to about 1 in 100,000 to 1 in 33,000 at a distance of 3,300 ft (1,000 m) in each year of exposure.

Because potential radon exposures of the general public living near the ULP lease tracts could exceed the NESHAP dose limit of 10 mrem/yr, mitigation measures would be required to (1) obtain actual radon emission rates to refine the dose estimates associated with radon exposures and (2) reduce the impact on the general public, if the refined estimates would exceed the 10-mrem/yr dose limit. See Section 4.3.5.3.1 for the suggested mitigation measures.

TABLE 4.5-3 Potential Maximum Radiation Doses, Radon Concentrations, and LCF Risks to a Resident Associated with the Emission of Radon from Three Sizes of Uranium Mines

	Radiation Dose (mrem/yr) and Radon Level (WL) per Mine Size[a]			LCF Risk (1/yr) per Mine Size		
Distance (m)	Medium	Large	Very Large	Medium	Large	Very Large
500	15.66 (0.0013)	31.32 0.0026)	27.4 (0.0023)	2E-05	4E-05	4E-05
1,000	11.26 (0.00094)	22.52 (0.0019)	9.05 (0.00076)	1E-05	3E-05	1E-05
1,500	7.44 (0.00062)	14.88 (0.0012)	5.53 (0.00046)	1E-05	2E-05	7E-06
2,000	5.34 (0.00044)	10.68 (0.00089)	3.72 (0.00031)	7E-06	1E-05	5E-06
2,500	4.08 (0.00034)	8.16 (0.00068)	2.7 (0.00023)	5E-06	1E-05	3E-06
3,000	3.26 (0.00027)	6.52 (0.00054)	2.09 (0.00017)	4E-06	8E-06	3E-06
4,000	2.44 (0.00020)	4.88 (0.00040)	1.53 (0.00013)	3E-06	6E-06	2E-06
5,000	1.94 (0.00016)	3.88 (0.00032)	1.2 (0.00010)	3E-06	5E-06	2E-06

[a] Radiation doses appear on the top line, and radon concentrations in terms of working level (WL) are in parentheses on the line below.

Collective Population Exposure. Collective exposures of the general public living within 50 mi (80 km) of the ULP lease tracts were evaluated by using the same method as that described in Section 4.3.5.3.1. The range of potential collective dose at the peak year of operations can be obtained by summing all the radon emissions from active uranium mines and placing the total emissions at the center of each lease tract group.

Table 4.5-4 presents the collective doses obtained by using the CAP88-PC model (Trinity Engineering Associates, Inc. 2007) for the general public living within 3 to 50 mi (5 to 80 km) of the assumed emission points during the peak year of operations under Alternative 5. According to the estimated results, the collective dose associated with underground mining ranges from 18.8 to 110 person-rem. The collective dose associated with open-pit mining is about 0.88 person-rem. Together, underground and open-pit mining would result in a total collective dose ranging from 20 to 110 person-rem during the peak year of operations. This collective exposure would cause a collective cancer risk of 0.03 to 0.1. Therefore, it is expected that no cancer fatality among the population would result from exposure to the radon gas emitted from the 19 uranium mines that would be operated simultaneously during the peak year of operations under Alternative 5. The total populations involved in these estimates would range from 27,062 to 178,473 people. If the collective dose was evenly distributed among the affected population, the average individual dose would range from 0.59 to 1.1 mrem (LCF risk of

TABLE 4.5-4 Collective Doses and LCF Risks to the General Public from Radon Emissions from Uranium Mines during the Peak Year of Operations under Alternative 5

Radon Source	Collective Dose (person-rem/yr)	Collective LCF Risk (1/yr)[a]
From underground mining[b]		
Based on the center of Group 1[c]	1.10E+02	1E-1
Based on the center of Group 2[d]	5.86E+01	8E-2
Based on the center of Group 3[e]	2.98E+01	4E-2
Based on the center of Group 4[f]	1.88E+01	2E-2
From open-pit mining[g]		
Based on the center of Group 3[e]	8.80E-01	1E-3
Total		
Minimum	1.97E+01	3E-2
Maximum	1.11E+02	1E-1

[a] Denotes the number of latent lung cancers that could result from radiation exposure.

[b] The total radon emission rate from underground mining during the peak year of operations would be 21,120 Ci/yr.

[c] If the emission was from the center of lease tract Group 1, the total population residing 3 to 50 mi (5 to 80 km) away would be 178,473.

[d] If the emission was from the center of lease tract Group 2, the total population residing 3 to 50 mi (5 to 80 km) away would be 86,657.

[e] If the emission was from the center of lease tract Group 3, the total population residing 3 to 50 mi (5 to 80 km) away would be 27,062.

[f] If the emission was from the center of lease tract Group 4, the total population residing 3 to 50 mi (5 to 80 km) away would be 33,166.

[g] The total radon emission rate from open-pit mining during the peak year of operations would be 600 Ci/yr.

8×10^{-7} to 1×10^{-7}; i.e., 1 in 1,250,000 to 1 in 1,000,000) during the peak year of operations. In reality, because the active lease tracts (the lease tracts with mining operations) would be scattered among the four lease tract groups rather than being concentrated in one single group as assumed in the calculations, the size of the population within 3 to 50 mi (5 to 80 km) of the lease tracts should be larger than 178,473 people. Therefore, the actual average individual dose should be just a fraction of the calculated values.

4.5.5.3.2 Reclamation. Residents who lived close to a uranium mine during or after the reclamation phase could be exposed to radiation as a result of emissions of radioactive particulates and radon gas from the waste-rock piles left aboveground. The potential radiation dose would depend on the direction and distance between the residence and the waste-rock piles and the emission rates of particulates and radon. The potential range for the radiation dose to resident under Alternative 5 is expected to be similar to the range under Alternatives 1 and 2, because the exposures would be dominated by the emissions from the waste-rock pile(s) that was (were) closest to this resident.

According to the calculation results presented in Section 4.1.5.2, if a resident lived 3,300 ft (1,000 m) from a waste-rock pile, then the radiation dose he could receive would be less than 3.5 mrem/yr. If the distance increased to 6,600 ft (2,000 m), then his exposure would drop to less than 1.3 mrem/yr. If there were two waste-rock piles nearby, then the potential dose that this resident would receive would be the sum of the doses contributed by each waste-rock pile. Based on the listed maximum doses in Table 4.1-8, the potential dose received by any resident living at a distance of more than 1,600 ft (500 m) from the center of a waste-rock pile is expected to be smaller than the NESHAP dose limit of 10 mrem/yr for airborne emissions (40 CFR Part 61). The potential LCF risk would be less than 9×10^{-6}/yr, which means the probability of developing a latent fatal cancer from living close to the ULP lease tracts for 1 year during or after reclamation would be 1 in 110,000. If a resident lived in the same location for 30 years, the cumulative LCF risk would be less than 3×10^{-4}; i.e., the probability of developing a fatal cancer is less than 1 in 3,300. The above estimates were obtained on the basis of the base concentrations assumed for waste rocks (70 pCi/g for Ra-226). Should the higher concentration of 168 pCi/g of Ra-226 be used, the potential radiation doses and LCF risks would increase by a factor of less than 3.

In reality, it is expected that waste-rock piles would be covered by a layer of soil materials during reclamation to facilitate vegetation growth. Because of this cover, emissions of radioactive particulates would be greatly reduced, if not eliminated completely. Emissions of radon from waste-rock piles could continue, although the emission rates would be reduced. In fact, because uranium isotopes and their decay products have long decay half-lives, the potential for radon to be emitted from waste-rock piles could persist for millions of years after the reclamation concluded.

In addition to radiation exposure, the residents living close to the ULP lease tracts could receive chemical exposures due to the chemical toxicity of the uranium and vanadium minerals contained in the waste rocks. Potential chemical exposures would be associated with the emissions of particulates and result from inhalation and incidental dust ingestion. By using the same exposure parameters as those used for radiation dose modeling, potential chemical risks for the nearby residents were evaluated. According to the evaluation results, the total hazard index would be well below the threshold value of 1, with inhalation being the dominant pathway. Therefore, it is expected that nearby residents would not experience any adverse effects from the potential exposures.

A less likely exposure scenario after the reclamation phase would be for a nearby resident to raise livestock in the lease tract and consume the meat and milk produced. According to the RESRAD calculation results, the potential dose would be less than 5.5 mrem/yr, which is a small fraction of the DOE dose limit of 100 mrem/yr for the general public from all applicable exposure pathways (DOE Order 458.1). Section 4.1.5.2 provides detailed discussions on this analysis.

4.5.5.4 General Public Exposure – Recreationist Scenario

In addition to the residents who live near the ULP lease tracts and could thus be affected by the emissions from the waste-rock piles left after reclamation concluded, a recreationist who unknowingly entered the lease tracts could also be exposed to radiation. To model the potential radiation exposure, it was assumed that the recreationist would camp on top of a waste-rock pile for 2 weeks, eat wild berries collected in the area, and hunt wildlife animals for consumption. This recreationist could receive radiation exposure through direct external radiation, inhalation of radon, inhalation of particulates, and incidental soil ingestion pathways while camping on waste rocks. The potential exposures would vary with the thickness of soil cover placed on top of waste rocks during reclamation. In the analysis, the thickness was assumed to range from 0 to 1 ft (0 to 0.3 m).

The potential dose that could be incurred by a recreationist under Alternative 5 would be similar to that under Alternatives 1 and 2. According to the RESRAD calculation results, the radiation dose incurred by the recreationist from camping on waste rocks during a 2-week trip would range from 0.88 mrem if the cover thickness was 1 ft (0.3 m) to 30 mrem if there was no cover. The corresponding LCF risk would range from 1×10^{-6} to 2×10^{-5}; i.e., the probability of developing a latent fatal cancer would be about 1 in 1,000,000 to 1 in 50,000. The majority of the radiation dose would result from direct external radiation. These dose estimates were derived based on a concentration of 70 pCi/g for Ra-226 assumed for waste rocks. If the assumed concentration was to increase to 168 pCi/g, potential dose and LCF risks would increase by a factor of less than 3.

The potential radiation dose associated with eating wild berries and wildlife animals was calculated by assuming ingestion rates of 1 lb (0.45 kg) and 100 lb (45.4 kg), respectively. The potential dose was estimated to range from 1.08 to 1.66 mrem, depending on the depth of plant roots assumed for the estimate. The corresponding LCF risk was estimated to be less than 8×10^{-7}; i.e., the probability of developing a latent fatal cancer would be less than 1 in 1,250,000.

No chemical risks would result from camping on a waste-rock pile if the waste rock pile was covered by a few inches of soil materials. In the worst situation in which there is no soil cover, a hazard index of 0.039 was calculated. The potential chemical risk associated with ingesting contaminated wild berries would be small, with a hazard index of less than 0.003. The hazard index associated with eating wildlife animals would be more than 100 times greater than that associated with eating wild berries, because of the potential accumulation of vanadium in animal tissues. The hazard index calculated was 0.39. However, because the sum of all these hazard indexes is much less than 1, it is expected that the recreationist would not experience any adverse health effects from these two ingestion pathways.

Most of the encounters between recreationists and ULP lease tracts are expected to be much shorter than 2 weeks. When the total dose associated with exposures to waste rocks from camping was used, a dose rate of less than 0.09 mrem/h (LCF risk of 7×10^{-8}; i.e., 1 in 14,000,000) was estimated.

A discussion of a detailed analysis of the potential exposure of an individual receptor to post-reclamation conditions at the mine site is provided in Section 4.1.5.3.

4.5.6 Ecological Resources

4.5.6.1 Vegetation

Exploration and development activities could occur on each of the 31 lease tracts included under Alternative 5. Previous disturbance from exploration or mine development has occurred on each of these lease tracts except Lease Tract 8A; however, new exploration and development could occur in either disturbed or undisturbed areas of lease tracts. Exploration and development on Lease Tract 8A would occur in undisturbed habitats.

Mine development and operations might include small surface mines. Most new mines are expected to be underground mines. During the peak year, it is assumed that 19 mines would be in operation simultaneously, as is the case under Alternative 4. However, development and operations would continue for a shorter duration under Alternative 5: for only 10 years. Ground disturbance would range from 15 acres (6.1 ha) for each of 16 medium-sized mines to 20 acres (8.1 ha) for each of 2 large mines, with a total of 280 acres (110 ha). In addition, the 210-acre (85 ha) open-pit mine (Lease Tract 7) would resume operations, resulting in a total of 490 acres (200 ha) of disturbance under Alternative 5.

The types of impacts from exploration, mine development and operations, and reclamation under Alternative 5 would be similar to those under Alternatives 3 and 4; however, a larger total area would be affected. Direct impacts associated with the development of mines would include the destruction of habitats during site clearing and excavation, as well as the loss of habitats at the locations of the waste-rock disposal area, various storage areas, project facilities, and access roads. The lease tracts included under Alternative 5 support a wide variety of vegetation types; the predominant types are piñon-juniper woodland and shrubland and big sagebrush shrubland. Some of the areas affected might include high-quality, mature habitats, resulting in greater levels of impact than those in previously degraded areas. Indirect impacts from mining would be similar to those described for Alternative 3 and would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or in water quality.

4.5.6.1.1 Wetlands and Floodplains. Wetlands occur in most of the lease tracts, and they might be directly or indirectly affected. Indirect impacts from mining would be similar to those described for Alternative 3 and would be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or in water quality.

4.5.6.2 Wildlife

Under Alternative 5, impacts on wildlife could result from exploration, mine development and operations, and reclamation on any of the lease tracts for a 10-year period. It is assumed that 19 mines would be developed and in operation at the same time in the peak years. The 19 mines would include 16 medium-sized mines (15 acres or 6.1 ha disturbed per mine), 2 large mines (20 acres or 8.1 ha disturbed per mine), and 1 very large mine (210 acres or 85 ha disturbed). The 210 acres (85 ha) for the very large mine (JD-7) were disturbed previously, as were 80 acres (32 ha) for topsoil storage. Therefore, areas of existing and new disturbances could occur at the other mine locations (unless mine development occurred at any of the mine locations that would have otherwise been reclaimed under either Alternative 1 or 2), and would disturb 280 acres (110 ha) of land containing various amounts of upland vegetation. Including the existing area disturbed for JD-7, this area of disturbance represents 1.9% of the total acreage in DOE's ULP. The remainder of the lease tracts (excluding areas where access roads and utility corridors could be required) would be undisturbed by mining activities under Alternative 5.

There would be few differences in impacts under Alternative 5 and Alternative 3 (Section 4.3.6.2). However, under Alternative 5, the potential impacts on wildlife would occur on additional mine sites and affect an additional 180 acres (73 ha) of land on any of the 31 lease tracts rather than just on any of the 13 pre-July 2007, then-active lease tracts. Although exploration, mine development and operations, and reclamation are expected to be incrementally greater under Alternative 5 than under Alternative 3, impacts on wildlife are still expected to be negligible for site exploration and minor to moderate for mine development, operations, and reclamation. While wildlife impacts would be long term (e.g., lasting for decades), they would be scattered temporally and, especially, spatially. In general, impacts would be localized, and they would not affect the viability of wildlife populations, especially if mitigation measures are implemented (see Section 4.6).

Impacts on wildlife following the reclamation of the mine sites would be negligible if no development or other use of the sites (other than that of natural resource protection) occurred.

4.5.6.3 Aquatic Biota

Impacts on aquatic biota from exploration, development and operations, and reclamation under Alternative 5 would be similar to those under Alternative 3 (Section 4.3.6.3) except that (1) during the peak years of operations, up to 19 mines could be in operation, and (2) the mines could be located on any of the 31 lease tracts. Overall, impacts on aquatic biota are expected to be negligible during site exploration and small to moderate (see Section D.6.2.2, Appendix D for impact category definitions) during mine development and operations and reclamation. Moderate impacts would be expected only if the mines were located near perennial water bodies. In general, any impacts on aquatic biota would be localized and not affect the viability of affected resources, especially if mitigation measures are implemented (see Table 4.6-1 in Section 4.6).

4.5.6.4 Threatened, Endangered, and Sensitive Species

Under Alternative 5, there would be no fundamental differences in the impacts on threatened, endangered, and sensitive species than the impacts under Alternative 4 (Section 4.4.6.4). The potential for impacts on threatened, endangered, and sensitive species under Alternative 5 would be similar to the potential for impacts under Alternative 4 (Section 4.4.6.4).

4.5.7 Land Use

Under Alternative 5, DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period (as they were when issued in 2008). It is assumed that a total of 19 mines would be in operation during the peak year of ore production. As a result, impacts under Alternative 5 would be the same as those under Alternative 4.

4.5.8 Socioeconomics

It is assumed that a total of 19 mines would be in operation at the same time in the peak year (16 medium, 2 large, and 1 very large), producing approximately 2,300 tons of uranium ore per day. Exploration activities would create direct employment for 24 people and would generate an additional 28 indirect jobs. Development and operational activities would create direct employment for 253 people during the peak year and would generate an additional 152 indirect jobs (Table 4.5-5). Development activities would constitute 0.6% of total ROI employment. Uranium mining would also produce $15.6 million in income.

Because of the small number of jobs required for exploration, the current workforce in the ROI could meet the demand for labor; thus, there would be no in-migration of workers. It is assumed that some in-migration would occur as a result of uranium mining activities; under Alternative 5, 122 people would move into the ROI. In-migration of workers would represent an increase of 0.09% in the ROI forecasted population growth rate. The additional workers would increase the annual average employment growth rate by less than 1% in the ROI. The in-migrants would have only a marginal effect on local housing and population and would require approximately 1% of vacant owner-occupied housing during mining development and operations. One additional physician, one additional firefighter, and one additional police officer would be required to maintain current levels of service within the ROI as a result of the increased population. No additional teachers would be required to maintain the current student-to-teacher ratio in the ROI.

TABLE 4.5-5 Socioeconomic Impacts of Uranium Mine Development, Operations, and Reclamation in the Region of Influence under Alternative 5

Parameter	Exploration	Development and Operations	Reclamation
Employment (no.)			
Direct	24	253	39
Indirect	28	152	25
Total	52	405	64
Income[a]			
Total	2.0	15.6	2.5
In-migrants (no.)	0	122	0
Vacant housing (no.)	0	74	0
Local community service employment			
Teachers (no.)	0	0	0
Physicians (no.)	0	1	0
Public safety (no.)	0	2	0

[a] Values are reported in $ million 2009.

Impacts in the ROI would be minor because (1) employment would be distributed across three counties, (2) the impact would be absorbed across multiple governments and many municipalities, and (3) the employment pool would come from a larger population group than if all employment originated from any one county. Mining workers could live in larger population centers in the ROI and close vicinity, such as Grand Junction, Montrose, or Telluride, and commute to mining locations. A report prepared for Sheep Mountain Alliance acknowledged that workers "may choose to live at some distance from the mill and mines to protect the investments they put into their homes. Some businesses serving the mill and mines and their workers may choose to do the same" (Power Consulting 2010). This suggests that the communities in close proximity to the proposed leases might not benefit as greatly from the positive direct and indirect economic impacts from uranium mining, but they could also avoid the conditions under which previous boom-and-bust periods occurred. Also, the report recognized that despite the decline in uranium and other mining activities following 1980 in the west ends of Montrose, Mesa, and San Miguel Counties, these counties as a whole experienced significant economic expansion after the collapse of the uranium industry in the mid-1980s due to a "growth of a visitor economy including tourists, recreationists, and second homeowners" (Power Consulting 2010). However, individual municipalities in smaller rural communities might experience a temporary increase in population from workers if they moved to communities closer to mining projects rather than commuting from longer distances elsewhere in the ROI. There would be a small number of in-migrating workers from outside the three-county ROI and thus minor impact on the ROI as a whole; however, the impact on individual communities could vary.

Potential impacts during reclamation would be minor. Reclamation would occur after operations ceased. The reclamation period would likely span 2 to 3 years, although only 1 year would require a workforce. Reclamation would require 39 direct jobs during the peak year for field work and revegetation and create 25 indirect jobs (see Table 4.5-5). During reclamation, the required workforce would generate $2.5 million in income. Because of the small number of jobs required for reclamation, the current workforce in the ROI could meet the demand for labor; therefore, there would be no further in-migration of workers or families and no social impacts.

4.5.8.1 Recreation and Tourism

Potential impacts on recreation and tourism would be similar to those under Alternative 3 as discussed in Section 4.3.8.1.

4.5.9 Environmental Justice

4.5.9.1 Exploration

The types of impacts related to exploration under Alternative 5 would be similar to those under Alternative 3 (Section 4.3.9.1). Because exploration activities would occur over relatively small areas and involve little or no ground disturbance, impacts associated with this phase are expected to be minor.

4.5.9.2 Mine Development and Operations

Under Alternative 5, there would be a total of 19 mines operating across the 31 DOE ULP lease tracts during the peak year. The types of impacts related to mine development and operations under Alternative 5 would be similar to those under Alternative 4 (Section 4.4.9.2).

4.5.9.3 Reclamation

Although potential impacts on the general population could result from exploration, mine development and operations, and reclamation under Alternative 5, for the majority of resources evaluated, the impacts would likely be minor. Specific impacts on low-income and minority populations as a result of participation in subsistence or certain cultural and religious activities would also be minor and unlikely to disproportionately affect low-income and minority populations.

4.5.10 Transportation

The transportation risk analysis estimated both radiological and nonradiological impacts associated with shipments of uranium ore from their points of origin at one of the 31 lease tracts to a uranium mill. Further details on the risk methodology and input data are provided in Section 4.3.10.1 and Section D.10 of Appendix D.

The Alternative 5 transportation assessment evaluates the annual impacts expected during the peak year of operations when 19 of the 31 lease tracts could have operating mines. Shipment of uranium ore is not presented over the life of the program because of the uncertainty associated with future uranium demand and mine development.

As was done for Alternative 4, a sample set of 19 of the 31 lease tracts was evaluated in the transportation analysis to represent operations during the peak year of production. As was also done for Alternatives 3 and 4, the selection of lease tracts for the transportation analysis considered the lease tract's location, lessee, and prior mining operations, if any. In addition to distance, its capacity was also considered when determining which mill would receive a particular mine's ore shipments. Thus, the nearest mill was not always a given shipment's destination. Later, at the time of actual shipment, various factors, such as existing road conditions due to traffic, weather, and road maintenance and repairs as well as mill capacity and costs, should be among the criteria used to determine the mill for a given ore shipment. This transportation analysis is intended to provide a reasonable estimate of impacts that could occur. Impacts were also estimated on the basis of the assumption that all shipments would go to a single mill in order to provide an upper range on what might be expected. Single shipment risks for uranium ore shipments are also provided so that an estimate for any future shipping campaign could be evaluated.

The transportation risk assessment considered human health risks from routine (normal, incident-free) transport of radiological materials and from accidents. The risks associated with the nature of the cargo itself ("cargo-related" impacts) were considered for routine transport. Risks related to the transportation vehicle, regardless of type of cargo ("vehicle related" impacts), were considered for routine transport and potential accidents. Radiological-cargo-related accident risks are expected to be negligible and were not quantified as part of this analysis, as discussed in Appendix D, Section D.10.1. Transportation of hazardous chemicals was not part of this analysis because no hazardous chemicals have been identified as being part of uranium mining operations.

4.5.10.1 Routine Transportation Risks

4.5.10.1.1 Nonradiological Impacts. The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 5 would be 92 per day, assuming an ore production rate of 2,300 tons per day and a truck load of 25 tons. Including round-trip travel, 184 trucks per day would be expected to travel the affected routes. As listed in Table 3.10-1, the lowest AADT along the route would be about 250 vehicles per day near Egnar on CO 141. If all 184 trucks per day passed through Egnar, in the extreme case of all shipments going to the White Mesa Mill, there would be a 74% increase in traffic in this area but only a 3% increase in the most heavily travelled location of Monticello, Utah—again, if all shipments went to White Mesa Mill. No additional traffic congestion would be expected in any area, since there would be only about five or six additional trucks per hour in each direction, assuming a 16-hour workday for transport.

For the example case with operations at 19 mines (1 very large, 2 large, and 16 medium-sized), the total distance travelled by haul trucks during the peak year would be approximately 2.72 million mi (4.38 million km), assuming round-trip travel between the lease tracts and the mills as shown in Table 4.5-6. Based on peak-year assumptions of 92 shipments per day, 20 days per month, 22,080 round-trips would be expected. The estimated total truck distance travelled of approximately 2.72 million mi (4.38 million km) would be about 22% of the total heavy truck miles travelled (12.6 million mi or 20.3 million km) along the affected highways in 2010 (CDOT 2011; UDOT 2011). In general, actual annual impacts over the course of the ULP could be lower or higher than these estimated impacts because the shipment numbers given are for the estimated peak year, which would have the largest number of annual shipments; because the ore could be transported to a different mill than the one assumed for the ULP PEIS analysis for a given lease tract, leading to a shorter or larger travel distance; and because lease tracts other than those used in the sample case could be developed, leading to shorter or larger travel distances.

To help put the sample case results in perspective, Table 4.5-6 also lists the total distances that ore would be shipped if all of the ore was shipped to one mill or the other. Because of the relative locations of all of the lease tracts with respect to the mills, shipping all of the ore to the White Mesa Mill (4.90 million mi or 7.88 million km) would represent close to the upper bound for the total distance for all shipments. Conversely, shipment of all of the ore to the Piñon Ridge Mill (1.45 million mi or 2.34 million km) would represent close to the lower bound for total distance.

As previously discussed in Section 4.3.10.2.1, most of the distance travelled by the haul trucks would occur on State or U.S. Highways. To access these roads, the haul trucks might travel distances of up to several miles on county and local roads, depending on the location of the lease tract and the location of the mine within the lease tract. Several residences are located near

TABLE 4.5-6 Peak-Year Collective Population Transportation Impacts under Alternative 5

		Radiological Impacts				Accidents Roundtrip	
Scenario	Total Distance (km)	Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	Injuries	Fatalities
Sample case	4,380,000	0.34	0.0002	1.8	0.001	0.81	0.073
All to Piñon Ridge Mill	2,336,000	0.18	0.0001	0.94	0.0006	0.43	0.039
All to White Mesa Mill	7,881,000	0.61	0.0004	3.2	0.002	1.5	0.13

lease tracts along such roads. In those cases, the number of passing haul trucks could range from about 4 (small mine) to 16 (large mine) trucks per day, depending on the size of the nearby mine, as shown in Table 4.3-12. No residences are located along the short distance between the very large mine (JD-7) and the highway.

4.5.10.1.2 Radiological Impacts. Radiological impacts during routine conditions would be a result of human exposure to the low levels of radiation near the shipment. The regulatory limit established in 49 CFR 173.441 (Radiation Level Limitations) and 10 CFR 71.47 (External Radiation Standards for All Packages) to protect the public is 10 mrem/h at 6 ft (2 m) from the outer lateral sides of the transport vehicle. As discussed in Appendix D, Section D.10.4.2, the average external dose rate for uranium ore shipments is approximately 0.1 mrem/h at 6.6 ft (2 m), which is two orders of magnitude lower than the regulatory maximum.

Collective Population Risk. The collective population risk is a measure of the total risk posed to society as a whole by the actions being considered. For a collective population risk assessment, the persons exposed are considered as a group; no individual receptors are specified. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.34 person-rem for the peak year, assuming about 22,080 shipments for the sample case, as shown in Table 4.5-6. The total collective population dose of 0.34 person-rem could result in an LCF risk of approximately 0.0002. Therefore, no latent fatal cancers are expected. These impacts are intermediate between the impacts estimated if all ore shipments went to the Piñon Ridge Mill or to the White Mesa Mill, as shown in Table 4.5-6.

Collectively for the sample case, the truck drivers (transportation crew) would receive a dose of about 1.8 person-rem (0.001 LCF) during the peak year of operations from all shipments. Again, no latent fatal cancers would be expected. For perspective, the collective dose of 1.8 rem (1,800 mrem) over 22,080 shipments is less than three times the amount that a single individual would receive in 1 year from natural background radiation and human-made sources of radiation (about 620 mrem/yr).

For scenarios other than those presented in the ULP PEIS, single shipment risks were provided for transporting ore from any of the lease tracts considered under any alternative to the Piñon Ridge Mill (Table 4.3-13) and the White Mesa Mill (Table 4.3-14). In conjunction with Table 4.5-6, all collective population impacts related to any combination and number of ore shipments between lease tracts and uranium mills can be estimated.

Highest-Exposed Individuals during Routine Conditions. In addition to assessing the routine collective population risk, the risks to individuals for a number of hypothetical exposure scenarios were estimated, as described further in Section E.10.2.2 of Appendix E. The scenarios were not meant to be exhaustive but were selected to provide a range of potential exposure situations. The estimated doses and associated likelihood of LCF estimates were discussed in Section 4.3.10.2.2.

4.5.10.2 Transportation Accident Risks

The total distance travelled by haul trucks during the peak year would be approximately 2.72 million mi (4.38 million km), including round-trip travel between the lease tracts and the mills, as discussed in Section 4.5.10.1.1 for the sample case. As shown in Table 4.5-6, potential transportation accident impacts in the peak year would include zero expected fatalities and potentially one injury from traffic accidents. For perspective, over the entire affected counties from 2006 through 2010 (San Juan County in Utah and Dolores, Mesa, Montrose, and San Miguel Counties in Colorado), a total of 21 heavy-truck-related traffic fatalities occurred (DOT 2010a–e), representing an average of 4.2 fatalities per year.

4.5.11 Cultural Resources

Under Alternative 5, impacts would be similar to those discussed in Section 4.4.11, except they would be of shorter duration.

Impacts from exploration would be expected to be the same as those described in Section 4.3.11.1. They would accrue mostly from exploration test borings and would be minimal within any lease tract. Drill pads are generally small (15 × 50 ft or 4.6 × 15 m) and boring can usually be accomplished with minimal surface disruption. Drilling sites and the proposed locations for any new road construction would have to undergo cultural surveys before any dirt could be moved, and cultural resources could generally be avoided. Secondary impacts from increased access, traffic, and human presence would be similar but on a larger scale, since three times as many lease tracts would be in play. As listed in Table 2.4-2, 221 known cultural resource sites could be exposed to secondary impacts under this alternative.

Impacts from mine development and operations would be similar in nature to those described in Section 4.3.11.2, but on a larger scale. They would include disturbance of archaeological sites, damage to or demolition of historic structures, damage to or destruction of plant or animal resources that are important to Native Americans, and damage to or disruption of sites that are considered sacred or culturally important to traditional cultures. The agents of disturbance would likely include earth-moving activities, the demolition or significant alteration of existing structures for mine development, increased human presence, increased access, increased noise, and increased traffic. Based on the average site frequency across all lease tracts and the proposed numbers and sizes of new mines, an estimate of direct impacts was generated. This estimate is provided in Table 4.5-7. An estimated total of 23 cultural resource sites would likely be affected by the development of mining activities under Alternative 5. Impacts from reclamation activities would be the same as those discussed Section 4.1.11. They would include adverse impacts on historically important mining structures and features, ground-disturbing activities if borrowing from undisturbed areas or road construction and improvement occurred, and temporary increases in traffic and human presence. Potential positive impacts from reclamation could include the restoration of habitats used by plant and animal resources that are important to Native Americans, the restoration of solitude, and the elimination of some visual intrusions in places that are important to traditional cultures.

TABLE 4.5-7 Cultural Resource Sites Expected To Be Directly Affected under Alternative 5

Size Categories under Alternative 5	No. of Mines in Each Size Category	Expected No. of Sites by Size Category	Total No. of Sites Expected
Small	0	0.8	0
Medium	16	1.2	20
Large	2	1.7	3
Total			23

4.5.12 Visual Resources

As indicated in Section 3.5, Alternative 5 would continue the ULP with the 31 lease tracts for the remainder of the 10-year period as the leases were when they were issued in 2008. Under this alternative, all lease tracts would be evaluated with respect to the exploration, mine development and operations, and reclamation phases.

4.5.12.1 Exploration, Mine Development and Operations, and Reclamation

Visual impacts would generally be the same under this alternative as the impacts described in Sections 4.1.12 and 4.3.12. As stated for Alternative 4, the primary difference from Alternative 1 would be that activities would occur on all lease tracts.

Visual impacts associated with exploration and mine development and operations are discussed further in Sections 4.3.12.1 and 4.3.12.2. Impacts associated with reclamation activities are discussed further in Sections 4.1.12.1 through 4.1.12.5.

4.5.12.2 Impacts on Surrounding Lands

Under Alternative 5, DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period as the leases were when they were issued in 2008. Because of the similarities between Alternatives 4 and 5, impacts on surrounding SVRAs under Alternative 5 would be the same as those under Alternative 4. See Section 4.4.12.2 for the analysis of these resources.

4.5.13 Waste Management

Potential impacts on waste management practices under Alternative 5 would be the same as those under Alternative 4.

4.6 MEASURES TO MINIMIZE POTENTIAL IMPACTS FROM ULP MINING ACTIVITIES

The potential impacts discussed in Sections 4.1 to 4.5 are expected to be minimized or reduced by implementation of the measures listed in Table 4.6-1. These measures would be implemented by the lessees and apply to the three phases of the proposed action (exploration, mine development and operations, and reclamation), as applicable. The measures have been grouped by the 11 objectives included in Table 4.6-1 and further categorized into the following three categories: (1) compliance measures—measures that are required by applicable regulations; (2) mitigation measures—measures that are identified by DOE as being required and that are identified in the current leases or could be included in the next lease modifications (and may or may not be required to fulfill regulatory requirements); and (3) BMPs—best industry practices and activities that should be considered during implementation, as practicable.

Reclamation activities would be conducted to assure that post-reclamation mine conditions are protective of the environment and human health. Mitigation measures such as those listed in Table 4.6-1 would be implemented so that potential exposure to a reasonable end-state scenario (i.e., a recreational visitor scenario at the mine site footprint and within the lease tracts and a resident scenario for outside the lease tracts) would be at acceptable risk levels (e.g., meet applicable dose requirements or the EPA's acceptable risk range) for the appropriate end-state land use.

Specifics associated with the measures (compliance or mitigation measures or BMPs) that involve monitoring, sample collection, and the installation of protective elements (e.g., depth of soil cover on waste-rock piles, the necessity for and/or type of liners for water evaporation ponds, other elements) during operations and reclamation would be identified in the mine plans submitted to DOE for review and approval.

4.7 CUMULATIVE IMPACTS

Potential impacts of the five alternatives in combination with the impacts of past, present, and reasonably foreseeable future actions in the region are considered in this section.

Consistent with 40 CFR 1508.7, in the ULP PEIS, a "cumulative impact" is an impact on the environment that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (Federal or non-Federal) or person that undertakes such actions. A cumulative impacts assessment accounts for both geographic (spatial) and time (temporal) considerations of past, present, and reasonably foreseeable actions. Geographic boundaries can vary by resource area—depending on the amount of time an impact remains in the environment, the extent to which such an impact can migrate, and the magnitude of that impact. Although the geographic extent of cumulative impacts may be less for some resource areas, the boundary for this analysis is conservatively defined as 50 mi (80 km) for all resource areas (see Figure 4.7-1). The primary factor considered for the purpose of the cumulative impacts analysis for the ULP PEIS is whether the other actions would have some influence on the resources in the same time and space as those affected by the

TABLE 4.6-1 Measures Identified to Minimize Potential Impacts from Uranium Mining at the ULP Lease Tracts

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
M-1	**Reduce dust emissions; reduce air emissions**			
	• Apply water or chemical suppressants on unpaved haul roads, disturbed surfaces, and temporary stockpiles.	X		
	• Limit soil-disturbing activities and travel on unpaved roads.		X[d]	
	• Design and construct new access roads to meet appropriate standards; roads should be no larger than necessary to accommodate their intended function.		X[d]	
	• Cover unpaved access roads, frequently used on-site roads, and parking lots with aggregate.	X		
	• Assure all heavy equipment meets emission standards as required.	X		
	• Limit idle time of vehicles and motorized equipment.			X
	• Fuel all diesel engines used with ultra-low sulfur diesel (sulfur content of ≤15 parts per million [ppm]).			X[e]
	• Avoid construction traffic and reduce speeds on unpaved surfaces.	X		
	• Ensure that all vehicles transporting loose materials are covered (e.g., with tarpaulins), both when travelling with a load of ore and when returning empty; loads should be sufficiently wet and kept below the freeboard.	X		
M-2	**Identify and protect paleontological resources**			
	• Consult with affected BLM Field Offices to determine whether areas of moderate to high fossil-yield potential (i.e., PFYC 3, 4, or 5) or known significant localities occur within proposed areas of disturbance and if surveys, sampling, or the development of paleontological resources management plan would be needed.		X	
	• Immediately notify the BLM authorized officer of any paleontological resources discovered as a result of mining activities so that appropriate measures to mitigate adverse effects to significant paleontological resources can be determined and implemented. Operations may continue if activities can avoid further impacts on the fossil discovery or can be continued elsewhere.		X	

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
M-3	**Reduce noise-related impacts**			
	• Maintain noise level below Colorado maximum permissible limit of 55 dBA during the day (7 a.m.–7 p.m.) and of 50 dBA at night (7 p.m.–7 a.m.), and below EPA guideline level of 55 dBA L_{dn} at receptor location.	X		
	• Maintain equipment in good working order in accordance with manufacturer's specifications.			X
	• Limit noisy activities to the least noise-sensitive times of the day (daytime between 7 a.m. and 7 p.m.) and weekdays and limit idle time for vehicles and motorized equipment.			X
	• Notify area residents of high-noise and/or high-vibration-generating activities (e.g., aboveground and belowground blasting) in advance.			X
	• Employ noise-reduction devices (e.g., mufflers) as appropriate.			X
	• Provide a noise complaint process for surrounding communities.			X
	• Site noise sources to take advantage of topography and distance; construct engineered sound barriers and/or berms as necessary.			X
	• Limit operational noise to 49 dBA or less within 2 mi (3 km) from an occupied/active Gunnison sage-grouse lek.			X
M-4	**Protect soils from erosion; protect local surface water bodies from contamination and sedimentation; protect local aquifers from contamination**			
	• Identify local factors that cause slope instability (e.g., slope angles, precipitation) and avoid areas with unstable slopes.			X
	• Avoid creating excessive slopes during excavation; use special construction techniques, where applicable, in areas of steep slopes, erodible soil, and stream channel crossings.		X[f]	
	• Apply all dust palliatives in accordance with appropriate laws and regulations; ensure that dust suppression chemicals are not sprayed on (released to) soils or streams.		X[g]	
	• Control and direct runoff from slope tops to settling or rapid infiltration basins until disturbed slopes are stabilized; stabilize slopes as quickly as possible.	X[h]		
	• Assure operators comply with CDRMS requirements regarding groundwater and groundwater contamination.	X		
	• Obtain borrow materials from authorized or permitted sites.		X[i]	
	• Retain sediment-laden waters from disturbed areas with the lease tract through the use of barriers and sedimentation devices (e.g., berms, straw bales, sandbags, jute netting, or silt fences) as necessary.	X[h]		
	• Place barriers and sedimentation devices around drainages and wetlands.		X[g]	

TABLE 4.6-1 (Cont.)

Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
• Require developers using on-site groundwater supplies to conduct a hydrologic study consistent with that required by the state's environmental protection plan.	X		
• Conduct routine inspections to assess effectiveness and maintenance requirements for erosion and sediment control systems.			X
• Maintain, repair, or replace barriers and sedimentation devices as necessary to ensure optimum control.	X[h]		
• Inspect and clean tires of all vehicles to ensure they are free of dirt before they enter paved public roadways to the extent practicable.			X
• Locate a diversion ditch upstream of the mine site to intercept surface water flow or shallow groundwater and channel it around the site; tailor the location and length of the ditch to site-specific conditions, taking into account the location of mine waste piles, the site topography, and surface flow patterns.	X[h]		
• Place drill holes at a distance from existing water rights to the extent possible.			X
• Plug open drill holes and areas around vent shafts to reduce the volume of groundwater entering an underground mine during operations to the extent possible; use underground sumps to contain water flow, as needed; pump water from groundwater seepage to control water flow, if necessary, into surface mine-water treatment pond.		X[j]	
• Divert water pumped from mines (or drill sites) to a lined sedimentation pond for treatment. Locate settling pond(s) in topographically low areas (but not any that are along drainages or near naturally flowing water). The purpose of treatment is to promote the precipitation of heavy metals through oxidation processes like aeration. (Employ this option at sites at which the mine drainage is high in total suspended solids).	X[h]		
• As sedimentation ponds are cleaned, test sediments and precipitates for proper disposal.	X[h]		
• Locate mine ore storage and waste-rock or tailings piles on topographically high ground so they do not come into direct contact with flowing or ponded water; grade the ore storage area and construct an earthen berm around it. Divert any runoff from the area to a sedimentation pond for testing and treatment.		X	
• Contain any runoff from mine waste-rock piles (e.g., divert it to a sedimentation pond) and treat it, as needed.	X[h]		
• Provide off-site (downgradient) groundwater monitoring consistent with Colorado requirements for groundwater protection permits. New mining activities should consider cumulative impacts in combination with other projects also occurring in the vicinity with implementation of necessary measures for the protection of human health and the environment.	X[i]		
• Site and design mine entrances and activities so that they avoid direct and indirect impacts on important, sensitive, or unique habitats, including, but not limited to, wetlands (both jurisdictional and nonjurisdictional), springs, seeps, streams (ephemeral, intermittent, and perennial), 100-year floodplains, ponds and other aquatic habitats, riparian habitats, remnant vegetation associations, rare or unique biological communities, crucial wildlife habitats, and habitats supporting sensitive species populations.		X[k]	

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
	• Restrict activities at previously mined sites so they do not further encroach toward perennial streams (e.g., the Dolores River); new mining activities should not be allowed within 0.25 mi (0.40 km) of perennial streams and should consider cumulative impacts in combination with other projects also occurring in the vicinity with implementation of necessary measures for the protection of human health and the environment; avoid the placement of facilities or roads in drainages; and make necessary accommodations for the disruption of runoff.		X[l]	
	• Identify surface water runoff patterns at the mine site and develop mitigation that prevents soil deposition and erosion throughout and downhill from the site; potential adverse impacts could be minimized by incorporating erosion-control techniques such as water bars, weed-free hay bales and silt fences, vegetation, erosion-control fabric, temporary detention basins, and land contours in the construction design.	X[h]		
	• Assure that herbicides used meet the specifications and standards of BLM and county weed control staff.	X[m]		
	• Seed soil stockpiles to minimize erosion and growth of weeds.			X
	• Apply methods such as chisel plowing[n] or subsoiling[o] (tilling), as necessary, to abandoned roads and areas no longer needed to alleviate soil compaction.			X
	• Limit herbicide use to nonpersistent, immobile substances. Do not use herbicides near or in U.S. waters, including ponds, lakes, streams (intermittent or perennial), and wetlands, unless the herbicide is labeled for such uses. If herbicides are used in or near U.S. waters, the applicator shall ensure that the applications meet the requirements of the EPA's "Pesticide General Permit for Discharges from the Application of Pesticides." Determine setback distances in coordination with Federal and state resource management agencies. Before beginning any herbicide treatments, ensure that a qualified biologist has conducted surveys of bird nests and of sensitive species to identify the special measures or BMPs that are necessary to avoid and minimize impacts on migratory birds and sensitive species. The herbicides to be used would be approved by BLM through submission of "Pesticide Use Proposal" forms. The state-, county-, and BLM-listed plant species scheduled for eradication that are found in the project area would be eradicated and reported to BLM through submission of "Pesticide Application Records."	X[m]		
M-5	**Minimize the extent of ground disturbance and the duration of ground-disturbing activities**			
	• Reduce the surface footprint of disturbed areas (buildings, service areas, storage areas, stockpile areas, and loading areas) within the lease tracts to the extent possible.			X
	• Minimize the duration of ground-disturbing activities, especially during periods of heavy rainfall.			X
	• Expand disturbed areas (e.g., waste-rock pile storage areas) incrementally to the extent practicable.			X

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
	• Use existing roads and disturbed areas (and transportation ROWs) to the extent possible (before constructing new roads or disturbing new areas).		X	
	• If ground-disturbing activities require an extended schedule, employ measures to limit exposure to wind and water during the activity.			X
	• Avoid clearing and disturbing sensitive areas (e.g., steep slopes and natural drainages) and minimize the potential for erosion.		X	
	• Limit access to disturbed areas and staging areas to authorized vehicles traveling only on designated (dust-stabilized) roads.			X
	• Minimize disturbance to vegetation, soils, drainage channels, and stream banks.		X[p]	
M-6	**Restore original grade and reclaim soil and vegetation**			
	• Salvage topsoil and vegetation prior to site disturbance and place in stockpiles (to be used in final reclamation).			X
	• Use DOE-developed seed mixture (see Table 4.1-9).	X[m]		
	• Reestablish the original grade and drainage pattern of all disturbed areas before final reclamation to the extent practicable.		X[p]	
	• Test for agronomic nutrient profile to determine whether amendments are needed to establish vegetation before final reclamation.			X
	• Place topsoil over the top of disturbed areas and seed (e.g., by broadcast or drill seeder).		X	
	• Monitor seeded areas for some period following seeding to ensure vegetation is reestablished.	X[h]		
	• Grade mine waste-rock or tailings piles to create a gently sloping (more stable) surface.		X[f]	
	• Recontour soil borrow areas and cut and fill slopes, berms, waterbars, and other disturbed areas to approximate naturally occurring slopes.		X[f]	
M-7	**Protect wildlife and wildlife habitats (and grazing animals, if present) from ground disturbance and general site activities**			
	• Use wattles or other appropriate materials to reduce potential for sediment transport off the site.			X
	• Avoid unnecessary disturbance or feeding of wildlife. The collection, harassment, or disturbance of wildlife and their habitats should be reduced through employee and contractor education about applicable state and Federal laws.			X

TABLE 4.6-1 (Cont.)

Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
• Minimize the number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas). For example, cap uncovered pipes at the end of each workday to prevent animals from entering the pipes. If a sensitive species is discovered inside a component, do not move that component, or, if it must be moved, move it only to remove the animal from the path of activity, until the animal has escaped.			X
• Establish buffer zones around sensitive habitats and either exclude project facilities and activities from those areas or modify them within those areas, to the extent practicable.			X
• If any Federally listed threatened and endangered species are found during any phase of the project, consult with the USFWS as required by Section 7 of the ESA and determine an appropriate course of action to avoid or mitigate impacts.	X		
• Schedule activities to avoid critical winter ranges for big game (mule deer and elk) when they are heavily used (December 1 through April 15), or utilize compensatory mitigation (e.g., habitat enhancement or replacement) to offset long-term displacement of big game from critical winter ranges. Compensatory mitigation projects may be developed in coordination with CPW.		X	
• Conduct pre-disturbance surveys for threatened, endangered, and sensitive species within all areas that would be disturbed by mining activities. These surveys would be used to determine the presence of sensitive species on the lease tracts and develop the appropriate measures to avoid, minimize, or mitigate impacts on these species. If sensitive species are located in the area that might be developed, coordination with the USFWS and CPW would be necessary to determine the appropriate species-specific measures.		X	
• Minimize increases in the number of nuisance animals and pests in the project area, particularly any individuals or species that could affect human health and safety or that could adversely affect native plants and animals to the extent practicable.			X
• Monitor to the extent practicable the potential for an increase in the predation of sensitive species (particularly Gunnison sage-grouse) from ravens and other species that are attracted to developed areas and that use tall structures opportunistically to spot vulnerable prey.			X
• Locate soil borings, mine entrances, and travel routes to avoid important, sensitive, or unique habitats, including, but not limited to, wetlands, springs, seeps, ephemeral streams, intermittent streams, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare natural communities, and habitats supporting sensitive species populations as identified in applicable land use plans or best available information and science.		X[g]	
• Conduct pre-construction raptor nest surveys to ensure compliance with the Migratory Bird Treaty Act; follow the recommended buffer zones and seasonal restrictions for Colorado's raptors (CPW 2008).	X[q]		

TABLE 4.6-1 (Cont.)

Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
• Schedule activities to avoid, minimize, or mitigate impacts on wildlife. For example, avoid crucial winter ranges, especially during the periods when they are used. If there are plans to conduct activities during bird breeding seasons, a nesting bird survey should be conducted first. If active nests are detected, the nest area should be flagged, and no activity should take place near the nest (at a distance determined in coordination with the USFWS) until nesting is completed (i.e., until nestlings have fledged or the nest has failed) or until appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. Coordinate the timing of activities with BLM, USFWS, and CPW. Prior to authorization of ground disturbing activities a habitat suitability analysis would be done and for habitats found suitable, a protocol survey would be done. If nesting birds are found, seasonal and year-round buffers would be established with USFWS coordination.		X	
• Avoid and minimize impacts to bats during mine renewal activities (as well as during mine closure and reclamation) as follows: – Reentry of existing mines that contain winter roosting bats should be avoided during the winter season (October 1 through April 15). For existing mines expected to be reused, exclusion devices could be used to prevent bats from using the mines during winter. This would involve screening out bats by placing chicken wire with ≤1-in. (2.5-cm) mesh across the bat gate or open-access point at mine complexes that are ungated. Exclusions should be installed by September 1, if possible, but no later than September 30. – Existing mines utilized as summer roosting sites (other than maternity roost sites) can be handled similarly. The summer season is considered April 15 through September 1. – Any mine to be reworked that is used as a maternity roost should undergo an exclusion effort by April 15 and should be maintained from at least April 15 through June 15. Also, the portal(s) should be covered during night to prevent the potential reuse as maternity sites. In the event that a maternity roost will be permanently impacted, consideration should be given to preserving nearby mine features, if possible, to serve as mitigation and as a possible alternate habitat for bats. This is also recommended to mitigate impacts for a large winter roost site that will be permanently impacted. The creation of artificial bat habitat could also serve as an important alternative to mitigate impacts on maternity roosts or large winter roost sites. – For mine sites used year round, mining renewal activities should be spring (April through May) or fall (September through October). – The development and enactment of bat mitigation should be coordinated with the Colorado Bat Working Group and CPW.		X	

TABLE 4.6-1 (Cont.)

Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
• Avoid vegetation clearing, grading, and other construction activities during the bird breeding season; if activities are planned during the breeding season, a survey of nesting birds should be conducted first. If active nests are detected, the nest area should be flagged, and no activity should take place near the nest (at a distance determined in coordination with the USFWS) until nesting is completed (i.e., until nestlings have fledged or the nest has failed) or until appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. Coordinate the timing of initial development activities with the BLM, USFWS, and CPW.	X[q]		
• Relocate wildlife found in harm's way away from the area of the activity when safe to do so.			X
• Design stream crossings to provide in-stream conditions that would allow for and maintain uninterrupted movement of water and safe passage of fish; minimize removal of any deadfall and overhanging vegetation that provides shelter and shading to aquatic organisms.			X
• Exclude new mining and other surface-disturbing activities within 0.25 mi (0.4 km) of the Dolores River to avoid impacts on a desert bighorn sheep movement corridor (and other wildlife).		X[l]	
• Limit vegetation maintenance for transmission lines located near aquatic habitats or riparian areas (e.g., use minimum buffers identified in the applicable land use plan or best available science and information) and perform maintenance mechanically rather than with herbicides. Cutting in wetlands or stream and wetland buffers should be done by hand. Tree cutting in stream buffers should only target trees able to grow into a transmission line conductor clearance zone within 3 to 4 years. Cutting in such areas for construction or vegetation management should be minimized, and the disturbance of soil and remaining vegetation should be minimized.			X
• The leaseholder should consult with the USFWS to address concerns regarding mine-water treatment ponds. Water pumped from mines should be diverted to a lined sedimentation pond for treatment. Settling ponds should be located in topographically low areas but not in any areas that are along drainages or near naturally flowing water. The treatment ponds should be constructed in accordance with applicable regulations. As applicable, the ponds should be fenced and netted to prevent use by wildlife (or livestock), including birds and bats. The lower 18 in. (46 cm) of the fencing should be a solid barrier that would exclude entrance by amphibians and other small animals.		X[q]	
• Before mine entrances are closed during reclamation, conduct a summer and winter bat survey, if required, to determine the number and species of bats that could potentially occupy a site. Depending on the results of the surveys, undertake actions that could include the installation of bat gates. If bat surveys indicate no presence of bats, promptly close off all mine openings when finished with mining activities before bats have an opportunity to establish roosts or hibernacula.		X[q]	

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
	• Use herbicides that have a low toxicity to wildlife and untargeted native plant species, as determined in consultation with the USFWS. Do not use herbicides near or in U.S. waters, including ponds, lakes, streams (intermittent or perennial), and wetlands, unless the herbicide is labeled for such uses. If herbicides are used in or near U.S. waters, the applicator shall ensure that the applications meet the requirements of the EPA's "Pesticide General Permit for Discharges from the Application of Pesticides." Determine setback distances in coordination with Federal and state resource management agencies. Before beginning any herbicide treatments, ensure that a qualified biologist has conducted surveys of bird nests and of sensitive species to identify the special measures or BMPs that are necessary to avoid and minimize impacts on migratory birds and sensitive species. The herbicides to be used would be approved by BLM through submission of "Pesticide Use Proposal" forms. The state-, county-, and BLM-listed plant species scheduled for eradication that are found in the project area would be eradicated and reported to BLM through submission of "Pesticide Application Records."	X[m]		
	• If a transmission line is required, it should be designed and constructed in conformance with *Avian Protection Plan Guidelines* (APLIC and USFWS 2005), in conjunction with *Suggested Practices for Avian Protection on Power Lines* (APLIC 2006), to reduce the operational and avian risks that result from avian interactions with electric utility facilities. For example, transmission line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This would also minimize potential increased presence of ravens and raptors that may prey upon Gunnison sage-grouse. Shield wires should be marked with devices that have been scientifically tested and found to significantly reduce the potential for bird collisions.		X[q]	
M-8	**Minimize the establishment and spread of invasive (vegetative) species**			
	• Monitor the area regularly and eradicate invasive species immediately.	X[m]		
	• Use DOE-developed seed mixture (see Table 4.1-9) and weed-free mulch.	X[m]		
	• Clean vehicles to avoid introducing invasive weeds.			X
M-9	**Identify and protect cultural and historic resources**			
	• Assure that all activities comply with Section 106 of the NHPA.	X		
	• Assure that all individuals performing cultural resources management tasks and services meet the Secretary of the Interior Standards for Archaeology and Historic Preservation.	X		

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
	• Identify through searches of records, field surveys, and consultation with tribes, as necessary, all cultural resources in the area of potential effects and evaluate them for eligibility for inclusion on the NRHP.	X		
M-10[r]	**Minimize lighting to off-site areas; minimize contrast with surrounding areas**			
	• Design lighting to provide the minimum illumination needed to achieve safety and security objectives. Minimize or eliminate lighting of off-site areas or the sky. All unnecessary lighting should be turned off at night to limit attracting migratory birds, bats, or other wildlife.			X
	• Minimize the number of structures required.			X
	• Construct low-profile structures whenever possible to reduce the structures' visibility.			X
	• Repeat and/or blend materials and surface treatments (e.g., paint buildings) to correspond with the existing form, line, color, and texture of the landscape.			X
	• Select appropriately colored materials for structures, or apply appropriate stains as coatings, so they blend with the backdrop of the lease tract.			X
	• Use materials, coatings, or paints having little or no reflectivity whenever possible.			X
	• Avoid installing gravel and pavement wherever possible to reduce contrasts in color and texture with the existing landscape to the extent practicable.			X
	• Avoid downslope wasting of excess fill material.			X
	• Control litter and noxious weeds by removing them regularly during mine development and operations.			X
	• When accurate color rendition is not required (e.g., roadway, basic security), lighting should be amber in color, using either low-pressure sodium lamps or yellow LED lighting, or an equivalent.		X	
	• Undertake interim restoration during the operating life of the mine, as soon as possible after disturbances have occurred.		X[p]	
	• Ensure that lighting for structures on the mining sites does not exceed the minimum number of lights and brightness required for safety and security and does not cause excessive reflected glare.		X	
	• Use full cut-off luminaires recommended or approved by the International Dark Sky Association to minimize uplighting; direct lights downward or toward the area to be illuminated.			X
	• Ensure that light fixtures do not spill light beyond the lease tract boundaries to the extent practicable.			X

TABLE 4.6-1 (Cont.)

	Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
M-11	**Protect human health from radiological exposures**			
	• Monitor radon emissions and related operational conditions to obtain data for the estimation of more precise radon doses with respect to the potential exposures of nearby residents, including (1) monitoring the radon discharge concentration continuously whenever the mine ventilation system is operational, (2) measuring each mine vent exhaust flow rate, and (3) calculating and recording a weekly radon-222 emission rate for the mine. Model the dose to the nearest member of the public by using COMPLY-R, as required by 40 CFR Part 61, Subpart B.	X		
	• In cases where radon doses to nearby residents exceed the NESHAP (40 CFR Part 61 Subpart B) dose limit of 10 mrem/yr, implement one or more of the following measures to reduce the potential radon exposures: (1) increase the ventilation flow rate, (2) reroute ventilation flow, (3) reroute ventilation to a new vent, (4) modify the vent stack, (5) decrease the vent stack diameter, (6) increase the vent stack release height, or (7) construct additional bulkheads.	X		
	• Promptly and properly close off all mine openings and install warning signs of potentially high levels of radiation exposures when finishing the mining activities to prevent any inadvertent intrusion to the mine or getting too close to the mine openings.		X	
	• Assure an adequate thickness for the surface soil material covering waste-rock piles before seeding. The thickness should be adequate to prevent the underlying waste rocks from exposure to the ground surface over time. Through modeling and/or monitoring, evaluate measured uranium and decay product concentrations in waste rocks to determine whether the thickness is sufficient to mitigate potential radiation exposures.		X	
	• Develop an emergency rescue plan and ensure a trained rescue team can be dispatched immediately when needed.		X	
M-12	**Assure safe and proper transportation**			
	• Maintain the haul trucks for exclusive use only. Avoid using trucks for cartage of material other than uranium ore unless they have been properly cleaned for unrestricted use.	X		
	• Use a gravel track pad or similar method to minimize tracking of mud and dirt from any mine site onto the local public and county roads that provide site access.			X
	• Assure that uranium ore shipments proceed directly to the mill from the mine location. Identify locations for potential "safe havens" for temporary wayside parking or storage in the event there are unforeseen delays or scheduling issues associated with the mill.		X[s]	

TABLE 4.6-1 (Cont.)

Measure Description	Compliance Measure[a]	Mitigation Measure[b]	BMP[c]
• Assure that mine and mill operators are aware of the routes used for shipments of uranium ore.		X[s]	
• The State of Colorado Highway Access Code recognizes the right of reasonable access, by development, to the state highway system, providing the development mitigates traffic impacts on the highway at the point of access to the state highway. This would also apply to the traffic generation/impacts from the lease tracts considered in the ULP PEIS. As a measure to minimize potential traffic impacts due to the ULP proposed action, the following steps would be taken by each lease operator prior to opening a mining operation on a lease tract:			
1. The lessee should contact CDOT to meet for an access pre-application meeting to determine the size and scope of traffic impacts to be considered before submitting an access application.			X
2. The lessee shall submit a complete Access Permit Application to CDOT (Region 5 Access Permit Office) for its review. This application should include a traffic impact study (TIS) that identifies the directional distribution and daily and peak-hour volumes of traffic generated to identify if intersection improvements are warranted. Depending upon the size and impacts of a facility, the requirements for a TIS maybe waived for smaller operations, depending upon the outcome of the pre-application meeting. Typically the lessee would receive a response from CDOT within 20 days if additional documentation was needed before the permit would be completed. If CDOT accepted the application with no revisions, a permit would be issued or denied within 45 days of receipt of the application. If revisions were necessary, the application review period (20-day review) would restart upon receipt of the revised information by CDOT.	X		
3. The mine development constructs intersection improvements per the requirements of the access permit issued prior to commencement of the activity.	X		

[a] Compliance measures are those measures needed to fulfill regulatory requirements. Note that Appendix C of the lease agreement requires lessees to comply with all applicable statutes and regulations. Generic leases for the ULP are presented in Appendix A of the ULP PEIS.

[b] Mitigation measures identified in the table include measures that are required by DOE as identified in current leases or that could be added to the leases when modified. DOE may also identify additional mitigation measures.

[c] BMPs are those practices and activities generally implemented within the industry to conserve resources. These BMPs are not necessarily required by DOE but may be implemented to further reduce impacts.

[d] See Appendix C, Section I of the lease agreement.

Footnotes continued on next page.

TABLE 4.6-1 (Cont.)

[e] Except for older diesel equipment meeting emissions requirements that need higher sulfur content for proper functioning.

[f] See Appendix C, Section L of the lease agreement.

[g] See Appendix C, Section J of the lease agreement.

[h] The CDRMS requires lessees to obtain permits for their mining operations and to submit and follow an EPP. Runoff and run-on are specifically addressed on a site-by-site basis, as are issues concerning hydrology and reestablishment of vegetation.

[i] Article XIII MINING PLAN of the lease agreement addresses the process for reclamation; the ULP will work with the BLM to identify and clear local sources of borrow material.

[j] See Appendix C, Section M of the lease agreement; also required to be submitted under Article XII EXPLORATION PLAN of the lease agreement.

[k] See Appendix C, Sections G and H of the lease agreement, which address the location of mining infrastructure.

[l] See Appendix C, Section T of the lease agreement (for applicable lease tracts).

[m] Requirement of the surface management agency, BLM.

[n] Chisel plowing is a method used to alleviate shallow soil compaction by inserting a narrow tool in soil to depths of at least 14 in. (35 cm).

[o] Subsoiling is a method used to alleviate shallow soil compaction by tillage of soil to depths of at least 14 in. (35 cm).

[p] See Appendix C, Section H of the lease agreement.

[q] Measure per CPW.

[r] Primary source of information is USDA and DOI (2007).

[s] See Appendix C, Section P of the lease agreement.

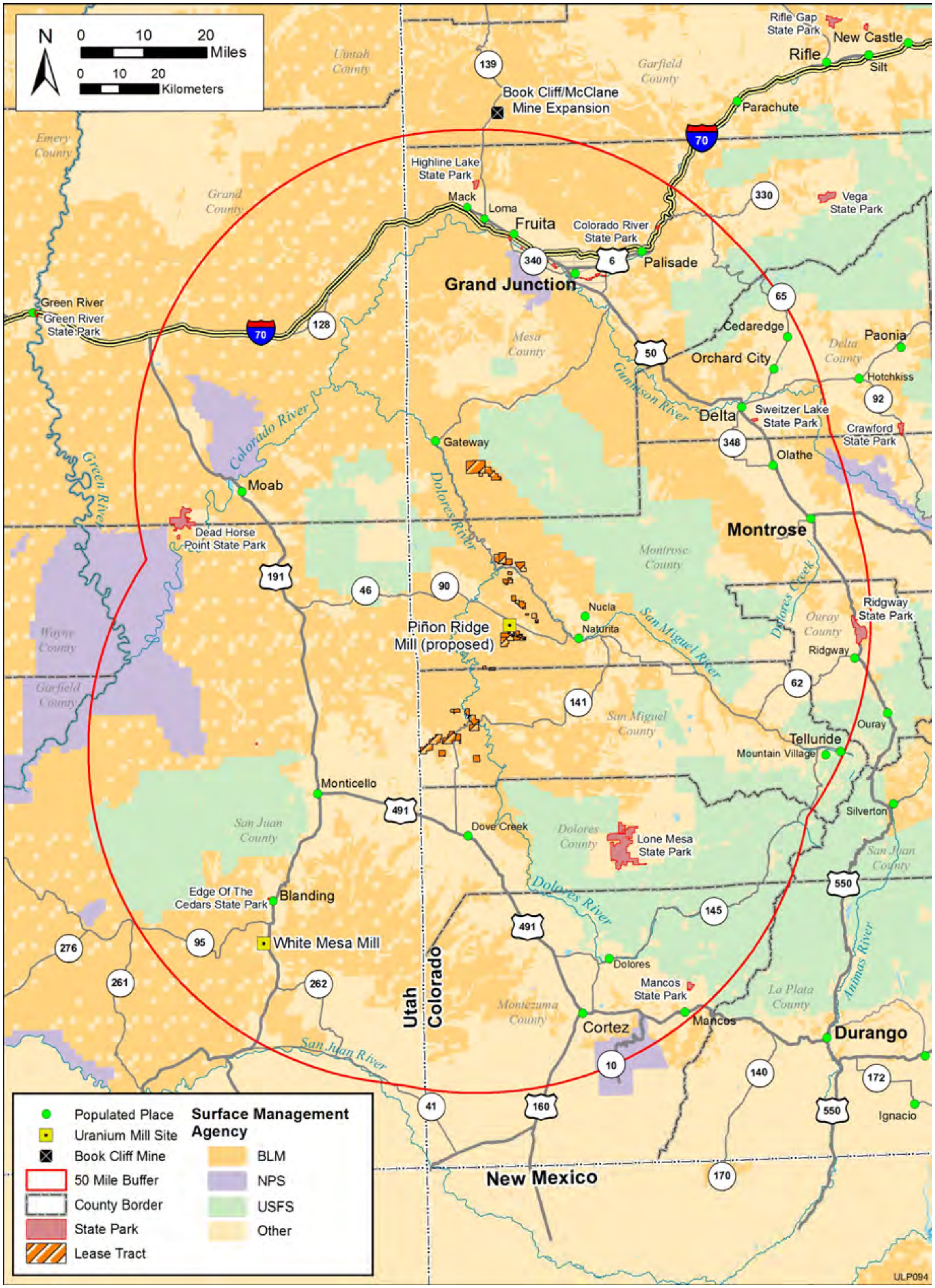

FIGURE 4.7-1 Region of Influence for Cumulative Effects

implementation of any of the five alternatives, including the preferred alternative (i.e., continue the ULP with the 31 lease tracts for the next 10-year lease period or for another reasonable period of time).

The primary uses of land within the immediate vicinity (10 mi [16 km]) of the ULP lease tracts are grazing, wildlife habitat, and uranium/vanadium exploration and development. Most of this land is managed and owned by the BLM and USFS. Most of the land within 50 mi (80 km) of the ULP lease tracts is owned by either the Federal Government or the States of Colorado or Utah. At the time of the preparation of the ULP PEIS, no large actions were being planned on BLM land.

In the analysis that follows, impacts of the five alternatives are considered in combination with the impacts of past, present, and reasonably foreseeable future actions. This section begins with a description of reasonably foreseeable future actions in the ROI for cumulative effects (see Figures 4.7-1 and 4.7-2), including those that are ongoing, under construction, or planned/proposed for future implementation. In general, past and present actions are accounted for in the affected environment section (Section 3).

4.7.1 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions within the ROI for cumulative effects are discussed in the following sections. These actions were identified primarily from a review of the Schedule of Proposed Action for the San Juan National Forest and other relevant documents and data sources (Edge Environmental, Inc. 2009; USDA 2011b, 2012a). The actions listed are planned, under construction, or ongoing.

4.7.1.1 Piñon Ridge Mill

Energy Fuels Resources Corporation has planned to construct the Piñon Ridge Mill (in Paradox Valley, between Naturita and Bedrock in Montrose County, Colorado) (Energy Fuels 2012d). CDPHE issued a final radioactive materials license to Energy Fuels Resources Corporation (located in Lakewood, Colorado; an asset of Ontario's Energy Fuels, Inc.) in early 2011, following the performance of an environmental impact assessment (CDPHE 2011d). The license application included an environmental report, which outlined the proposed action alternatives, affected environment, environmental impacts, and cumulative impacts (Edge Environmental, Inc. 2009). On June 13, 2012, a Colorado court set aside CDPHE's action in issuing the license, remanded the case for further proceedings, and ordered CDPHE to convene an additional hearing scheduled for April 2013. On April 25, 2013, CDPHE decided to issue to Energy Fuels Resources Corporation a final radioactive materials license that imposed a number of conditions on the construction and operation of the proposed Pinon Ridge Mill (CDPHE 2013). In May 2013, a group of plaintiffs filed for judicial review of that CDPHE decision in the District Court for the City and County of Denver.

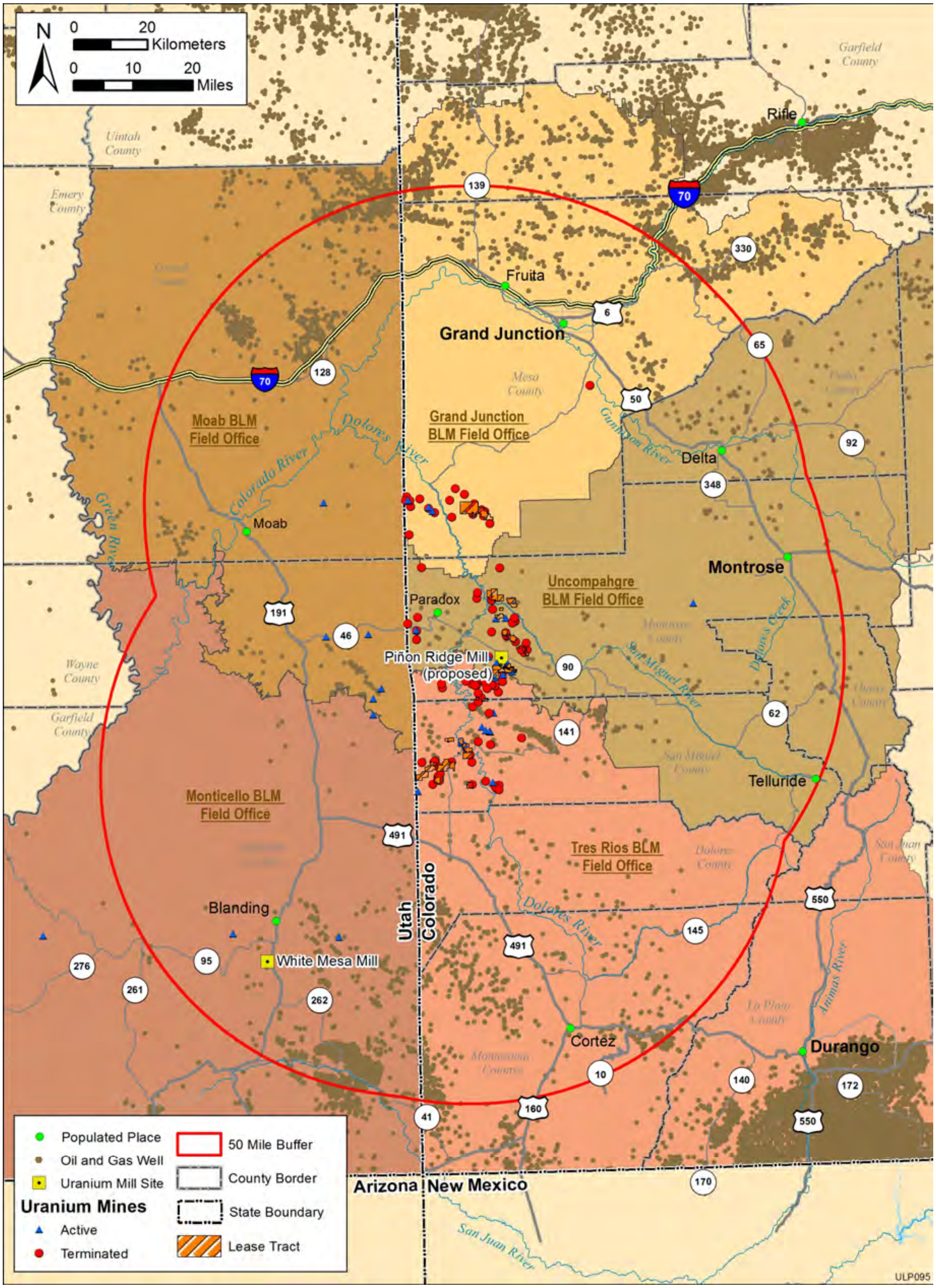

FIGURE 4.7-2 Uranium Mining and Oil and Gas Wells within the Region of Influence for Cumulative Effects

The proposed Piñon Ridge Mill, as the first new conventional uranium mill constructed in 30 years, would process uranium and vanadium into uranium oxide concentrate (yellowcake) and vanadium oxide concentrate, respectively, by using the solvent extraction process (Edge Environmental, Inc. 2009; Energy Fuels 2012a). The mill is expected to process ore from five to nine mines at any one time, and feeder mines are expected to change over the course of the mill's 40-year lifetime. A surge in uranium exploration, mining, and permitting is anticipated if the mill is constructed, including permitting and development of uranium/vanadium deposits controlled by Energy Fuels (CDNR 2012; Edge Environmental, Inc. 2009; Energy Fuels 2009).

The proposed Piñon Ridge Mill would be constructed on approximately 400 acres (160 ha) within an 880-acre (360-ha) property; the licensed (restricted) portion of the site would occupy approximately 300 acres (120 ha). Facilities would consist of a stockpile pad, process buildings, administration and maintenance buildings, waste management facilities (such as tailing cells and evaporation ponds), and ancillary facilities. Construction is expected to last for 21 months and employ 125 to 200 workers (at the peak of construction). During operations, the mill is projected to employ approximately 85 people around the clock. Operations are expected to last for 40 years (Edge Environmental, Inc. 2009; Energy Fuels 2012a).

Ore would be mined mostly from existing operations (owned and operated by Energy Fuels) throughout southwestern Colorado and southeastern Utah. Ore would be shipped to Piñon Ridge Mill, stored at the ore stockpile pad, crushed and mixed with water to create a fine slurry, and leached with sulfuric acid, resulting in the precipitation of uranium oxide and vanadium oxide concentrates (500 tons per day). Uranium oxide concentrate would be shipped to a conversion plant, while vanadium oxide concentrate would be shipped to a plant that produces ferro-vanadium products (Edge Environmental, Inc. 2009).

Table 4.7-1 summarizes the potential environmental impacts from the proposed Piñon Ridge Mill.

4.7.1.2 Planned Uranium Exploration

Exploration for uranium typically involves the drilling of exploration holes with diameters ranging from 3 to 6 in. (7.6 to 15 cm), and it is typically accompanied by the construction of mud pits (to collect drill cuttings and manage drilling fluids). Monitoring wells might also be required to monitor groundwater quality and depth. Surface disturbance is typically limited. As noted in Section 4.7.2.2, uranium exploration activities are generally short term (BLM 2009b) and are not expected to have significant impacts on the environment or human health.

4.7.1.3 Coal Mining

The Book Cliff Mine (formerly the Red Cliff Mine) is a proposed underground coal mine located 11 mi (18 km) north of Mack and Loma, Colorado. Proposed by CAM-Colorado, LLC (a subsidiary of Rhino Energy, LLC), the mine would extract low-sulfur coal from existing

TABLE 4.7-1 Potential Environmental Impacts of the Proposed Piñon Ridge Mill

Resource Area	Anticipated Impacts
Air quality	Potential nonfugitive emissions would not exceed thresholds for a major source permit or PSD thresholds. Modeling indicates that PM_{10} emissions would not cause the exceedance of NAAQS or Colorado Ambient Air Quality Standards (CAAQS). No significant dust or fume emissions would be expected from routine transportation of uranium ore or hazardous materials.
Noise	The estimated maximum noise level at the property boundary would be below the most restrictive maximum permissible noise level established by county regulation.
Geology and soils	Approximately 415 acres (170 ha) would be disturbed by site development activities. Construction impacts could include erosion of surface water control and settling. Surface disturbances would be stabilized by vegetation during operation.
Surface water	Design of the mill, ore pad, tailings cells, and evaporation ponds would result in no off-site stormwater discharge. Stormwater runoff from outside the zero-discharge footprint would be controlled by using BMPs. Operational impacts could include the spread of contamination through facility flooding, erosion of stormwater channels, and reduction of surface water flow to the Dolores River.
Groundwater	Primary impacts during operations could be the potential depletion of the bedrock aquifer by supply wells, which could potentially affect other groundwater users (impacts are not quantifiable until site withdrawals begin). The capture of stormwater runoff would limit infiltration or runoff to the Dolores River. Leaks and spills could affect water quality, but containment features and the absence of groundwater below parts of the facility would limit the impact.
Public health – radiological	Radiological exposures would occur from transportation, on-site storage, and mineral processing operations, as well as via airborne, waterborne, and de minimis pathways. The estimated dose to the maximum exposed theoretical receptor at the site boundary would be 8.2 mrem/yr (including radon), which falls within the applicable regulatory limits of 25 mrem/yr (EPA) and 100 mrem/yr (CDNR). The estimated dose to the maximum exposed actual off-site receptor (nearest downwind resident) would be 0.5 mrem/yr. Natural background dose in the area is 400 mrem/yr. Occupational doses would be expected to be less than 500 mrem/yr.
Public health – nonradiological	Chemical and particulate exposures would occur from transportation, on-site storage, and mineral processing operations. Impacts on air quality in the area of the facility would be less than levels deemed protective of human health. Occupational exposures to elevated levels of nonradiological contaminants of concern would be unlikely; no significant health impacts from routine operations would be expected.
Ecological resources	No Federally threatened, endangered, or candidate species were observed during wildlife surveys, and no state species of concern were observed. Four habitats of importance to area wildlife were identified on the project site; Energy Fuels has proposed offsets to the potential impacts. Indirect impacts could occur from degradation of habitat by the facility and increased traffic. Contents of evaporation ponds and tailing cells could be toxic to invading threatened and endangered species, and the project could hinder reestablishment of Gunnison sage-grouse. No jurisdictional wetlands are located at the site, and no aquatic species or habitats occur at the site. Indirect impacts on vegetation could occur if the project displaced native herbivores or if invasive, non-native species became established in disturbed areas. Soil disturbance, vehicle traffic, and other project activities could promote the spread of invasive plants. Increased traffic and erection of fences would increase the potential for collisions with and mortality of terrestrial wildlife and some threatened and endangered species. Radiation dose rates to plants and animals in the vicinity of the facility would be below recommended limits, and exposures from inhalation would be minimal. Nonradiological impacts on biota would be minimized.

TABLE 4.7-1 (Cont.)

Resource Area	Anticipated Impacts
Socioeconomics	The project would employ 25 to 45 and 125 to 200 workers during the construction of ancillary facilities and construction of the mill, respectively; the mill would employ 85 workers during 24/7 operation. As many as 538 direct and 664 indirect jobs could be created by stimulating regional mining and transportation activities, mainly near the locations of mines expected to provide ore for the mill. Approximately 80% of mill employees would be expected to be local residents, but the creation of direct and indirect jobs would result in growth of the Nucla/Naturita area and increase the demand for housing in mill- and mine-area communities. Some infrastructure and services might be inadequate for a period, especially during construction. Increases in local employment and housing demand would result in greater tax revenues. A future economic downturn would be possible due to the variable nature of the resource extraction economy. The influx of construction workers would introduce a transient population. Induced effects of the increase in local employment might encourage the development of new businesses; employment decreases could have negative impacts on the community.
Recreation and tourism	Increased availability of local services might lead to the expansion of recreation and tourism in the area. An association of negative impacts from mining and milling on recreation and tourism has not been demonstrated.
Land use	The project site would be unavailable for recreational or range/grazing use during construction and the 40-year operational period. No changes in land use would be expected for existing uranium mines in the region, but operations might result in resumed production of some regional uranium mines that are on standby.
Visual and scenic resources	Construction would not significantly affect the viewshed from Davis Mesa or State Highway 90 (CO 90), and impacts would be temporary. Facility features would be noticeable to travellers on CO 90 but would not dominate the view of the casual observer; existing open-pit mine overburden piles, waste-rock dumps, mine buildings, and access roads currently draw attention from CO 90. Visual impacts would be most prominent later in the 40-year facility lifetime, when evaporation ponds would be completed to full capacity.
Transportation	Worker and heavy-truck traffic associated with facility construction and operations could affect area landowners and recreationists; average daily traffic on CO 90 and CO 141 would increase by 40% and 30%, respectively, during the peak quarter of construction. Ore deliveries, product shipments, and commuting workers would continue to contribute to an increase in traffic over baseline levels, but the impact would be much smaller than it is during construction. The CDOT does not consider the increased level of traffic to be large. The condition of certain unimproved roads could worsen from use by increased mill traffic. No significant radiological or nonradiological health impacts would be expected from routine transportation.
Cultural and paleontological resources	The project would not be expected to affect any historic properties, and it is expected that artifact surveys would continue as the facility was developed. There would be little potential for disturbance of known cultural sites or unanticipated discoveries during operations. No impacts on paleontological resources were identified.
Wastewater	Process water would be allowed to evaporate while salts precipitated to the bottom of the lined ponds. A large portion of tailings water would be recovered for reuse in the mill, and all gray water (from showers and sinks) would be recycled as process water. Makeup water would represent about 40% of total process flows.

TABLE 4.7-1 (Cont.)

Resource Area	Anticipated Impacts
Accidents	Transportation accidents involving uranium ore would not be likely to have an adverse impact on biota because of the relatively low toxicity and concentration of hazardous constituents in uranium ore. The primary impact on affected surface water bodies would be a short-term increase in turbidity and suspended solids.

Source: CDPHE (2011d)

Federal coal leases, potential new leases, and private land within the Cameo Seam. At full production, the mine would be expected to produce 6 to 8 million tons per year; however, production would depend on market demand. The mine would be expected to operate continuously and employ 200 to 250 full-time employees. Within its first 5 years, the mine would be expected to produce up to 3 million tons per year. The life expectancy of the mine is 30 years (BLM 2009a).

The BLM has prepared a Draft EIS for the Book Cliff Mine (Red Cliff Mine 2012; BLM 2009a). Table 4.7-2 summarizes the potential impacts from the proposed Book Cliff Mine. If approved, the project would consist of portal conveyor transfer buildings, fuel oil storage/fueling stations, electrical transformers, a bathhouse/office building, outdoor material storage areas, an equipment shop, a warehouse, a wash bay, covered storage, a sewage treatment plant, a water tank and water treatment buildings, a mine vent fan, noncoal waste storage, rock dust storage, a unit train load-out area, a pump house, a maintenance road, a water pipeline and diversion line, coal storage piles, a coal preparation plant, and mine access roads and entry points. In addition, a 14-mi (22-km) dedicated transmission line and a 2-mi (3-km) railroad connection spur would also be constructed. It is anticipated that construction of the mine would last for 2 years, cost $160 million, and encompass 23,000 acres (9,300 ha) of land (BLM 2009a). Several other coal mines in the ROI for cumulative effects are closed or no longer producing. See Section 4.7.2.3 for more information on current coal-mining activities.

4.7.1.4 Uranium Mill Remediation

Multiple abandoned/decommissioned uranium mills are located within the ROI for cumulative effects. These sites were radiologically and/or chemically contaminated by milling, processing, research, and/or weapons manufacturing operations.

Title I of UMTRCA designated 22 inactive uranium ore-processing sites for remediation. Remediation of these sites resulted in the creation of 19 disposal cells that contain encapsulated uranium mill tailings and associated contaminated material. For these sites, DOE became a licensee to the NRC. Inspection, reporting, and record-keeping requirements are defined in 10 CFR Part 40.27, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites.” All but one of the Title I disposal sites are under the general license. Four of these sites are within the ROI of the ULP lease tracts: the Naturita, Colorado, processing

TABLE 4.7-2 Potential Environmental Impacts of the Proposed Book Cliff Mine

Resource Area	Anticipated Impacts
Air quality	Construction and operations could increase the amount of fugitive dust and nitrogen emissions, as well as GHG and CO_2 emissions.
Noise	During construction, an increase in loud noise from large vehicles and equipment and rock-blasting would be expected. Rock-blasting would be expected to last approximately 6 months and would be heard within a 1,250-ft (380-m) radius. During operations, noise would not be expected to reach residential areas; however, the new railroad spur would increase train noise, and residents in Mack would hear the train passing and its horn blowing at least eight times a day.
Geology and soils	Construction and operations could aggravate landslides and cause caving or sinkholes, lowering of the surface, and accelerated erosion. A reduction in the ability to recover oil and gas deposits might also occur. Construction and operations would make it difficult to revegetate the surface because of high soil salinity. Runoff from stock and waste piles could increase the corrosive properties of the soil. Mining would likely result in mixed soil horizons.
Water resources	Sediment erosion could disturb or reroute surface water flow or drainage and result in the discharge of untreated stormwater into streams. Groundwater could be affected by the seepage of water that contained salts and metals leached from waste rock. Impacts would be considered minimal if proper water treatment and storage practices were implemented.
Occupational health	Workers would have an increased risk of the following: inhalation of toxic dust; on-site traffic accidents; occupational accidents resulting from improper use of industrial equipment; exposure to prolonged noise and extreme temperature fluctuations (resulting in body stress); exposure to chemical leaks; falling rocks; roof falls; exposure to poor underground and aboveground air quality; injuries from rock-blasting; and diseases from inhaling bird and bat excrement.
Ecological resources	A total of 240 acres (96 ha) for the mine facility and 210 acres (86 ha) for underlying railroad would be cleared of vegetation. The mine would potentially affect 0.1 acre (0.04 ha) of jurisdictional wetland. Construction and operations would reduce habitat for a number of plant and animal species. Increased traffic might result in increased wildlife collisions and mortality. Increased sediment flow could affect spawning native fish species, such as the round-tailed chub and flannel-mouth sucker. Loss of individuals of several threatened and endangered species could occur; not all species were noted in the project area. If proper wildlife management practices are implemented, this impact would be minimal.
Grazing	Approximately 460 acres (190 ha) of livestock forage would be lost for the duration of the project. Additional grazing land could be lost, because shrubbery has an increased potential to catch fire from sparks caused by railroad transport.
Socioeconomics	Construction and operations would create new jobs, likely resulting in an increase in the size of the local population and a need for additional housing and community services. New businesses might start, and established businesses might expand, resulting in increased employment opportunities. Property values might decrease due to their proximity to the mine and/or ancillary facilities, but they might also increase depending on new development. The influx of business and people has the potential to reduce the “rural” way of life. Industrialization could increase due to the expansion of the railroad. Operations would increase local, state, and Federal revenues.
Land use	Agricultural land, grazing activities, recreational use, and wildlife habitat would be restricted or unavailable for the duration of the project (approximately 30 years).

TABLE 4.7-2 (Cont.)

Resource Area	Anticipated Impacts
Recreation	Construction of the water pipeline, transmission line, and railroad would temporarily limit access to recreational trails located within the North Fruita Desert SRMA and result in visual disturbance from unsightly construction equipment and project areas. Long-term impacts include restricted access to or the rerouting of recreational trails, the elimination of the mine area for recreational use, and visual disruption from transmission line, railroad, and water pipeline ROWs.
Visual and scenic resources	Surface disturbance as a result of unsightly construction areas and staging areas would be likely to occur and would be considered temporary. Night lighting during construction and operations would result in night sky disturbance. Construction and operations would result in the alteration of the landscape from mining facilities, the railroad spur, access roads, and the transmission line.
Transportation	During construction, traffic along Utah State Highway 139 and at projected railroad crossings might be temporarily obstructed or rerouted for up to 4 weeks. During operations, occasional delays would be anticipated at railroad crossings and near mine entrances or access roads.
Cultural resources and paleontology	There would be no direct impacts on cultural resources or traditional cultural properties within the mine footprint. Indirect impacts might occur as a result of the reconfiguration of OHV and recreational trails. Construction and operations would pose a high risk of uncovering or destroying paleontological resources.
Hazardous materials	Hazardous materials might result if toxic materials were uncovered or inadvertently produced during the mining process.
Utilities	Temporary power outages could occur during construction or maintenance of the transmission line.

Source: BLM (2009a)

and disposal sites; the Slick Rock, Colorado, processing and disposal sites; the Grand Junction, Colorado, processing and disposal sites; and the Moab mill tailings site in Utah. A portion of the cell at the Grand Junction, Colorado, disposal site will be left open to receive additional contaminated materials; it is managed by DOE. The Moab mill tailings site is not yet under the DOE general license.

Uranium processing sites addressed by Title II of the UMTRCA were active when the act was passed. These sites were commercially owned and regulated under an NRC license. In later years, licensing and regulation of some of these sites transferred to the states, such as Colorado and Utah. After remediation is deemed complete, the Title II UMTRCA sites are transferred to DOE. DOE then administers Title II sites under the provisions of a general NRC license granted under 10 CFR Part 40.28, “General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites.” Two of these sites are within the ROI of the ULP lease tracts: the Durita, Colorado, processing and disposal sites; and the Lisbon Valley, Utah, processing and disposal sites. These sites have not yet transferred to the DOE Office of Legacy Management (LM).

Three former mill sites are listed in the EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Resource Conservation and Recovery Act (RCRA) site database: Fry Canyon Mill, Utah; the Uravan Uranium Project (Union Carbide) in Uravan, Colorado; and the Monticello, Utah, disposal and processing sites. The BLM has determined that site remediation is necessary at the Fry Canyon Mill (near the Daneros Mine, outside the region of cumulative effects), but a time frame for CERCLA work is unknown. The Uravan Uranium Project site has undergone remediation. Transfer of the site to DOE is currently under discussion between the current owner and multiple county, state, and Federal agencies. Remediation at the Monticello sites was conducted by DOE. Ongoing activities include operation and maintenance of remedial action systems, routine inspection and maintenance, records-related activities, and stakeholder support.

4.7.1.5 Reforestation Projects

In August 2009, the Narraguinnep and Bradfield wildfires destroyed nearly 7,500 acres (3,000 ha) of the San Juan National Forest, Mancos/Dolores District (CSFS 2009). The San Juan National Forest, Mancos/Dolores District, has proposed to reforest portions of the areas affected by the fire with ponderosa pine seedlings. Project implementation reportedly began in April 2012 (USDA 2011b).

In 2002, the Nizhoni Fire destroyed a ponderosa pine forest in San Juan County, north of Blanding. In 2010, the U.S. Department of Agriculture's (USDA's) Moab/Monticello Ranger District proposed to restore ponderosa pine over approximately 2,000 acres (810 ha). The prescribed burns can be used to create open areas and reduce vegetative fuels before manual planting. The project was approved in August 2011; its current status is unknown.

4.7.1.6 Western Area Power Administration (WAPA) ROW Maintenance

In 2010, WAPA began developing a plan to proactively maintain 280 mi (450 km) of ROW and access to electrical structures and equipment located within the National Forest systems in Colorado, Utah, and Nebraska. Unmaintained ROWs pose dangers to the electrical line, surrounding environment, and people living in the area. Vegetation buildup in a ROW can prevent access to the line for repair or maintenance and makes the line more susceptible to damage from wildfires (WAPA 2012a,b).

The proposed plan outlines a phased approach to implement changes to the current program. The short-term phase proposes clearing ROWs of all tall tree species. The mid-term phase intends to manage threats from vegetation, such as the buildup of timber and brush, to structures and conductors. In the long term, WAPA plans to maintain ROWs to ensure the safety and reliability of electrical service. The plan will include a modified vegetation management program intended to comply with best practices and Federal regulations while allowing access to the electrical facilities for regular maintenance (WAPA 2012a,b).

4.7.1.7 Construction of Agricultural Water Facilities (Ditch Bill Easements)

The Colorado Ditch Bill Act of 1986 (Public Law 99-545) authorizes the Secretary of Agriculture to issue permanent easements for water conveyance systems used for agricultural irrigation or livestock watering. Granting easements is not a USDA discretionary decision. An applicant meeting the criteria specified in the act is entitled to an easement, and the decision to grant it does not constitute a Federal action subject to NEPA review. However, conditions of the easement (including operations and maintenance) might require NEPA review (USDA 2012b). Similarly, the Moab and Monticello Ditch Bills authorize easements in Utah.

A number of Ditch Bill easement applications occurring within the Grand Mesa, Uncompahgre, San Juan, and Manti-La Sal National Forest administrative areas are currently in the scoping process or on hold (USDA 2012a,c,d). While the granting of the easement is nondiscretionary, a NEPA analysis is often done on a group of easement applications to document any environmental concerns; determine whether there is a need to establish discretionary terms and conditions in an operations and maintenance plan (OMP); and protect threatened, endangered, and sensitive species. The type and magnitude of impacts from Ditch Bill easements depend on the location and nature of the projects. In many cases, a site visit and site-specific impact analysis would be necessary. Impacts representative of those that could occur as a result of implementing terms and conditions on a Ditch Bill easement include beneficial actions to improve resource conditions and habitat in easement areas (e.g., the stabilization of ground to prevent erosion and reduce sedimentation in downstream habitats, the control of noxious weeds, and the protection of cultural resources). Establishment of an OMP would not result in incremental adverse impacts (USDA 2009b).

4.7.1.8 Other Future Projects

Other proposed or planned activities with the potential to contribute to cumulative impacts relate to utility corridors and ROW maintenance, water use and management, grazing and grazing management, wildlife management, and other land and resource management activities. For some of these activities, an environmental assessment may not yet have been completed, so the environmental impacts have not been quantified.

- Closure and reclamation of the abandoned Vision uranium mine (USDA 2012d);

- Closure and reclamation of abandoned coal and uranium mines;

- Continued aerial application of fire retardant on National Forest Service lands (USDA 2011b,d);

- Management of gypsy moths, spruce beetles, and other insects (USDA 2008, 2012a,c);

- Changes in reservoir operation to help meet flow recommendations for the Gunnison and Colorado Rivers (Montrose County) (DOI 2012);
- Management of existing and proposed utility corridors, gathering pipelines, and ROWs;
- Wild horse management, wildlife habitat improvement, and wildlife conservation (various counties);
- Vegetation and forest (fuels) management (USDA 2011b, 2012c) (likely to continue on BLM lands);
- Timber sales and fuels management (ongoing and planned projects in various counties) (USDA 2011b; BLM 2012c; USFS and BLM 2013);
- Dolores River restoration treatments (BLM 2012a);
- Exploratory geophysical seismic surveys, including drilling and detonation of explosives underground;
- Final San Juan National Forest and Proposed Tres Rios Field Office Land and Resource Management Plan (USFS and BLM 2013);
- San Juan National Forest Oil and Gas Leasing Availability (Record of Decision published in September 2013)—the environmental analysis for this decision is captured in USFS and BLM (2013);
- BLM Uncompahgre Resource Management Plan Revision (initiated in February 2010);
- Master Leasing Plan and Amendments to the BLM Moab and Monticello Resource Management Plans (initiated in March 2012; necessary in order to consider new leasing of oil/gas and potash projects on public lands);
- Boggy-Glade Travel Management Plan (public comment period in progress; implements a new travel management rule and designates routes for motorized travel in Boggy Draw and the Glade in Dolores and Montezuma Counties);
- Ridgway Comprehensive Travel Management Plan;
- Resource Management Plan Amendment for Mancos-Cortez Travel Management Plan; and
- The BLM Grand Junction Field Office is in the process of revising its Resource Management Plan to guide management of about 1 million acres

[400,000 ha] of public land it administers. The Final Resource Management Plan and ROD are expected in 2014.

4.7.2 Present and Ongoing (Past) Actions

The following sections describe present and ongoing actions within the ROI for cumulative effects. Some of the actions described are past actions that are either ongoing or have the potential to become active in the foreseeable future.

4.7.2.1 White Mesa Mill

The White Mesa Mill, located 6 mi (10 km) south of Blanding, Utah, is the only conventional uranium mill currently operating in the United States. The mill precipitates uranium oxide concentrate (yellowcake) and vanadium oxide concentrate from the processed ore. It is licensed to process 2,000 tons of ore per day and produce 8 million lb (3.6 million kg) of uranium oxide per year. The mill is also licensed to process and reclaim uranium from alternative feed materials, including uranium-bearing waste materials derived from uranium conversion, metal processing facilities, and U.S. Government cleanup projects. The mill began processing conventional ore in 2011, after years of processing only alternative feeds (Denison 2012a). In 2011, the mill produced approximately 1.0 million lb (0.45 million kg) of uranium oxide and 1.3 million lb (0.6 million kg) of vanadium oxide (Denison 2012b; EIA 2010). Cotter Corporation has begun to ship unprocessed, stockpiled ore from its Canon City Mill to the White Mesa Mill, where it will be processed. Cotter Corporation has estimated that the shipping of this ore will continue until approximately March 31, 2013. This ore had been originally shipped, in 2005 and 2006, from ULP lease tracts (Williams 2012).

The mill was originally licensed by the NRC to Energy Fuels Nuclear, Inc., in 1980; the license was renewed in 10-year increments in 1987 and 1997. The State of Utah assumed regulatory oversight in 2004, and the license was reissued in 2005. Denison Mines assumed ownership of the mill in 2006 and submitted an application in 2007 for renewal of the state license (UDEQ 2012a; Denison 2012a). Denison possesses 15 license amendments allowing the mill to process 18 different alternative feeds (Denison 2012b). At full capacity, the mill employs about 150 people (Denison 2012a). In April 2012, Energy Fuels Resources Corporation and Denison Mines announced that all of Denison’s mining assets in the United States (including the White Mesa Mill) will be acquired by Energy Fuels Resources Corporation (UDEQ 2012b).

Three other uranium mills exist in the United States; all were on standby at the end of 2010 (EIA 2012).

Table 4.7-3 summarizes the potential environmental impacts from operation of the White Mesa Mill.

1 **TABLE 4.7-3 Potential Environmental Impacts from Operation of the White Mesa Mill**

Resource Area	Anticipated Impacts
Air quality	Discharge of air pollutants during operations would be minor, and the effects would be negligible. The concentration of particulates, SO_2, and NO_x at the site boundary would be below air quality standards.
Noise	No information was available.
Geology and soils	Soils in the project vicinity are normally subject to erosion due to their lack of consolidation and poor vegetative cover. Construction and operations of the mill would accelerate wind and water erosion. Total off-site sediment transfer would be reduced as a result of the project.
Surface water	There would be a minimal impact on surface water resources; there would be no discharge of mill effluents or sanitary wastes on surface waters.
Groundwater	Approximately 480 ac-ft (160 million gal) per year of groundwater would be drawn from the Navajo aquifer, with no expected effect on the aquifer or other users; the permit allows up to 810 ac-ft (260 million gal) per year. The possibility of groundwater degradation is expected to be remote due to the elimination of seepage (by multicomponent lining of tailings cells) and the high net evaporation rate in the area.
Public health – radiological	Background radiation levels in the area of the mill would increase as a result of continuous but small releases of radioactive material (including uranium, radium, and radon) during operations. The calculated dose at the nearest potential residence in the direction of prevailing winds (4.0 mi or 6.4 km in 1979) from inhalation, external exposure, and consumption of contaminated food products would be 5.8 mrem/yr. The calculated collective dose to the population within 50 mi (80 km) would be 3.4 person-rem/yr (compared to 7,500 person-rem/yr from natural background). Calculated individual public doses are a small fraction of NRC limits in unrestricted areas. The combined occupational exposure for most workers would be expected to be less than 25% of applicable Federal limits.
Ecological resources	Construction and operations of the mill would result in a loss of habitat for terrestrial biota (vegetation, foraging for wildlife), but it is expected that the loss would be small and should not significantly reduce the amount of habitat for regional species because of the availability of similar rangeland throughout the region. Impacts from suspended PM would be expected to be negligible. Construction noise and increased human activity might cause wildlife to migrate away from the project vicinity. The fence around the tailings impoundment would exclude large animals, and the acidity/salinity of the water would make it unattractive to waterfowl. No impacts on endangered plant or animal species would be expected.
Socioeconomics	Construction and operations would be expected to employ up to 250 (peak) and 85 workers, respectively. A total population increase of 1,500 to 2,000 would be anticipated (due to milling and associated mining operations, including direct and non-basic-sector jobs), along with increased commercial and residential development in neighboring communities. New housing units would be in demand.
Land use	A total of 480 acres (200 ha) would be altered for the mill, tailings area, and roads. The 330-acre (140-ha) tailings area might be unavailable for further productive use when the mill area is reclaimed after operations cease, but the land might be returned to former grazing use after radiation levels are reduced to acceptable levels. Land use in surrounding areas might be affected; for example, land might be used for increased residential and commercial development to serve the mill-related population growth or mineral extraction in the vicinity.
Visual and scenic resources	Stack emissions would be visible to the public travelling on US 163, but they would not be expected to be visible from major recreational areas in the vicinity.

TABLE 4.7-3 (Cont.)

Resource Area	Anticipated Impacts
Transportation	Traffic volume on area highways would increase substantially (due to mill employees, new mine employees, new workers in the non-basic sector, and heavy-truck traffic), increasing traffic congestion. Approximately 250 and 125 workers per day would commute to and from the facility during the peak construction period and peak operational period, respectively.
Cultural and paleontological resources	Six historical sites were identified by the survey; of the five eligible for inclusion in the NRHP, one would be adversely affected by the mill and would require mitigation. No impacts on paleontological resources were identified.
Waste and wastewater	A total of 2,000 tons per day of waste material (tailings) would be produced for on-site deposition. Process water (310 gal or 1,200 L per minute) would be discharged to the tailings impoundment. There would be no discharge of liquid or solid effluents from the mill/tailings site.
Accidents	Accidents related to mill activities might include trivial incidents (not resulting in radiological release), small and large radiological releases (in comparison to annual releases from normal operation), nonradiological accidents, and transportation accidents. No health impacts on the off-site public would be expected as a result of postulated radiological or nonradiological accidents and most mill-related transportation accidents.

Source: NRC (1979)

4.7.2.2 Uranium Mining

The Uravan Mineral Belt is the oldest uranium mining area in the United States. Although there was no uranium ore production in Colorado from 2009 through 2011 and uranium prospecting activities in general are down, there have been some mining- and reclamation-related activities in the region (e.g., development of environmental protection plans). There are currently 31 actively permitted uranium mines in southwestern Colorado (CDRMS 2012f). The following sections present information on the status of mining projects within the ROI for cumulative effects.

4.7.2.2.1 Daneros Mine. The Daneros project, a conventional underground mine initially proposed by Utah Energy Corporation in 2008, is located in Bullseye Canyon in San Juan County, Utah. The BLM issued final approval for the mine permit in May 2009 for 7 years of mine operation. Expected to produce 500,000 lb (23,000 kg) of uranium oxide per year for processing at the White Mesa Mill, the Daneros Mine is the state's first new uranium mine in 30 years. The mine is expected to employ 8 to 11 employees, working two shifts (BLM 2009b). The mine was acquired by Denison Mines through its acquisition of White Canyon Uranium Ltd. in 2011 and was later acquired by Energy Fuels Resources Inc. through its acquisition of Denison's U.S. assets in 2012.

Anticipated adverse environmental impacts associated with the mine project include altered visual resources, dust generation from mining and transportation, particulate and criteria pollutant emissions from fossil fuel combustion, radioactive dust and gas emissions, soil disturbance and vegetation clearing, displacement of desert bighorn sheep and the degradation of their habitat, health impacts on mine workers and the general public related to radiation exposure and transportation, and decreases in recreation and tourism-related recreation. None of these impacts are considered significant. No significant cultural resources were identified in the area of potential effects, and no historic properties would be affected. The project would require 5,000 gal (19,000 L) per day of well water for mining and dust suppression and would not be expected to affect existing water rights in Bullseye Canyon. Additional traffic from mining operations would not have a noticeable impact on local roads (BLM 2009b). Table 4.7-4 summarizes the potential environmental impacts from the Daneros Mine.

The Daneros Mine was placed on standby status in October 2012 (Energy Fuels 2013a). In March 2013, Energy Fuels Resources Inc. submitted an NOI to revise operations at the Daneros Mine. Plans include the maximum possible expansion of the project over the life of the mine (Filas 2013).

4.7.2.2.2 La Sal Mines Complex. Denison's La Sal Mines complex is a collection of four separate, existing underground uranium mines (Pandora, La Sal, Snowball, and Beaver Shaft) in the vicinity of La Sal, Utah (San Juan County). The complex began operations in the 1970s and is part of a series of underground mines previously operated by Atlas Minerals and Umetco Minerals Corporation. Surface facilities are located on both private and public lands administered or managed by the BLM, USDA (USFS), and State of Utah (CDM 2010). In 2012, the complex was one of two actively producing mines in the state (Edge Environmental, Inc. 2009; UDNR 2012). Ore produced at the complex was shipped to Denison's White Mesa Mill for processing. Denison submitted a request in 2010 to amend its plan of operations to include expansion of the Pandora Mine, further exploration activities within the complex, and the drilling of vent holes on private and public land; these activities were expected to take place in three phases between 2011 and 2030. The La Sal Mines complex was acquired by Energy Fuels Resources Inc. in 2012 through its acquisition of Denison's U.S. assets.

The La Sal Mines Complex is currently on standby status (Energy Fuels 2013b).

4.7.2.2.3 Whirlwind Mine. Energy Fuels Resources Corporation's Whirlwind Mine is located 5 mi (8 km) southwest of Gateway in Mesa County, in the Gateway Mining District and spanning the Colorado/Utah border. The mine is composed of two formerly closed uranium-vanadium mines, the Urantah Decline and Packrat Mines. The mining claim block encompasses 4,900 acres (2,000 ha), but the mine is underground and is permitted for 24 acres (10 ha) of surface disturbance. Surface facilities include two portal areas containing waste-rock stockpiles, topsoil stockpiles, a water treatment plant, fuel and oil storage areas, support buildings, monitoring areas, ventilation shafts, and power drops (BLM 2008b).

BLM completed an environmental assessment for the proposed Whirlwind Mine project in 2008; upon finding no significant impact on the surrounding area, the BLM authorized restoration of the mine and the resumption of ore production. Energy Fuels completed

1 **TABLE 4.7-4 Potential Environmental Impacts of the Daneros Mine**

Resource Area	Anticipated Impacts
Air quality	Impacts from mine development could include dust generation, diesel exhaust, the release of GHGs, and the release of radioactive dust and gases from truck travel on unimproved roads. Radon emissions from mine shafts could result in minor air quality impacts, but the low amount of radon would not pose a health risk. With mitigation, operations would not result in the exceedance of NAAQS; air quality impacts would be minor and would not violate state or Federal standards.
Noise	No noise impacts were identified.
Geology and soils	No geology or soil impacts were identified.
Water resources	Operations would not affect surface water quality. Operations would require 5,000 gal (19,000 L) per day for mining and dust suppression, eventually drawn from a well in the Cutler White Rim aquifer. No drawdown is expected, and existing water rights would not be affected.
Human health	Public health impacts from radiation exposure and transportation are expected to be minimal. Radon emissions would quickly disperse, resulting in impacts on the general public much lower than the dose limit of 10 mrem/yr set in 40 CFR Part 61 for airborne emissions. A post-operation exposure rate of less than 1 mrem/yr is estimated for a recreationist camping on top of the reclaimed waste-rock pile with a soil cover material of 6 in. (15 cm) or more for 14 days.
Socioeconomics and environmental justice	No socioeconomic or environmental justice impacts were identified.
Ecological resources	Increased human activity, traffic, and noise and the removal of habitat might displace the desert bighorn sheep (or disrupt their normal movement patterns) during the life of the project.
Land use	Access to the mine site would be restricted during the life of mine operations for public safety purposes. After operations, the public would have access to the reclaimed waste-rock pile.
Recreation	No recreational impacts were identified.
Visual and scenic resources	No visual and scenic impacts were identified.
Transportation	The increased truck traffic from operations (16 round trips per day) would not have a noticeable impact on the level of service for local roads and would not measurably affect traffic flow/patterns. The risk of accidents is expected to be minimal.
Cultural resources, Native American concerns, and paleontology	No impacts on cultural or paleontological resources were identified.
Hazardous materials	No hazardous materials impacts were identified.

Source: BLM (2009b)

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construction of the mine in 2009 but announced late that year that the mine would be put into maintenance status (BLM 2008b; Energy Fuels 2012c; CDNR 2011).

The Whirlwind Mine is one of two mines expected to provide ore to the proposed Piñon Ridge Mill (Edge Environmental, Inc. 2009; CDPHE 2011d). Ore could also be transported to the White Mesa Mill for processing. If reopened and operating at full capacity, the mine would employ 24 workers covering three 8-hour shifts, 5 days per week. Using the room and pillar mining technique, initial ore production is expected to reach 100 tons per day, increasing to 200 tons per day as market demand increases. Life expectancy of the mine is 10 years (BLM 2008b; Energy Fuels 2012c).

Table 4.7-5 summarizes the potential environmental impacts from the Whirlwind Mine.

4.7.2.2.4 Energy Queen Mine. The Energy Queen Mine (formerly known as the Hecla Shaft) is located in the La Sal Mineral Belt, approximately 3 mi (4.8 km) west of La Sal, Utah. The mine was originally owned as a joint venture of Hecla Mining Company and Union Carbide (Umetco Minerals Corporation), operating from 1979 to 1983, when it was closed due to a decline in uranium prices. Ownership of the mine was transferred to Energy Fuels Resources Corporation in 2006; land and mineral rights are privately owned. In 2007, Energy Fuels Resources Corporation began acquiring adjacent and nearby land for exploratory drilling and potential expansion (Peters 2011).

In 2009, Energy Queen Mine was fully permitted by the Utah Division of Oil, Gas, and Mining and San Juan County. The mine shaft is currently flooded, and plans are being evaluated to dewater it. In addition, mining facilities, surface facilities, and equipment are currently being evaluated. The existing water treatment plant and settling ponds will need to be replaced prior to reopening the mine. Energy Fuels estimates a 12-month turnaround for mine rehabilitation, from dewatering to full production. The mine is expected to produce approximately 200 tons or more of uranium/vanadium ore per day (Peters 2011; Energy Fuels 2012b).

Energy Queen Mine is one of the mines expected to provide ore to the proposed Piñon Ridge Mill (CDPHE 2011d). Although the environmental impacts of each uranium mining project would vary, descriptions of the potential environmental impacts of a uranium mine can be found in Sections 4.7.2.2.1 and 4.7.2.2.3.

4.7.2.2.5 Sunday Mines. The Sunday Mines are underground uranium and vanadium mines located in Big Gypsum Valley, southwest of the town of Naturita, in San Miguel County, Colorado. The Sunday Mines consist of five operating mines: the Topaz; Sunday; West Sunday; Carnation; and St. Jude Mines. Denison Mines (USA) Corp. currently holds claim rights and permitting responsibility for the Sunday Mines. The mines were permitted with the CDRMS in 1978, as required, but historical evidence shows they may have existed as early as the 1950s. Operations at the Sunday Mines include underground mining operations, waste-rock placement, temporary ore storage, transportation of ore to the White Mesa Mill, water supply and use, chemical storage, dust control, and light equipment maintenance.

TABLE 4.7-5 Potential Environmental Impacts of the Whirlwind Mine

Resource Area	Anticipated Impacts
Air quality	Construction and operations could increase the amount of fugitive dust in the area; however, air quality is not expected to exceed ambient air quality standards. The potential for radon exposure in enclosed spaces exists but is considered minimal.
Noise	An increase in noise is expected from mining operations, including the use of ventilation fans and generators, large construction and mining equipment, and rock blasting. A slight increase in traffic-related noise is expected three times a day. Noise is not expected to exceed 50 dB outside the established noise boundary.
Geology and soils	The mine would deplete the uranium ore deposit and increase waste rock. Approximately 24 acres (10 ha) of topsoil would be disturbed and saved for reclamation. The potential exists for topsoil to mix with waste rock, ore, or soil containing other minerals, which could affect reclamation efforts at the end of the project.
Water resources	Groundwater could be affected by the seepage of water from waste rock. Construction of mines and shafts/vents/drill holes might affect aquifers, increase mineral contamination, and mix water sources between aquifers. Sediment erosion could disturb or reroute surface water flow or drainage and result in the discharge of untreated stormwater into streams. Fuel, chemical, or ore spills could affect both surface water and groundwater. Impacts will be minimal to negligible if proper water treatment, transport, and storage practices are implemented.
Human health	With proper implementation of EPA guidelines and MSHA regulations, potential impacts on the health of the general public are expected to be lower than the 10 mrem/yr dose limit set in 40 CFR Part 61 Subpart B for airborne emissions.
Socioeconomics and environmental justice	Operations would create 10 to 24 full-time, year-round jobs, with most positions expected to be filled by local hires. No significant impacts on housing/infrastructure or community services are expected. Operations would result in increased local, state, and Federal revenues. An increase in indirect income for local businesses is likely. Property taxes could increase depending on development that occurs as a result of mine operations. No environmental justice impacts were identified.
Ecological resources	Approximately 24 acres (10 ha) of plant (mostly piñon) and animal habitat will be disturbed, resulting in a minimal reduction in habitat and food supply. Soil disturbance, foot traffic, and mining equipment could spread invasive plants and noxious weeds; the impact would be minimal if a proper vegetation management plan is implemented. Fuel, chemical, or ore spills could affect floodplain areas. Increased vehicle traffic might result in wildlife collisions and mortality. Big game animals may need to exert more energy during winter months to avoid vehicle traffic, construction equipment, and mine operations, which could be detrimental to their survival. Ore or chemical spillage, water depletion, unexpected water releases, and increased sediment flow could affect water flow or contaminate streams and harm aquatic species. Potential impacts on the habitat and food resources of threatened, endangered, and sensitive species could occur, although only four sensitive species were noted in the area. Habitats of these species could be directly affected by operations, fugitive dust, increased traffic, and dust abatement methods. Wild turkeys, chuckers, black-throated gray warblers, Virginia's warblers, and peregrine falcons were noted in the area, but minimal impacts are anticipated. Impacts would be minimal to negligible if proper management practices are implemented. No impacts were identified for wilderness areas, wild and scenic rivers, and farmlands.

TABLE 4.7-5 (Cont.)

Resource Area	Anticipated Impacts
Grazing	There would be no significant impact on the two AUMs located within the two grazing allotments within the project area.
Land use	Night lights and noise may disturb the landowner to the northwest.
Recreation	An increase in the number of ore-hauling trucks might delay the arrival of recreationists at hiking and biking trailheads. Accidents between ore-hauling trucks and bicyclists and motorcyclists could occur.
Visual and scenic resources	The mine can be seen from points of interest, such as the Palisade WSA and the La Sal Mountains and foothills; however, the mine does not dominate the view of the casual viewer.
Transportation	Increased traffic is expected on local roads. Increases of 14 light-duty vehicle round trips and 9 heavy-duty vehicle round trips are expected per day.
Cultural resources, Native American concerns, and paleontology	No impacts on cultural resources or traditional cultural properties were identified. However, the potential to discover or damage buried deposits that are not readily identifiable does exist. There is also some potential for discovering or damaging vertebrate fossils within the Morrison Formation located within the mine.
Hazardous materials	As a result of a chemical, fuel, or oil spill, impacts could occur on a variety of resources.

Source: BLM (2008b)

BLM released an EA for the Sunday Mines in 2008; BLM is further analyzing this action in an EA. The assessment proposed expanding the Topaz Mine and adding vent holes and exploratory drilling at the Sunday Mines. Denison estimated that a maximum of 72,000 tons of ore would be produced annually from the Topaz Mine. Denison was unable to estimate the locations of the vent holes, but it did estimate that there would be no more than 60 exploration holes unreclaimed at any time, resulting in a maximum surface disturbance of 10 acres (4.0 ha) (BLM 2008c). The Sunday Mines were acquired by Energy Fuels Resources Corporation in 2012 through its acquisition of Denison's U.S. assets.

Although environmental impacts would vary for each uranium mining project, descriptions of the potential environmental impacts of a uranium mine can be found in Sections 4.7.2.2.1 and 4.7.2.2.3.

4.7.2.2.6 Other Uranium Mining and Uranium Exploration. The Uravan Mineral Belt in western Colorado includes an estimated 1,200 historic mines, with production dating back to 1898 (1948 for uranium). Total uranium ore production in Colorado was estimated to be more than 255,000 lb (116,000 kg) in 2005, all originating from Cotter Corporation mines in the Uravan Mineral Belt near Nucla and Naturita. The Cotter Corporation JD-7 open-pit mine is adjacent to the Piñon Ridge Mill site. The Cotter Corporation mines ceased production in November 2005, partly due to high energy costs and the high cost of transporting ore to Cañon

City for milling (the JD-7 open-pit mine had not started production). As of December 2011, Cotter Corporation was not seeking to renew its radioactive materials license for the Cañon City mill and had initiated closure of the facility (CDNR 2012).

Denison's Sunday Mines began producing uranium in San Miguel County in 2007; ore from these mines was shipped to the White Mesa Mill in Blanding. Production at these mines ceased in 2009 due to declining uranium prices, but the BLM's Tres Rios Field Office is currently preparing an environmental assessment for reopening the complex. Limited uranium production began at Bluerock Energy's J-Bird Mine in Montrose County in 2008, but production ceased when the mine was transferred to Rimrock Exploration and Development. The mine remains in maintenance status, and no production is anticipated in the immediate future (CDNR 2011). Bluerock sought approval of a plan of operation for Cone Mountain Mine (south of Gateway) but the company ceased development activity later in the same year (Argus 2008a,b). The Prince Albert (Rimrock), Last Chance (Nuvemco), and Return (Beck) Mines may have had limited production for test purposes within the last 4 years.

There are 31 actively permitted uranium mine projects in southwestern Colorado, and one new permit is under review. No uranium production was reported from 2009 to 2011, and none of the actively permitted mine projects is producing as of October 2012; 24 are in maintenance status, seven are being (or have been) reclaimed, and two are involved in development activities. In September 2011, all uranium operators were notified of the requirement to submit an environmental protection plan, file for an exemption, or commence final site reclamation by October 2012 (CDNR 2012).

There are 12 permitted uranium mines in Utah; only 2 of the 12 (Daneros and La Sal) are actively producing (UDNR 2012). Several former underground uranium mines are located in the Red Canyon watershed (near the operating Daneros Mine) and other areas of the state that are outside the ROI for cumulative effects. Small, remote mining operations that have not been reclaimed are not considered to be a significant human health hazard; the impacts on wildlife are minor; and low precipitation levels make it unlikely that hazardous concentrations of radioactive minerals and other compounds would significantly affect local watershed characteristics (BLM 2009b).

Although environmental impacts would vary for each uranium mining project, descriptions of the potential environmental impacts of a uranium mine can be found in Sections 4.7.2.2.1 and 4.7.2.2.3.

Pre-mining exploration and mine sampling work is ongoing on BLM permits and claims. Uranium exploration (i.e., drilling) activities are generally short term and are not expected to have direct or cumulative significant environmental or public health effects, provided there are no extraordinary circumstances nearby (e.g., the presence of Federally listed threatened and endangered species in the vicinity of the project area; the presence of floodplains or wetlands in the project area that would be affected; the presence of WA, WSA, or National Recreation Areas near the project area; or the presence of Native American religious or cultural sites, archaeological sites, or historic properties within the project area) (USDA 2011a). Uranium exploration activities typically involve few workers, low traffic volumes, and no emissions (Edge Environmental, Inc. 2009).

4.7.2.2.7 Exploration and Reclamation Activities on the ULP Lease Tracts between 2009 and 2011. Between 2009 and 2011, DOE approved the implementation of various exploration and reclamation activities on several lease tracts. Exploration plans were approved for Lease Tracts 13A, 15A, 17, 21, 24, 25, and 26 and were implemented for all these lease tracts except for 15A and 17 (see Table 4.7-6). Most exploration plans called for the drilling of one exploratory hole. However, one plan called for the drilling of two holes (on Lease Tract 21), one plan called for six holes (on Lease Tract 26), and one plan called for eight holes (on Lease Tract 24). The equipment used for exploration activities was typically a truck-mounted rotary drill, a bulldozer, a probe truck and support truck, and a small track-hoe. During exploration activities, groundwater was not encountered; however, most plans included a rigid-frame water and pipe truck to be on site for use if needed. The drill sites were accessed by overland travel along designated routes on existing roads. Improvements to existing roads were made to the extent necessary to allow proper access for the required equipment. In one case (for the exploratory activities on Lease Tract 26), a new road was required. The new road was 30 × 100 ft (9.1 × 30 m) and led from an existing road to the drill site. The estimated surface disturbance area for these activities was less than 1 acre (0.4 ha) in all cases. After exploration activities were completed, the areas were reclaimed in accordance with CDRMS regulations. Drill cuttings were returned to the borehole first to a depth of 5 or 7 ft (1.5 or 2.1 m). Polyurethane foam or concrete was used to fill the next 3 or 5 ft (0.9 or 1.5 m), and the remaining 2 ft (0.6 m) was filled with native soil. The site was graded to blend with the surrounding natural topography and reseeded with an approved mixture of native plant species.

A mine re-entry plan was also implemented for Lease Tract 26. The existing mine was accessed by foot, and the bulkhead of the mine was broken up by using hand tools. The area inside the mine was carefully tested for hazardous air constituents before workers entered the mine. After completion of the mine inspection, the mine was re-secured. The bulkhead was replaced with similar materials and secured with a metal gate with a lock that was installed.

Various reclamation plans were submitted for disturbed areas located on Lease Tracts 5, 6, 7, 10, 11, 11A, 12, 13, 16, 16A, 17, 19, 19A, 20, 21, 22, 22A, 23, 26, and 27 (see Table 4.7-7). Plans for reclamation included mining-related features, such as open drill holes and vents, land subsidence features, and abandoned mine portals and adits. Reclamation plans for subsidence features typically included digging out the subsidence, refilling it with available surface soil materials, recontouring it, and reseeding it with an approved seed mixture. Other lease tracts had features, such as surface pits and trenches, that would be reclaimed in the same manner as would the subsidence features.

Plans to reclaim open drill holes and vents involved filling the hole with a polyurethane plug, covering it with surface soil materials, and reseeding it with an approved seed mixture. Abandoned mine portal openings and adits would be reclaimed by closing the portal with large rocks and then backfilling it with available materials from the mine waste-rock dump. The remaining mine waste rock would then be recontoured to blend with the natural topography. The

1 **TABLE 4.7-6 Summary of Exploration Plans for the ULP Lease Tracts**

Lease Tract	Proposal	Trucks and Equipment	Site Access	Workers	Water Estimate	Surface Disturbance	Reference
26	Drill six holes	A truck-mounted rotary drill rig, probe truck, pickup trucks, small track-hoe, and/or skid-steer loader	Access to five of the drill holes was by existing roads, and access to one hole required about 100 × 30 ft (30 × 9.1 m) of new road construction	No information available	There is no mention of water use estimates in documents. There is no surface water near the sites, and no groundwater was in the formations to be penetrated.	More than 0.3 acre (0.1 ha)	DOE 2009a
26	Access the New Verde mine through the bulkhead, evaluate mine, close mine	Workers would use hand tools (hammers, mallets) to break out the bulkhead and enter the mine. Respirators would be used, if necessary.	Access to the portal site was by overland travel on existing roads: a former mine access road and on public roads	About four workers were needed. A health and safety person was a crew member to monitor conditions in the mine before workers entered.		No surface-disturbing activities will be conducted.	DOE 2010c
25	Drill one hole	Truck-mounted rotary drill rig, rigid-frame water and/or rod truck, pickup trucks	Drill site was accessed via existing dirt road. The drill holes required overland travel of 100 ft (30 m) between the county road and drill hole site.	No information available	No water was encountered during drilling. The nearest perennial stream was the San Miguel River, located about 1.5 mi (2.4 km) to the northeast.	Approximately 10 × 10 ft (3 × 3 m) or 0.002 acre (0.0008 ha)	DOE 2009i
24	Drill eight holes	Truck-mounted rotary or hammer drill rig, probe truck, pickup trucks, small track-hoe, and/or skidsteer loader	Drill sites were accessed via existing soil and rock surface. No surfacing actions were required, but one small tree was removed for access purposes.	An estimated three to four workers and oversight personnel were required for this project.	Groundwater was not encountered during any of the drilling. There was no surface water within 1mi (1.6 km) of any of the drill hole locations.	Approximately 0.5 acre (0.2 ha)	DOE 2009h
21	Drill two holes	Small, truck-mounted rotary drill rig; rigid-frame water and/or rod truck (single or dual rear axles) if needed; support vehicle for drilling crew (3/4 ton, 4×4 pickup truck or equivalent)	No new roads were constructed; all drill sites were accessed by overland travel along designated routes. Existing roads were improved only to the extent necessary to allow proper access to the required equipment.	No information available	The proposed drilling is expected to be dry. There are no bodies of water on or near the area of exploration activity. The nearest perennial stream is the San Miguel River, located 3.5 mi (5.6 km) to the northeast.	Estimated to be 0.002 acre (0.0008 ha) per drill hole	DOE 2009b

TABLE 4.7-6 (Cont.)

Lease Tract	Proposal	Trucks and Equipment	Site Access	Workers	Water Estimate	Surface Disturbance	Reference
13A	Drill one hole	Small, truck-mounted rotary drill rig; rigid-frame water and/or rod truck; pickup truck support vehicle; water truck if needed	No new roads were constructed; all drill sites were accessed by about 75 ft (23 m) of overland travel along designated routes. Existing roads were improved only to the extent necessary to allow proper access to the required equipment.	No information available	No groundwater was encountered during drilling. It was not anticipated that water would be required during the drilling or plugging process. The nearest perennial stream is the Dolores River, located 1 mi (1.6 km) to the southwest.	More than 0.5 acre (0.2 ha)	DOE 2009c
17	Drill one hole (presently suspended)	Bull dozer (small CAT-4 equivalent) or small tire-mounted backhoe and loader; truck-mounted rotary drill rig; probe truck (3/4 or 1 ton) and support truck (1/2 or 3/4 ton); rigid-frame water and pipe truck (single or dual rear axles) if needed	Drill site will be accessed by existing roads. Minor road improvements may be needed in a few rough spots.	No information available	There are no water bodies on or near the exploration site. No groundwater is expected to be encountered during drilling. Historical data indicate that the hole will be dry. The nearest perennial stream is the Dolores River, located about 2 mi (3 km) to the west.	Less than 1 acre (0.4 ha)	DOE 2010b
15A	Drill one hole (presently suspended)	Bulldozer (small CAT-4 equivalent) or small tire-mounted backhoe and loader; truck-mounted rotary drill rig; probe truck (3/4 or 1 ton) and support truck (1/2 or 3/4 ton); rigid-frame water and pipe truck (single or dual rear axles) if needed	Drill site will be accessed by existing dirt roads.	No information available.	There are no water bodies on or near the exploration site. No groundwater is expected to be encountered during drilling. Historical data indicate that the hole will be dry. The nearest perennial stream is the Dolores River, located 1 mi (1.6 km) to the east.	Less than 1 acre (0.4 ha)	DOE 2010a

TABLE 4.7-7 Summary of Reclamation Plans Implemented in 2009 to 2011 for the ULP Lease Tracts

Lease Tract No.	Description of Reclamation Work	Reference
5	Open drill holes located throughout the lease tract were permanently closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	DOE 2009e
6	Numerous open drill holes located throughout the lease tract were closed with a polyurethane foam plug, covered with surface soil materials, and reseeded.	DOE 2010d
7	The adit was backfilled with on-site materials (large rocks and mine waste rock), finished to the desired grade with common borrow surface materials, and reseeded.	DOE 2010e
	The vents associated with the mine were closed with a polyurethane foam plug, covered with surface soil materials, and reseeded.	
10	Six adits were permanently closed and backfilled with mine waste-rock materials and gated to conserve potential bat habitat. Mine waste-rock dumps were recontoured to blend in with the natural topography. The area was covered with surface soil materials and reseeded.	DOE 2009g
	The portal was permanently closed and backfilled with mine waste-rock materials. Mine waste-rock dumps were recontoured to blend in with the natural topography. The area was covered with surface soil materials and reseeded.	
	Subsidence was backfilled with surface soil materials and reseeded.	
	Subsidence was backfilled with surface soil materials and reseeded.	
	The shaft that had subsided to a depth of 35–40 ft (11–12 m) was backfilled with available mine waste-rock materials to within 5 ft (1.5 m) of the ground surface. A polyurethane plug was placed on top, and the remaining portion of the shaft was backfilled to the surface, mounded slightly with available surface soil materials, and reseeded.	
	The vent that had subsided to a depth of 40–50 ft (12–15 m) was backfilled with available materials to within 5 ft (1.5 m) of the ground surface. A polyurethane plug was placed on top, and the remaining portion of the shaft was backfilled to the surface, mounded slightly with available surface soil materials, and reseeded.	
	Several small subsidences were backfilled to the ground surface, mounded slightly with available materials, and reseeded.	
11	A subsidence had to be dug out to allow placement of large rocks in the opening and then be pushed back. The opening was backfilled with additional mine waste-rock material, covered with common borrow surface materials, and reseeded.	DOE 2010d
	Material from the waste-rock dump had washed out into the roadway and was cleaned up and regraded to allow access beyond the site.	
	Numerous pits and trenches were reclaimed. Side walls of the pits and trenches were broken down, and mine waste-rock piles were dozed. Surface soil materials were used as a cover, and the site was graded to fit in with the natural landscape.	

TABLE 4.7-7 (Cont.)

Lease Tract No.	Description of Reclamation Work	Reference
	Several large surface pits and trenches (and associated adits) were backfilled with available spoils material, recontoured to blend in with the natural topography, covered with other available surface soil materials, pocked, and reseeded.	
	Two large rim adits were closed with rocks, backfilled with available mine waste-rock and other surface soil materials, pocked, and reseeded.	
	A small subsidence that leads into a previously reclaimed mine was permanently closed with a polyurethane foam plug, covered with surface soil materials, and reseeded.	
11A	The portal was permanently closed and backfilled with mine waste-rock materials. The ore chute was dismantled and buried on site. Mine waste-rock dumps were recontoured to blend in with the natural topography. The area was covered with surface soil materials and reseeded.	DOE 2009g
12	At the abandoned mine sites, the portals were permanently closed with rocks and backfilled with mine waste-rock materials. Mine waste-rock dumps were recontoured to blend in with the natural topography. The area was covered with surface soil materials and reseeded.	DOE 2009d
	The subsidence was dug out and refilled with available surface soil materials and reseeded.	
	An open drill hole was permanently closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	
13	Two subsidence features were backfilled with available surface soil materials, pocked, and reseeded with an approved seed mixture.	DOE 2009e
16	The subsidence features were backfilled with available surface soil materials and reseeded.	DOE 2009g
	Several small surface pits and trenches were backfilled with available mine waste-rock and other surface soil and then reseeded.	
	The subsidence was backfilled with available mine waste-rock and other surface soil materials and then reseeded.	
16A	The subsidence was dug out, refilled with available surface soil materials, and reseeded.	DOE 2009f
	The small subsidence was dug out, refilled with available surface soil materials, and reseeded.	
	A series of surface pits and trenches were backfilled with available mine waste-rock materials, covered with other available surface soil materials, pocked, and reseeded.	
17	A portal subsidence was dug out and closed with on-site materials. The vent was closed. The hoist shack was demolished, burned, and buried on the site.	DOE 2010e
19	Several subsidence features were backfilled with available surface soil materials and reseeded.	DOE 2011d
19A	A mine adit was sealed with a polyurethane foam bulkhead applied to the wooden door structure after the door was cleared of debris and closed.	DOE 2010f
	A subsided vent was be backfilled with available surface soil materials, mounded, and reseeded.	

TABLE 4.7-7 (Cont.)

Lease Tract No.	Description of Reclamation Work	Reference
19A (Cont.)	A 24-in. (61-cm) open vent with metal casing was secured by welding grating to the casing.	
20	A 20-in. (51-cm) open vent with metal casing was secured by welding grating to the top of the casing.	DOE 2011c
	A 24-in. (61-cm) open vent with metal casing was secured by welding grating to the casing. A second 24-in. (61-cm) open vent was similarly reclaimed.	
21	The abandoned mine site was reclaimed. The wooden ore-storage bin was stabilized in place, and the remaining wooden/timber structures were left undisturbed. All trash and debris were placed in the decline trench before it was closed. The decline portal was closed with rocks and backfilled with available surface soil materials. The mine waste-rock dump was left undisturbed. The three vents associated with the mine were closed with polyurethane foam plugs, covered with surface soil materials, and reseeded. An open drill hole was similarly closed.	DOE 2010d
	The shaft had subsided again and was backfilled with mine waste-rock materials to a level equal with the top of the existing timber sets. The shaft was closed with a concrete plug, and the remainder was backfilled with additional mine waste-rock materials, covered with available surface soil materials, and seeded. All trash and debris associated with the site were buried before the shaft was backfilled. The shaft's headframe and hoist house were left in their original condition.	
22	The south side of the main dump was dressed up to near its original configuration and reseeded. Other features on the site are historical and were not disturbed.	DOE 2009g
	The smaller abandoned mine site was reclaimed. The decline portal was closed with large rocks, backfilled with mine waste-rock materials, and reseeded. The top of the smaller dump was raked by hand and reseeded. Other features on the site are historical and were not disturbed.	
	All debris at the large, abandoned mine site was left undisturbed. The decline portal was closed and backfilled with mine waste-rock materials. Mine waste-rock dumps were left undisturbed. The disturbed areas were covered with surface soil materials and reseeded.	
	The mine vents were closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	
22A	Debris at the large, abandoned mine site was gathered, placed in the decline trench, and burned. The decline portal was closed with large rocks, backfilled with mine waste-rock materials, covered with surface soil materials, and reseeded. Other features on the site were historical and not disturbed. Two remaining vents were closed, covered, and seeded.	DOE 2009g
	The seven vents were closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	
	The open drill hole was closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	
	The subsidence was dug out and backfilled with available surface soil materials and reseeded.	

TABLE 4.7-7 (Cont.)

Lease Tract No.	Description of Reclamation Work	Reference
23	The subsidence was dug out, filled with available surface soil materials, and reseeded.	DOE 2009d
	Two open vents were reclaimed. Metal casings were terminated below grade. Then the vents were closed with polyurethane foam plugs, covered with surface soil materials, and reseeded.	
26	The portal of the abandoned mine site was closed with large rocks and then backfilled with available mine waste-rock materials. The mine waste-rock dump was recontoured to blend with the natural topography. The area was then covered with other surface soil materials, pocked, and reseeded.	DOE 2010f
	The portal at the abandoned mine site was closed with rocks and backfilled with available mine waste-rock and other available surface soil materials. The posts and cribbing were left intact. The vertical shaft was backfilled with polyurethane foam to within 3 ft (0.9 m) of the surface, and surface soil was added. Mine waste-rock materials were recontoured. The area was reseeded. The historic windlass was preserved.	
	The subsidence was dug out and then refilled with available surface soil materials and reseeded. The drainage was rerouted to the east of the subsidence area.	
	The vent casing from a small cased vent was removed or terminated below grade, and the subsidence was backfilled with available surface soil materials and reseeded.	
	A subsided shaft was backfilled with available surface soil materials and reseeded.	
	An 18-in. (46-cm) cased vent was removed and terminated about 1ft (0.3 m) below grade. The vent was closed with a polyurethane foam plug, backfilled with available surface soil materials, and reseeded.	
	A subsided shaft was backfilled with available surface soil materials and reseeded.	
	A 14-in. (36-cm) cased vent was already closed. A bucket of soil from an adjacent pile was placed in the subsidence, and the area was reseeded.	
	A subsided shaft (water drop) was reclaimed. The water pipe was terminated about 1 ft (0.3 m) below grade, and the subsidence was backfilled with available surface soil materials and reseeded.	
	A subsided shaft was backfilled with available surface soil materials and reseeded.	
27	The subsidence was dug out, refilled with available surface soil materials, and reseeded.	DOE 2010f

area would then be covered with other surface soil materials, pocked if needed, and reseeded with an approved seed mixture.

Some reclamation plans included other activities. For example, on Lease Tract 11, debris needed to be cleared from a road, where it had settled after running off from a mine site. In addition, the reclamation activities on Lease Tracts 17 and 22A involved collecting and burning/burying mine timbers and other wooden debris. The debris would then be placed in the decline trench before its closure. A small number of lease tracts had special resources that took some effort to protect. For example, there were historic features located on Lease Tracts 21, 22, and 22A. Special plans were made to protect these resources while reclamation activities were implemented.

4.7.2.3 Coal and Other Mineral Mining

The 20-acre (8-ha) New Horizon Mine near Nucla is a surface coal mine owned and managed by Western Fuels Association, a not-for-profit, national fuel supply cooperative. The mine is the exclusive coal supplier to the Nucla Station coal-fired power plant (5 mi [8 km] southeast), producing approximately 350,000 to 400,000 tons of coal per year (Tri-State 2012a). The coal mined from the Dakota sandstone is higher in ash and sulfur content than are the types of coal mined in other parts of Colorado. The mine employed 23 miners in 2007 (CDNR 2008).

As of 2010, there were no actively producing Utah coal mines within the ROI for cumulative effects (UDNR 2011).

Although environmental impacts would vary for each coal mining project, descriptions of the potential environmental impacts of a coal mine can be found in Section 4.7.1.3.

Other permitted activities in the ROI for cumulative effects include the mining of sand/gravel, borrow material, sandstone, gold, and quartz/granite (over 4,650 acres or 1,880 ha), as well as the mining and exploration of copper and the mining of limestone quarries (BLM 2011b). The Lisbon Valley Copper Mine resumed operations after receiving BLM approval on its revised plan of operations in 2011.

4.7.2.4 Oil and Gas Exploration and Extraction

BLM routinely offers land parcels for competitive oil and gas leasing to allow exploration and development of oil and gas resources for public sale. Continued leasing is necessary so that oil and gas companies can seek new areas for oil and gas production or develop previously inaccessible or uneconomical reserves. In 2010 and 2011, oil and gas leases were issued within the ROI for cumulative effects (by BLM Field Offices), covering a total of approximately 2,100 acres (830 ha) of land surface. Approximately 3,000 wells are located within the ROI for cumulative effects (as shown in Figure 4.7-2), including wells that are actively producing, shut-in but capable of production, plugged, and abandoned; this total does not include capped wells. The majority of these oil and gas wells were drilled in the 1970s and 1980s (BLM 2010c).

The type and magnitude of impacts from exploration and future development will depend on the location and nature of the proposed exploration and development. As such, specific impacts on some resource areas cannot be predicted at the leasing stage (BLM 2011l). In many cases, a site visit and site-specific impact analysis would be necessary. Although environmental impacts would vary for each oil and gas exploration project, Table 4.7-8 summarizes potential impacts that could occur within the ROI for cumulative effects during exploration and future development of lease parcels.

Oil and gas exploration activities depend on market conditions. As of January 2012, BLM had developed a proposal to revise the 1993 revision of the oil and gas leasing EIS decision to change conditions, revise leasing stipulations, and identify land availability (USDA 2012c).

Gothic shale gas, a potential new gas development play underlying portions of the region of cumulative effects (including San Miguel and Dolores Counties), has also been recently analyzed as a foreseeable scenario for oil and gas development within the Paradox Basin (SJPLC 2011).

4.7.2.5 Long-Term Grazing Permits and Allotments

Livestock producers are required to hold a permit or lease to graze livestock on public land. BLM Field Offices administer grazing permits and allotments throughout the ROI for cumulative effects (Grand Junction, Uncompahgre, Tres Rios, Moab, and Monticello). Grazing areas in Colorado are generally in rough mountainous terrain, with steep side slopes and insufficient livestock water or forage, which results in large areas of grazing allotments that are infrequently or not grazed. This generally lessens adverse impacts on wildlife, soils, and cultural resources. Most allotments have been grazed continuously since implementation of the Taylor Grazing Act (1934), if not even before then (1890) (BLM 2011j).

BLM performs an environmental assessment to analyze the impacts of renewing 10-year grazing permits within a given landscape health assessment (LHA) area; only actions necessary to graze livestock are considered (BLM 2011j). Although environmental impacts would vary for each grazing permit, Table 4.7-9 summarizes the potential impacts that could occur within the ROI for cumulative effects during present and future grazing activities.

4.7.2.6 Power Generation and Transmission

Owned by Tri-State Generation & Transmission, Nucla Station is a 100-MW coal-fired power plant located just outside Nucla, Colorado. It is the world’s first utility-scale power plant to employ atmospheric circulated fluidized-bed combustion. The plant started operating in 1959 as a conventional electric generating station and currently employs 50 people. Between 1985 and

1 **TABLE 4.7-8 Potential Environmental Impacts of Oil and Gas Exploration and Development**

Resource Area	Anticipated Impacts[a]
Air quality	Exploration and development of lease parcels could adversely impact local air quality through emissions of PM, criteria air pollutants, and GHGs as a result of soil and surface disturbance, transportation, engine exhaust, and windblown dust and emissions of VOCs from gas flaring and venting. Generally it is not possible to quantify emissions, but they are unlikely to result in the exceedance of NAAQS or CAAQS guidelines. Generally, it is not possible to quantify the net impact on the climate from global or local GHG production.
Geology and soils	Direct impacts from construction and lease tract ok development include the removal of vegetation; disturbance, exposure, compaction, and destabilization of soils; an increased susceptibility to erosion; and the mixing of soil horizons, loss of soil productivity, and possible contamination of soils with chemicals or petroleum constituents. The magnitude of disturbance depends on the size of the well pads, the type of drilling, and the terrain and slope. Indirect impacts could include increased runoff, erosion, and sedimentation.
Surface water	Clearing and grading would alter overland flow and recharge patterns. Compaction of soil and reduced infiltration could lead to increased runoff and an increase in the frequency and extent of downstream flooding.
Groundwater	Impacts could occur as a result of the failure of well integrity, surface spills, or the loss of process fluids into groundwater. Changes in groundwater quality (including cross-contamination of aquifers) could affect downstream users. Development would require the use of existing or new water disposal facilities.
Human health	Substances emitted and used during exploration and development may pose a risk to human health and the environment.
Ecological resources	Direct construction impacts could include the removal and loss of vegetation on well pads, pipelines, and roads. Indirect impacts could include the creation of an environment in which invasive species and other noxious weeds could become established, the loss of the wildlife habitat base and rangeland productivity, and changes in visual aesthetics. Cumulative water depletions from the Colorado River Basin could jeopardize some threatened, endangered, and sensitive species. If such species or their habitats occurred within or near a lease tract, further analysis of impacts would be required. Continued development activity would contribute to habitat fragmentation and degradation, noise-related changes in wildlife behavior, displacement of resources into less suitable habitat, disruption of nesting and breeding, and increased vehicle-related wildlife collisions and mortality. If farmlands (prime or unique), ACECs, WAs, WSAs, Wild and Scenic Rivers, wetlands and riparian zones, and floodplains are within or near a lease tract, further analysis of impacts would be required.
Socioeconomics and environmental justice	Impacts are related to temporary or permanent employment, the rental or purchase of equipment, royalties paid to Federal and state governments, and other expenditures related to development . Indirect employment opportunities (related to exploration and service support industries) could be created in the region. Environmental justice impacts would not be likely due to the remoteness of exploration activities and the dispersal of minority and low-income populations throughout affected counties.
Transportation	Local roads would be affected by increased traffic from exploration and production vehicles, equipment, deliveries, and workers.
Land use	Development could conflict with other permitted uses, reduce the availability of land for recreation or range and grazing use, or affect existing ROWs. Development near a fence or corral could compromise the land's usefulness.

TABLE 4.7-8 (Cont.)

Resource Area	Anticipated Impacts[a]
Recreation	Areas used for grazing or hunting could experience an increase in activity and noise disturbance.
Cultural resources and paleontology	Surveys/lease tract development (including well pads, access roads, pipelines, and other infrastructure) have the potential to identify/disturb previously unrecorded cultural resource sites, traditional cultural properties, and paleontological resources.
Visual and scenic resources	Construction and infrastructure could affect the character of the landscape and detract from the undisturbed visual setting.
Solid and hazardous wastes	Substances used and emitted in exploration, development, and production may pose a risk to human health and the environment.

[a] This table is intended to provide a summary of exploration and development activities and to broadly address potential impacts. It is not intended to strictly describe the lease offerings from which they are adapted, nor can all potential impacts be quantified without site-specific analysis.

Sources: BLM (2011 l,m)

1987, the plant was refitted to employ atmospheric circulating fluidized-bed combustion technology, which removes pollutants inside the coal boiler, resulting in more efficient fuel combustion and reduced emissions. The plant covers 60 acres (24 ha) and draws water from the San Miguel River. The plant receives about sixty 25-ton loads of coal per day from its sole source, the New Horizon Mine (located 5 mi [8 km] northwest of the plant (Tri-State 2012a).

Tri-State Generation & Transmission is also in the process of upgrading its 50-year-old, 69-kV transmission line that supplies secondary power from Nucla Station to the Telluride area. BLM published a Final EIS in 2001 (66 FR 226, November 23), but this document was not located. Construction on the 51-mi (82 km), 115-kV upgrade began in June 2010; the final phase of construction was scheduled to begin in May 2012, with completion of the project expected in the fall of 2012 (Tri-State 2012b). The new line will run in the approximate original alignment of the dismantled line—from the Nucla Substation west of Naturita to the Sunshine Substation southwest of Telluride. Ten miles (16 km) of the new line will be constructed underground in response to landowner concerns. Construction of the new line includes modifying the Nucla and Sunshine Substations, replacing the Wilson Mesa Substation, and expanding the Norwood Substation. The San Manuel Power Association will remove the Oak Hill and Specie Mesa Substations that supported the 69-kV line and reclaim the land (Tri-State 2012b,c).

4.7.2.7 Potash Exploration

The BLM Tres Rios Field Office, formerly the Dolores Public Lands Office, has received 21 permit applications from RM Potash for potash exploration, affecting 40,000 acres (16,000 ha) of land in the vicinity of Egnar, Colorado (BLM 2011a). BLM has prepared an EA to evaluate exploration drilling on some of these land applications. BLM analyzed the potential

1 **TABLE 4.7-9 Potential Environmental Impacts of Livestock Grazing**

Resource Area	Anticipated Impacts[a]
Air quality	Gaseous emissions and fugitive dust may be produced where livestock gather, but concentrations are expected to rapidly dissipate. Emissions from grazing are not expected to exceed air quality standards.
Geology and soils	Grazing can reduce vegetative cover and biological soil crust (two factors that help maintain soil health and moisture content). Overgrazing removes organic matter that provides nutrients for continued plant growth. Soil crust disturbance reduces nutrient cycling, water infiltration, and moisture retention. Reduction of native perennial vegetation can lead to the domination of weeds.
Water resources	A major concern related to surface-water quality is accelerated sediment yield from upland soil and stream channel erosion. No impacts on groundwater or water rights were identified.
Ecological resources	If farmlands (prime or unique), ACECs, Was, WSAs, Wild and Scenic Rivers, wetlands and riparian zones, and floodplains are within or near a grazing allotment, further impact analysis would be required. The reauthorization of grazing permits might or might not include changes to historical levels of grazing use, and it would not impair wilderness characteristics or classifications of stream segments eligible for listing as wild, scenic, or recreational. The lack of irrigation and the arid climate in the ROI for cumulative effects generally prevents soils from being used for private agricultural production; therefore, the renewal of grazing permits would not harm the potential for future classification as “prime” or “unique” farmlands. Grazing might have long-term positive impacts on vegetation and controlling weed infestations. If threatened, endangered, or sensitive species or their habitats occurred within or near a grazing allotment, further impact analysis would be required. Grazing might impact migratory birds through disturbance of birds and nests, causing destruction, disruption, or abandonment of the nest and influencing reproductive success; effects would be greater for species that nest in vegetation types that are prone to grazing. Grazing is expected to have a minimal effect on terrestrial and aquatic wildlife. If riparian areas or known wetlands occurred within or near a grazing allotment, further impact analysis would be required.
Socioeconomics and environmental justice	No environmental justice impacts are anticipated.
Transportation	Grazing permits do not allow for restriction of access to or travel through public lands where legal access currently exists. The renewal of grazing permits would have no impact on transportation.
Land use	The environmental impact of improved rangeland management by BLM and grazing permittees is expected to be positive.
Recreation	Grazing permits do not allow for restriction of access to or travel through public lands where legal access currently exists. The renewal of grazing permits would have no impact on recreational use.
Cultural resources and paleontology	Direct impacts could include trampling, chiseling, and churning of soils and cultural features and items of Native American religious concern; artifact breakage; and impacts from standing, leaning, and rubbing against aboveground features. Indirect impacts could include erosion and potential for unlawful collection or vandalism. Continued grazing in areas where cultural sites are present might contribute to substantial ground disturbance and have irreversible adverse effects on historic properties. The potential for damage to undisturbed paleontological resources is expected to be low, because in situ fossils are seldom encountered in alluvial areas.
Visual and scenic resources	The renewal of grazing permits is not expected to result in visual or scenic impacts.

TABLE 4.7-9 (Cont.)

Resource Area	Anticipated Impacts[a]
Solid and hazardous wastes	Solid or hazardous wastes could be introduced as a result of the maintenance associated with range improvements (e.g., fuels and lubricants could spill from heavy equipment). The improper disposal of solid waste and improper use of hazardous substances (e.g., herbicides and pesticides) could contaminate public land.

[a] This table is intended to summarize permitted grazing activities and broadly address potential impacts. It is not intended to strictly describe the permit actions from which they are adapted, nor can all potential impacts be quantified without site-specific analysis.

Source: BLM (2011j)

effects of approving up to six potassium prospecting permit applications and implementing the associated exploration plan(s) that RM Potash submitted for the proposed exploration project. Core drilling is proposed on the six permit application sites to confirm the presence of potash and determine its thickness and grade. The EA was completed in October 2012 (BLM 2012h). The BLM Tres Rios Office approved five of six Potash Prospecting Permits in the summer of 2013 and deferred a sixth. As of November 2013, no drilling has taken place.

Potash exploration is also performed on lands administered by the State of Utah (BLM 2011b). Three companies produced approximately 374,000 short tons of potash in Utah in 2010; only one (Intrepid Potash-Moab) produced potash within the ROI for cumulative effects (UDNR 2011).

4.7.2.8 Lisbon Natural Gas Processing Plant

The Lisbon Gas Plant is located approximately 35 mi (56 km) south of Moab in San Juan County. Operated by Patara Midstream, LLC, it is a major source of GHG and VOC emissions in the ROI for cumulative effects. The plant was originally permitted by the Utah Department of Environmental Quality in 2002 (UDEQ 2011).

4.7.2.9 Paradox Valley Desalinization Plant

The Paradox Valley Unit desalinization plant is located adjacent to the Dolores River, approximately 2 mi (11 km) east of Bedrock. Operated by the BOR, the plant prevents natural salt loads in groundwater from entering the Dolores River by intercepting and disposing of brine via deep-well injection. Major facilities include a brine production well field, brine surface treatment facility, and deep injection well (CDPHE 2011d). The existing deep-injection well, completed in 1988, is nearing the end of its useful life, and action will be needed by BOR to continue long-term salinity control at the Paradox Unit (BOR 2013b). BOR is preparing an EIS to describe the potential alternatives as well as the impacts of the construction and operation of facilities to continue to dispose of brine at Paradox Valley. A new injection well alternative and an evaporation pond alternative as well as other alternatives are being considered for future brine disposal (BOR 2013b).

4.7.2.10 Cameo Station Power Plant

In 2007, Xcel Energy announced it plans to shut down the 1,100-acre (450-ha) Cameo Station Power Plant (near Palisade, Colorado) by the end of 2010. The plant, fueled primarily by coal from nearby McClane Canyon Mine in Garfield County, operated for 53 years as a coal-fired electrical generation facility until it was determined to be inefficient (KKCO 2007).

Prior to closing, Xcel Energy partnered with Abengoa Solar to develop a $4.5 million, first-of-its kind experiment in hybrid coal-solar facilities. In 2009, Cameo Station was expanded to include 6 acres (2.4 ha) of parabolic trough solar panels. It began operating as a hybrid facility in 2010. The panels replaced the thermal energy formerly provided by coal combustion. Xcel/Abengoa anticipated that the use of solar panels would reduce the amount of coal used at the facility by 2–3%, thereby reducing carbon emissions. The year-long experiment had favorable results, but the solar panels did not generate the projected thermal energy, and the project was not as cost effective as anticipated. The facility was closed in 2010, and dismantling began in September 2011 (Xcel 2010; GJSentinel 2011; KREX 2011).

4.7.2.11 Reconstruction of the Hanging Flume Replica

Under the Hanging Flume interpretive program, the Western Colorado Interpretive Association proposes to build a modern replica of a collapsed section of the original Hanging Flume northwest of Nucla. The Hanging Flume site is listed in the NRHP. The BLM completed an environmental assessment in 2009, prior to approval of the first phase of the project (construction of an overlook to replace a graveled parking area above the Dolores Canyon rim). Reconstruction of the flume is complete, having been approved by the BLM in 2011. No new disturbance of cultural resources occurred, and no traditional cultural properties are known to exist with regard to the area. The project had no adverse effects on threatened or endangered species or their habitats. The small scale of the project limited environmental impacts (BLM 2011c). The time frame for the project initiation and completion is not known.

4.7.3 General Trends

Table 4.7-10 lists general trends in the ROI for cumulative effects with the potential to contribute to cumulative impacts (although impacts here are not quantifiable); trends are discussed in the following sections. The discussion takes into account available information on populations and water use for the eight Colorado counties (Delta, Dolores, Mesa, Montezuma, Montrose, Ouray, San Juan, and San Miguel) and three Utah counties (Grand, San Juan, and Wayne) that lie within 50 mi (80 km) of the ULP lease tracts.

TABLE 4.7-10 General Trends in the Region of Influence for Cumulative Effects

General Trend	Potential Impacting Factors
Population growth	Urbanization Increased use of roads; increased traffic Increased use of resources (e.g., energy and water) Increased emissions of air pollutants Land use modification Employment Education and training Tax revenue
Energy demand	Increase use of energy resources Energy development (including alternative energy sources) Energy transmission and distribution
Water use and availability	Drought conditions and water loss Conservation practices Changes in water distribution and availability
Climate	Water cycle changes Increased wildland fires Changes in habitat Changes in farming production and costs

4.7.3.1 Population Growth

Between 2000 and 2010, population increased in both Colorado (by 17%) and Utah (by 24%) (Mackun and Wilson 2011). Three Colorado counties within the ROI for cumulative effects ranked in the top 20 most populous counties in the state and had significant increases in population between 2000 and 2010: Mesa County (ranked 11th in 2010), with an increase of 26%; Montrose County (ranked 17th in 2010), with an increase of 24%; and Delta County (ranked 18th in 2010), with an increase of 11% (U.S. Bureau of the Census 2011i). The only Utah county within the ROI for cumulative effects ranking in the top 20 most populous counties in the state was San Juan County. Between 2000 and 2010, population growth in San Juan County was 2.3% (U.S. Bureau of the Census 2011j). The U.S. Census Bureau projects population growth of 19% (for Colorado) and 32% (for Utah) over the next 20 years (from 2010 to 2030) (U.S. Bureau of the Census 2011b).

4.7.3.2 Energy Demand

The growth in energy demand is related to population growth through increases in housing, commercial floor space, transportation, and goods and services. Given that population growth is expected in several counties within the ROI for cumulative effects (Mesa, Montrose, and Delta Counties in Colorado and San Juan County in Utah), an increase in energy demand in these counties is also expected. However, the EIA projects a decline in per capita energy use to 2035, mainly because of improvements in equipment and vehicle efficiency and changes in the industrial sector from energy-intensive manufacturing to services. In general, primary energy use in the United States between 2010 and 2035 is expect to grow by about 0.3% each year, with the fastest growth projected for the commercial and industrial sectors (at 0.7% each year). Transportation and residential are each expected to grow by about 0.2% each year (EIA 2012).

4.7.3.3 Water Use and Availability

In 2005 (the latest year for which annual statistics are available), freshwater and saline water withdrawals in the Colorado and Utah counties within the ROI for cumulative effects were estimated to be 2,600 million gal per day: 2,500 million gal (7,718 ac-ft) per day from the eight Colorado counties, with 99.5% of the withdrawals coming from surface water sources, and 120 million gal (370 ac-ft) per day from the three Utah counties, with 72% of the total withdrawals coming from surface water sources. The highest water usage in 2005 occurred in Mesa and Montrose Counties (Colorado) at 930 and 710 million gal (2,842 and 2,167 ac-ft) per day, respectively (Kenny et al. 2009).

The U.S. Geological Survey tracks eight categories of water use in the United States: public supply; domestic; irrigation; livestock; aquaculture; industrial; mining; and thermoelectric power. In 2005, the greatest water consumption in Colorado and Utah counties within the region of cumulative effects was in the category of irrigation, which accounted for about 94% of water use (with as much as 870 million gal [2,700 ac-ft] per day in Mesa County in Colorado, and 48 million gal [150 ac-ft] per day from Wayne County in Utah). Mining accounted for only a small part of water consumption in both states and was highest in San Juan County (Utah), which used about 4.6 million gal (14 ac-ft) of mostly saline water per day. Consumption of water via the public supply was generally proportional to the county population and was highest in Mesa and Montrose Counties (Colorado). The highest per capita usage in 2005 occurred in Montrose (240 gal [900 L] per day) and Delta (200 gal [750 L] per day) counties in Colorado (Kenny et al. 2009).

Water consumption in the eight Colorado and three Utah counties within the ROI for cumulative effects decreased between 2000 and 2005 (due mainly to a decrease in irrigation): down 17.6% in Colorado counties and down 7.7% in Utah counties (based on data from Hutson et al. 2004 and Kenney et al. 2009). This decreasing trend will likely continue into the foreseeable future as drought conditions in the Upper Colorado River Basin decrease runoff for most rivers and reduce water supplies (BOR 2012).

4.7.3.4 Climate

According to a recent report prepared for the CWCB (Hoerling et al. 2008), temperatures in Colorado have increased by about 2°F (1.1°C) between 1977 and 2006. Climate models project continued increasing temperatures in Colorado—as much as 2.5°F (1.4°C) by 2025 and

4.0°F (2.2°C) by 2050 (relative to the 1950 to 1999 baseline temperature). In 2050, seasonal increases in temperature could rise as much as 5.0°F (2.8°C) in summer and 3.0°F (1.7°C) in winter. These changes in temperature would have the effect of shifting the climate typical of the Eastern Plains of Colorado westward and upslope, bringing temperature regimes that currently occur near the Colorado-Kansas border into the Front Range.

Because of the high variability in precipitation across the state, current climate models have not been able to identify consistent long-term trends in annual precipitation. However, projections do indicate a seasonal shift in precipitation, with a significant increase in the proportion of precipitation falling as rain rather than snow. A precipitous decline in snowpack at lower elevations (below 8,200 [2,500 m]) is expected by 2050.

In the past 30 years, the onset of streamflows from melting snow (called the "spring pulse") has shifted earlier in the season by two weeks. This trend is expected to continue as spring temperatures warm. Projections also suggest a decline in runoff for most of the river basins in Colorado by 2050. Hydrologic studies of the Upper Colorado River Basin (which includes the ROI for cumulative effects) estimate average decreases in runoff of 6 to 20% by 2050 (as compared to the twentieth century average). These changes in the water cycle, combined with increasing temperatures and related changes in groundwater recharge rates and soil moisture and evaporation rates, will increase the potential for severe drought and reduce the total water supply, while creating greater demand pressures on water resources (Hoerling et al. 2008).

In general, the physical effects of climate change in the western United States include warmer springs (with earlier snowmelt), melting glaciers, longer summer drought, and increased wildland fire activity (Westerling et al. 2006). All these factors contribute to detrimental changes to ecosystems (e.g., increase in insect and disease infestations, shifts in species distribution, and changing in the timing of natural events). Adverse impacts on human health, agriculture (crops and livestock), vegetation (including biological soil crusts), infrastructure, water supplies, energy demand (due to increased intensity of extreme weather and reduced water for hydropower), fishing, ranching, and other resource-use activities are also predicted (GAO 2007; NSTC 2008; Backlund et al. 2008; Schwinning et al. 2008).

The State of Colorado has plans to reduce its GHG emissions by 80% over the next 40 years (Ritter 2007). Initiatives to accomplish this goal will focus on modifying farm practices (e.g., less frequent tilling, improving storage and management of livestock manure, and capturing livestock-produced methane), improving standards in the transportation sector, providing reliable and sustainable energy supplies (e.g., small-scale hydropower, solar, wind, and geothermal energy), and joining the Climate Registry of North American GHG emissions, among others.

4.7.4 Cumulative Impacts from the ULP Alternatives

Potential impacts from the five alternatives in the ULP PEIS are considered in combination with impacts of past, present, and reasonably foreseeable future actions. For this cumulative impacts analysis, past projects are reflected in the affected environment discussion. Projects that have been completed, such as the exploration and reclamation activities implemented under the ULP in 2009 and 2011 as discussed in Section 4.7.2.2.7, are generally assumed to be part of the baseline conditions that were analyzed under the five alternatives discussed in Sections 4.1 through 4.5. The summary of ongoing and planned projects or activities in the ROI for cumulative effects is presented in Table 4.7-11. As mentioned previously, the ROI for cumulative effects is conservatively assumed to be a 50-mi (80-km) radius. The ROIs for the various resource areas are listed in Chapter 3, and for most of these resource areas, a 25-mi (40-km) radius was identified as the ROI. The analyses for environmental justice and human health addressed a 50-mi (80-km) radius, which is why the ROI for cumulative effects was extended to this larger radius.

The major ongoing projects listed in Table 4.7-11 that are related to uranium mining activities proposed under the five alternatives evaluated in the ULP PEIS include (1) the White Mesa Mill; (2) various permitted uranium mining projects in Montrose, Mesa, and San Miguel Counties, none of which are currently actively producing (of the 33 noted on Table 4.7-10, a few of the permits are for mines on the DOE ULP lease tracts); (3) the Daneros Mine; (4) the Energy Queen Mine, which is operational but currently inactive; and (5) the ongoing reclamation of abandoned uranium mines (these mines are not on the DOE ULP lease tracts). There are also several foreseeable projects related to uranium mining, which are currently in the planning phase (also listed in Table 4.7-11). These include the Piñon Ridge Mill and the Whirlwind Mine near Gateway.

Projects listed in Table 4.7-11 that are not related to uranium mining include the operating Nucla Station Power Plant; the Lisbon Natural Gas Processing Plant; the New Horizon Coal Mine; other mineral mining projects (for sand, gravel, gold, quartz, and granite); oil and gas exploration, transmission line, and transportation ROW projects; grazing and wildlife and vegetation management projects; and National Monument improvement projects.

The environmental impacts discussion in Chapter 4 (the impacts are also summarized in Section 2.4) concludes that potential impacts on the resource areas evaluated for the five alternatives generally would be minor and could be further minimized by implementing the compliance and mitigation measures and/or BMPs as required by project-specific mine plans. Estimates for potential human health impacts indicate that the emission of radon would be the primary source of potential human health radiation exposure. However, requirements for monitoring and ventilating mine operations and for worker safety are expected to mitigate potential impacts on human health. The potential radon dose estimates presented in the ULP PEIS were obtained by using a conservative value for the radon emission rate, which is a sensitive input parameter, and by using conservative assumptions with regard to the number of mines that would operate at the same time and the number of years of operation. The actual radon dose would be much lower if measured radon data and the actual number of years of operation were used to obtain the radon exposure estimates.

Although the various present, ongoing, and planned projects identified in the ROI for cumulative effects could contribute to impacts on the various environmental resource areas evaluated, it is expected that uranium-mining-related projects would be most similar with respect

TABLE 4.7-11 Summary of Major Projects and Activities in the Region of Influence for Cumulative Effects

Project	Summary	Location	Status
Planned/Future			
Piñon Ridge Mill	Energy Fuels plans to begin construction depending upon the outcome of litigation	Paradox Valley, 7 mi W of Naturita (Montrose Co.)	Planned
Book Cliff Coal Mine	Surface mine; proposed by CAM-Colorado	N of Fruita (Mesa Co.)	Proposed
Whirlwind Mine	Underground mine; permitted in 2008 but went on standby status a few months later; may operate again if economically viable	Vicinity of Gateway	Planned
Uranium/vanadium exploration	Exploratory drilling and accompanying activities	Various	Planned and ongoing
Potash exploration	Exploratory drilling for potash	Various	Under NEPA review
WAPA ROW maintenance	Vegetation management to protect transmission lines	Montrose Co. Delta Co. San Juan Co. Grand Co.	Under NEPA review
Utility corridors	Existing and proposed utility corridors and gathering pipelines through San Juan Public Lands	Dolores Co. Montezuma Co.	Under NEPA review
Seismic surveys	Exploratory geophysical seismic survey, including drilling and detonation of explosives underground	Dolores Co.	Under NEPA review
Aerial application of fire retardant on NFS lands	Continued aerial application of fire retardant on NFS lands	Various	Under NEPA review
Aspinall Unit operations	Reservoir operation changes to help meet flow recommendations for Gunnison and Colorado Rivers	Montrose Co.	Under NEPA review
Dolores River restoration treatments	Reduction of tamarisk and other invasive nonnative plant species	Various	Planned
Ditch Bill easements	Authorization of agricultural water conveyance facilities	Various	Under NEPA review
Present/Past (Ongoing or Potentially Ongoing)			
White Mesa Mill	The only conventional uranium mill currently operating in the country	6 mi S of Blanding	Operational

TABLE 4.7-11 (Cont.)

Project	Summary	Location	Status
Uranium mines in Colorado	33 actively permitted mining projects (none actively producing in Colorado)	Montrose Co. San Miguel Co. Mesa Co.	Various
Uranium mines in Utah	Daneros, Energy Queen	San Juan Co.	Operational, inactive
Abandoned mine closures	Closure and reclamation of the abandoned uranium and coal mines	Various	Ongoing, planned
Nucla Station Power Plant	100-MW coal-fired power plant owned by Tri-State Generation & Transmission Assoc.	Nucla	Operational
Lisbon natural gas processing plant	Processes natural gas and crude oil from the Lisbon Oil Field	35 mi S of Moab	Operational
New Horizon Coal Mine	Surface mine managed by Western Fuels Assoc., exclusive coal supplier to nearby Nucla Station	Nucla	Operational
Nucla-Sunshine transmission line ROW amendment	Transmission line upgrade; construction began in 2010; completion is expected in 2012	Between Nucla and Telluride	Under construction
Other mineral mining	Permitted sand/gravel, borrow material, sandstone, gold, and quartz/granite mining	Various	Operational
Oil and gas exploration, extraction, and transmission	Activity depends on market conditions	Various	Various
Grazing and grazing management	Renewal of grazing permits, analysis of range management	Various	Ongoing
Wildlife	Trapping and removal of wild horses, habitat improvement, vegetation management, wildfire fuel reduction	San Miguel Co. Dolores Co.	Ongoing
Narraguinnep and Bradfield reforestation	Vegetation management	Dolores Co.	Approved
Timber sales/fuel management projects	Three ongoing and two planned projects	Dolores Co. Montezuma Co.	Present and planned
Transportation ROWs	ROWs to access private property	Montezuma Co.	Various

to the types of potential environmental impacts that could occur, and most of these are located closer to (within 25 mi or 40 km) the lease tracts. Available information regarding potential impacts from these various projects is summarized in Sections 4.7.1 and 4.7.2; however, information for most of the projects is either not available or qualitative in nature.

Potential impacts from the five alternatives would generally be negligible to moderate. The potential (incremental) impacts from the five alternatives are tabulated in Table 4.7-12, along with impacts from several of the major uranium-mining-related projects discussed in Sections 4.7.1 and 4.7.2. Potential impacts from other large projects (e.g., oil and gas exploration, coal mines) can be gleaned from Tables 4.7-1 through 4.7-8.

For specific resources, the cumulative impacts as well as the incremental contributions to these impacts from implementation of the ULP under any of the five alternatives are summarized below:

- *Air quality*. Because of the relatively low population density, low level of industrial activities, and relatively low traffic volume in the ULP region, the quantity of anthropogenic emissions is small and the ambient air quality is relatively good. Particulate emissions associated with ongoing actions in the region, such as White Mesa Mill and uranium mining, and planned actions, such as Piñon Ridge Mill, are not expected to exceed ambient air quality standards. Cumulative impacts on air quality in the ULP region are therefore considered to be minor. Under Alternatives 1 and 2, PM_{10} and NO_x emissions during reclamation are estimated to be less than 1% and 0.1% of the emission totals, respectively, for the Colorado counties (Mesa, Montrose, and San Miguel) encompassing the ULP lease tracts. Under Alternatives 3 through 5, PM_{10} and NO_x emissions are estimated to be highest during the development and operations phase, ranging from 1.5 to 3.2% (PM_{10}) and 1.0 to 2.3% (NO_x) of emission totals. The contribution of any alternative to cumulative impacts in the region is expected to be negligible to minor. None of the ULP alternatives would cause measurable impacts on regional ozone or AQRVs at nearby Class 1 areas.

- *Acoustic environment.* There are no sensitive receptors (such as hospitals or schools) within 3 mi (5 km) of the ULP lease tracts, and only 17 residences lie within 1 mi (1.6 km) of the lease tracts (7 of which are adjacent to a lease tract). Although there are no noise surveys of the immediate vicinity, it is likely that the highest human-caused noise levels (in the range of 50 to 60 dBA) in the ULP region are intermittent and associated with state highways and agricultural/industrial activities. Planned and ongoing actions, such as the Piñon Ridge Mill and uranium mining, are not expected to exceed the maximum permissible noise levels. Noise-related cumulative impacts are therefore considered minor. Noise levels associated with reclamation activities under Alternatives 1 and 2 would be about 55 dBA at a distance of about 1,650 ft (500 m) from the reclamation site; this is the Colorado daytime maximum permissible limit in a residential zone. Under all alternatives, noise-related impacts are expected to be local and intermittent and, therefore, minor. Noise levels could exceed the Colorado limit at Lease Tract 13 under Alternatives 1 through 3 and at Lease Tracts 13, 13A, 16, and 16A under Alternatives 4 and 5, if any activities occurred near the boundary. The contribution of any of the five ULP alternatives to cumulative noise-related impacts in the region is expected to be minor.

- *Paleontological resources.* Significant paleontological resources within the ULP lease tracts (the ROI for cumulative effects) are associated with stratigraphic units of Jurassic and Cretaceous age. The PFYC ranking of the Jurassic-age Morrison Formation, the main source of uranium in the lease tracts and the geologic unit most likely to be affected by future mining, is 5 (very high), indicating that it is highly fossiliferous and most at risk for human-caused adverse impacts or natural degradation. Other uranium mines in the region have acknowledged the potential for discovering or damaging vertebrate fossils within in the Morrison Formation. Because there are compliance-driven measures governing the management of paleontological resources on Federal lands, the cumulative impacts on these resources are considered to be minor. Lessees would follow requirements set forth in project-specific paleontological management plans prepared in consultation with the BLM. Therefore, the contribution of any of the five ULP alternatives to cumulative impacts on paleontological resources is expected to be minor.

- *Soil resources.* Cumulative impacts on soil resources within and adjacent to the ULP lease tracts (the ROI for cumulative effects) would result mainly from ground-disturbing activities associated with mining activities under any of the five alternatives. These impacts are expected to be minor to moderate, but they would be short in duration and generally controlled through mitigation measures and BMPs.

- *Water resources.* Water resources in the ROI for cumulative effects include surface water in the Upper Dolores, San Miguel, and Lower Dolores watersheds; groundwater in the bedrock aquifers within Paradox Basin; and alluvial aquifers within the various canyons along the Dolores and San Miguel Rivers. Cumulative impacts on stream flow in the Dolores River are considered moderate due mainly to the effects of regulated flow by the McPhee Dam located upstream of the ULP lease tracts. Changes in the water cycle due to seasonal shifts in precipitation (and a decline in snowpack) are projected to cause up to a 20% decrease in runoff in the Upper Colorado River Basin (of which the Dolores and San Miguel Rivers are a part) in the foreseeable future; the decrease in runoff will also affect recharge rates in aquifers throughout the region. Water consumption, especially in terms of irrigation from surface water sources, is already on the decline because of regional drought conditions, and this trend is likely to continue into the foreseeable future. In terms of water quality, the cumulative impacts on groundwater and surface water in the Paradox Basin are considered to be moderate, due mainly to the naturally high saline groundwater that discharges to the Dolores River in Paradox Valley. Activities associated with ongoing actions in the region, such as the White Mesa Mill and uranium mining, and planned actions such as the Piñon Ridge Mill, could reduce runoff to the Dolores River; however, water quality impacts are not expected. Under all five alternatives, minor impacts on water quality could occur as a result of land disturbance and underground mining activities associated with mine development, operations, and reclamation; these impacts would be minimized by the implementation of compliance and mitigation measures and/or BMPs (Table 4.6-1). Cumulative impacts from ULP mining operations, in combination with other projects (such as that for Slick Rock mill sites monitoring near Lease Tract 13), would be re-evaluated as part of follow-on NEPA review for mining plans submitted. Mitigation measures would be implemented, as needed, for the protection of human health and the environment. Minor (local and temporary) impacts on stream flow are also expected. Minor (local and temporary) impacts on stream flow are also expected.

- *Human health.* Exposures from background radiation sources within a 50-mi (80-km) radius of the ULP lease tracts were estimated on the basis of two hypothetical scenarios: (1) considering an individual who lives near (i.e., 1,600 to 16,000 ft [500 to 5,000 m]) the lease tracts and (2) considering an individual pumping out groundwater from a well for drinking. Potential dose estimates show that an individual could receive a dose of about 120 mrem/yr from ambient gamma radiation, 290 mrem/yr from inhalation of radon, 0.47 mrem/yr from breathing airborne radionuclides in resuspended dust particles, and 25 mrem/yr from drinking untreated well water. Dose estimates associated with White Mesa and Piñon Ridge Mills (to the nearest receptor at the site boundary) range from 5.8 to 8.2 mrem/yr. The contribution of any of the five ULP alternatives to cumulative impacts due to radiation exposure in the region is expected to be negligible, ranging only from 1 to 10 mrem/yr for a resident living more than 1.5 mi (2,500 m) from the lease tract. The potential dose could be higher if the distance is less than 1.5 mi (2,500 m), but the dose would still be less than 31 mrem/yr.

- *Ecological resources (vegetation).* The ROI for cumulative effects (Montrose, Mesa, and San Miguel Counties) supports a wide variety of vegetation types, primarily woodlands and shrublands. Incremental impacts on vegetation result mainly from ground disturbance (which can destroy vegetation and introduce non-native species); indirect impacts include deposition of fugitive dust, soil erosion, sedimentation, and changes in water quantity or quality. Impacts are expected to be minor to moderate; establishment of native plant communities during reclamation would reduce impacts over the long term.

- *Ecological resources (wildlife).* Incremental impacts on wildlife in the region of cumulative effects (Montrose, Mesa, and San Miguel Counties) result mainly from habitat disturbance. Such impacts could be minor to moderate in the short term but would be localized and would not affect the viability of wildlife populations.

- *Ecological resources (aquatic biota).* Impacts on aquatic resources could result from increases in sedimentation and turbidity from soil erosion and runoff during mine development and operations. There would be a very low likelihood of an accidental ore spill into a perennial stream or river. Overall, localized impacts on aquatic biota would range from negligible to moderate and would not affect the viability of any aquatic species.

- *Ecological resources (threatened, endangered, and sensitive species).* Potential impacts on threatened, endangered, and sensitive species could range from small to moderate and short term to long term, depending on the location of the mines and amount of surface disturbance. Direct impacts could result from the destruction of habitats during site clearing, excavation, and operations. Indirect impacts could result from fugitive dust, erosion, sedimentation, and impacts related to altered surface water and groundwater hydrology. The USFWS concluded that implementation of the best management practices related to aquatic habitats and water quality will reduce water quality impacts to the extent that they are insignificant.

  Water withdrawals from the Upper Colorado River Basin to support mining activities may result in potentially unavoidable impacts on aquatic biota (particularly the Colorado River endangered fish species). For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the Colorado River endangered fish species and their critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS).

- *Land use.* Most of the lands surrounding the ULP lease tracts are managed by the BLM under its "multiple use" management framework. These lands are currently managed for uses that include conservation, recreation, agriculture (including grazing), rangeland, and minerals (via mining, leasing, and free use). Because these lands are managed under the authority of the BLM and USFS, the cumulative impacts within the 25-mi (40-km) radius (the ROI for cumulative effects) are considered to be minor. Lands within the Uravan Mineral Belt, including those on which the ULP lease tracts are located, were withdrawn from mineral entry in 1948 in order to reserve them for the exploration and development of uranium and vanadium resources. Under Alternatives 1 and 2, all mining activities on these lands would cease, and other activities within the lease tracts would continue. The contributions of the

ULP to cumulative impacts in the region would be minor since there would be no conflict between mining and other uses. Under Alternatives 3 through 5, mining activities within the lease tracts may preclude certain other uses (such as recreation and grazing), but their contributions to cumulative impacts would also be considered minor since the surrounding lands offer ample opportunity for these other uses.

- *Socioeconomics.* Cumulative socioeconomic impacts result from changes in employment opportunities and income, expenditures for goods and services, and tax revenues associated with various types of commercial, industrial, and recreational activities that are taking place within the ROI for cumulative effects (Montrose, Mesa, and San Miguel Counties). These impacts are generally considered beneficial to local communities, counties, and states. Unemployment in the three-county region is currently 9.6% (2011). Under Alternatives 1 and 2, socioeconomic impacts are expected to be minor, increasing the total employment by about 0.1% in the region. Under Alternatives 3 through 5, impacts would also be minor, increasing the total employment by less than 1% in the region.

- *Environmental justice.* Cumulative environmental justice impacts would encompass any (and all) impacts that could be disproportionately high and adverse on minority or low-income populations; however, there are no minority or low-income populations, as defined by CEQ guidelines, within the ROI for cumulative effects. As a result, there would be no anticipated cumulative impacts on these populations, and no contribution to these impacts from any of the five ULP alternatives.

- *Transportation.* Most roads in the ROI for cumulative effects pass through uninhabited public lands; however, routes used to haul uranium ore over the past 10 to 30 years pass 13 of 15 residences along the ULP lease tracts. Traffic volume along these routes is expected to increase with the continued operation of White Mesa Mill, the construction of Piñon Ridge Mill, and future uranium mining in the region. Under Alternatives 1 and 2, there would be no transport of uranium ore and therefore no change in current traffic trends. Ore shipments under Alternatives 3 through 5 would increase truck traffic along affected routes and would contribute to cumulative impacts, such as human exposure to low levels of radiation, increased traffic, and potential accidents. It is estimated that the number of shipments from mines to mills could be as high as 92 per day under Alternative 5. The average external dose rate is about 0.1 mrem/h at 6.6 ft (2 m), two orders of magnitude lower than the regulatory maximum. Estimated potential impacts include no LCFs to the collective population, no traffic fatalities, and possibly one traffic injury under Alternatives 4 and 5.

- *Cultural resources.* Incremental impacts from the five ULP alternatives could result from vandalism, theft, and damage or destruction of cultural artifacts within the lease tracts or in adjacent areas affected by mining activities. Adverse impacts on traditional cultural properties are also counted among the direct impacts on cultural resources. Direct impacts on these resources are not expected under Alternatives 1 and 2; however, vandalism and theft are possible impacts because of greater site accessibility. Ground disturbance under Alternatives 3 through 5 could damage or destroy artifacts and traditional cultural properties, and artifacts could be lost through vandalism or theft as a result of improved site access. Such impacts would be minimized or avoided, since all activities would comply with Section 106 of the NHPA.

- *Visual resources.* Incremental impacts from the five ULP alternatives relate mainly to alterations to vegetation and landforms, removal of structures and materials, changes to roadways, and changes in vehicular and work activities. Although impacts associated with exploration are generally expected to be minor, potential long-term impacts could result from mine development and operations, as would occur under Alternatives 3 through 5, because activities during these phases could increase contrasts in form, line, color, and texture. The magnitude of these impacts would need to be determined at the project level.

- *Waste management.* Incremental impacts on waste management within the lease tracts (the ROI for cumulative effects for waste management) are associated with the generation of waste from the various mining phases. These impacts are expected to minor under all five of the ULP alternatives.

Based on the information in Table 4.7-12 and other information presented in Sections 4.7.1 and 4.7.2, the potential cumulative impacts on the various environmental resources (e.g., air quality, water quality, soils, ecological resources, socioeconomics, transportation) and human health from various projects and activities within the 50-mi (80-km) ROI, when added to activities related to the ULP, would vary by resource but would generally range from negligible to moderate (see Table 2.4-1). The overall contribution of the ULP to these impacts is considered to be minor.[10]

[10] Because of the qualitative nature of information presented for most projects or activities in the ROI for cumulative effects, it is not possible to determine an overall cumulative impact in a quantitative sense. Even for projects where quantitative results are calculated or estimated, (e.g., for air emissions, human health doses, transportation, and socioeconomics in Table 4.7-12), the methodology and associated assumptions used for the calculations vary, making definitive comparisons among projects difficult. For the ULP PEIS, the potential incremental impacts of the five alternatives are based on conservative assumptions and mostly do not take credit for measures (compliance measures, mitigation measures, and BMPs) that would minimize the potential impacts. Hence, it is expected that the potential incremental impacts of the ULP would be less than those summarized in Table 4.7-12, since such measures would be implemented as required by project-specific mine plans and permits. For this reason, the overall incremental impact of the ULP alternatives is expected to be negligible.

TABLE 4.7-12 Potential Impacts of Select Projects Considered with the DOE ULP Alternatives

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Air quality	During reclamation, PM_{10} emissions are estimated to be about 140 tons/yr or about 0.92% of emission totals for the three counties (Mesa, Montrose, and San Miguel) encompassing the DOE ULP lease tracts. NO_x emissions are estimated at up to 0.09% of three-county total emissions. Thus, potential impacts on ambient air quality associated with reclamation activities would be minor and temporary in nature. In addition, these activities are not anticipated to cause any measurable impacts on regional ozone or AQRVs at nearby Class I areas. Potential impacts from these activities on climate change would be negligible.	The types of impacts and resulting emissions would be almost the same as those described for Alternative 1.	Air emissions during the exploration phase would be negligible, and thus potential impacts on ambient air quality, regional ozone, AQRVs, and global climate change would be negligible as well. During mine development, PM_{10} emissions would amount to about 1.5% of the three-county combined emissions. During mine operations, NO_x emissions of 140 tons/yr would be about 1.0% of three-county total emissions. Potential impacts from mine development and operations on ambient air quality, regional ozone, and AQRVs at nearby Class I areas would be minor and those on global climate change would be negligible. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.	Similar to Alternative 3, potential impacts from exploration on ambient air quality, regional ozone, AQRVs, and global climate change would be negligible. Potential impacts are anticipated to be small, with PM_{10} and NO_x emissions estimated to be no higher than about 3% and 2% of the three-county (Mesa, Montrose, and San Miguel) total, respectively. Potential impacts from mine development and operations on ambient air quality, regional ozone, and AQRVs at nearby Class I areas would be minor and those on global climate change would be negligible. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.	Similar to Alternatives 3 and 4, potential impacts from exploration on ambient air quality, regional ozone, AQRVs, and global climate change would be negligible. During development and operations, PM_{10} emissions would be about 3.2% and of the three-county total emissions. NO_x emissions of 313 tons/yr amount to about 2.3% of three-county total emissions. Potential impacts from mine development and operations on ambient air quality, regional ozone, and AQRVs at nearby Class I areas would be minor and those on global climate change would be negligible. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.	Particulate emissions at the site boundary would be below air quality standards.	PM_{10} emissions would not exceed regulatory limits. No significant dust or fume emissions are expected from transportation of uranium ore or hazardous materials.	An increase in fugitive dust would result but would not be expected to exceed ambient air quality standards.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Acoustic environment	During reclamation, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from the reclamation site, which is the Colorado daytime maximum permissible limit of 55 dBA in a residential zone. Most residences are located beyond the distances where the Colorado noise limit is reached, but, if reclamation activities occurred near the boundary of Lease Tract 13, noise levels at nearby residences could exceed the Colorado limit.	The type of impacts and resulting noise levels would be almost the same as those described for Alternative 1.	Potential noise impacts during the exploration phase would be minor and intermittent. During the mine development and operations phase, potential for noise impacts is anticipated near the mine sites and along the haul routes, but impacts would be minor and limited to proximate areas. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.	The types of impacts related to exploration, mine development, and operations under Alternative 4 are similar to those under Alternative 3. The types of impacts related to reclamation under Alternative 4 are similar to those under Alternative 1. However, if mine development or reclamation activities would occur near the lease tract boundary, noise levels at residences around Lease Tracts 13, 13A, 16, and 16A could exceed the Colorado limit.	The types of impacts related to exploration, mine development, and operations, and reclamation under Alternative 5 would be similar to those under Alternative 4.	No information was available.	Estimated maximum noise level at the property boundary would be below the most restrictive maximum permissible noise level established by county regulation.	An increase in noise is expected from mining operations and associated traffic. Noise is not expected to exceed 50 dB outside of the established noise boundary.

TABLE 4.7-12 (Cont.)

	ULP Alternatives							
Resource Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Soil resources	Activities during the reclamation phase could result in minor impacts on soil resources because they would involve ground disturbances that would increase the potential for soil compaction, soil horizon mixing, soil contamination, soil erosion and deposition by wind, soil erosion by water and surface runoff, and sedimentation of nearby surface water bodies.	Soil impacts from ground-disturbing activities at the 10 lease tracts requiring reclamation would be the same as those described for Alternative 1.	Because exploration activities would occur over relatively small areas and involve little or no ground disturbance, potential impacts associated with this phase are expected to be small. Under Alternative 3, ground disturbance during the peak production year would occur on an estimated 300 acres (120 ha) across 12 lease tracts, mainly during mine development. Impacts associated with this phase are expected to be minor to moderate. The types of impacts related to reclamation under Alternative 3 would be similar to those described for Alternative 1; however, ground disturbance would occur over a larger area.	The types of impacts from exploration under Alternative 4 would be minimal similar to those under Alternative 3. The types of impacts related to mine development and operations under Alternative 4 are similar to those under Alternative 3. Under Alternative 4, ground disturbance during the peak production year would occur on an assumed 460 acres (190 ha). Impacts associated with this phase are expected to be minor to moderate. The types of impacts related to reclamation under Alternative 4 would be similar to those under Alternatives 1, 2, and 3. However, ground disturbance would occur over a larger area.	Soil impacts under Alternative 5 for the exploration, mine development and operations, and reclamation phases would be the same as those described under Alternative 4 because DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period. The number of mines assumed to be operating at the peak year of ore production would be the same as the number under Alternative 4, except that a slightly larger surface area would be used for mine development.	Soils in the project vicinity are normally subject to erosion due to lack of consolidation and poor vegetative cover. Mill construction and operations would accelerate wind and water erosion. Total off-site sediment transfer would be reduced as a result of the project.	About 420 acres (170 ha) would be disturbed by site development activities. Construction impacts could include erosion of surface water control and settling. Surface disturbances would be stabilized by vegetation during operations.	The mine will deplete the uranium ore deposit and increase waste rock. About 24 acres (10 ha) of topsoil will be disturbed and saved for reclamation. The potential exists for topsoil to mix with waste rock, ore, or soil containing other minerals, which could affect reclamation efforts at the end of the project.
Water resources	Land disturbance activities associated with reclamation have the potential to affect water resources by eroding soil and by altering the	Under Alternative 2, impacts on water resources associated with the reclamation	Exploration activities would involve some land disturbance activities, such as vegetation clearing, grading, drilling, and building of	The types of impacts related to exploration under Alternative 4 would be similar to those under Alternative 3. The types of impacts related	The types of impacts related to exploration under Alternative 5 would be similar to those under Alternative 3. The types of impacts related	There would be a minimal impact on surface water resources. There is no discharge of mill effluents or	Impacts could include erosion of stormwater channels and reduction of surface water	Impacts on groundwater and surface water are considered minimal to

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Water resources (Cont.)	topography and soil conditions that affect hydrologic processes. Potential groundwater quality impacts resulting from the backfill materials and poor sealing of drill holes in wet mines would be minor. The short duration of reclamation (2 to 3 years) in comparison to mining operations (on the order of 10 years or more) would reduce direct impacts on water resources; however, given the potentially long time needed to reestablish vegetation and soil conditions after reclamation, indirect impacts of reclamation could be significant.	activities would be the same as those described for Alternative 1	access roads and drill pads, but these activities would occur over relatively small areas. The exploratory drill holes for wet underground mines would have the potential to allow groundwater leaching, but the impact is considered minor due to the limited amount of groundwater in the area. Of the three phases evaluated, the mine development and operations phase has the greatest potential to affect water resources, primarily as a result of land disturbance activities, erosion, mine water runoff, the staging of ores and waste rock, the alteration of shallow aquifers, the mixing of groundwater with varying geochemical characteristics, the use of chemicals, water use, and wastewater generation. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.	to mine development and operations under Alternative 4 would be similar to those described for Alternative 3. The increase in the area of surface disturbed and size of underground mines under Alternative 4 has the potential to increase impacts associated with erosion and groundwater contamination; however, the proximity of the lease tract to the Dolores River and the San Miguel River and amount of groundwater seepage would still be the primary factors governing impacts. Under Alternative 4, impacts associated with the reclamation activities would be the same as those under Alternative 1, but the scale of reclamation is greater.	to mine development and operations under Alternative 5 would be similar to those under Alternative 3. The increase in disturbed area and size of underground mines under Alternative 5 might increase the impacts associated with erosion and groundwater contamination; however, the proximity of the lease tract to the Dolores River and the San Miguel River and amount of groundwater seepage would be still be the primary factors governing impacts. Under Alternative 5, impacts on water resources associated with reclamation activities would be the same as those under Alternative 1, but the scale of reclamation is greater.	sanitary wastes to surface waters.	flow to the Dolores River.	negligible if proper water treatment, transport, and storage practices are implemented.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Human health	Potential human health impacts could result from implementation of reclamation activities and from the aboveground waste-rock piles that would be regraded, provided with a top layer of soil materials, and revegetated but remain on site after reclamation. Under this alternative, minor impacts could occur from radiation exposures. A reclamation worker could receive a dose up to 14.3 mrem/yr (with implementation of engineering controls when closing mine openings), a resident could receive a dose up to 8.9 mrem/yr, and a recreationist could receive one up to 30 mrem/yr.	Potential human health impacts under Alternative 2 would be the same as those under Alternative 1.	Under Alternative 3, it can be reasonably expected that the total dose that a worker would receive from mine exploration would be less than 5 mrem. During the year of peak operations, there could be two nonfatal injuries and illnesses among the 98 workers assumed for this alternative. Under this alternative, a mine worker could experience adverse health effect from exposure to vanadium, and the probability for him to develop a fatal cancer from long-term (10 years) exposure to radiation would be about 1 in 250. For the general public, it is possible that a resident could receive a radon dose of more than 10 mrem/yr during the development and operations of uranium mines, if this resident lived less than 1.6 mi (2.5 km) from a uranium mine. For the population living 3 to 50 mi (5 to 80 km) from the uranium lease tract area, the average radiation exposure would be	Potential human health impacts for individual receptors under Alternative 4 would be the same as those under Alternative 3. For the population living 3 to 50 mi (5 to 80 km) from the uranium lease tract area, the average radiation exposure during mine development and operations would be negligible, less than 1 mrem/yr.	Potential human health impacts for individual receptors under Alternative 5 would be the same as those under Alternative 3. For the population living 3 to 50 mi (5 to 80 km) from the uranium lease tract area, the average radiation exposure during mine development and operations would be negligible, less than 1.1 mrem/yr.	The dose to nearest potential residence was calculated to be 5.8 mrem/yr.	The estimated dose to a receptor at the site boundary is about 8.2 mrem/yr (including radon). The estimated dose to the nearest downwind off-site receptor is 0.5 mrem/yr.	No impacts on human health are predicted if EPA guidelines and MHSA regulations are properly implemented.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Human health (Cont.)			negligible, less than 0.4 mrem/yr. The types of impacts associated with mine reclamation would be similar to those discussed under Alternative 1.					
Ecological resources	Reclamation would be expected to establish native plant communities over the long term. Impacts could include habitat loss, fugitive dust, erosion, sedimentation, and the hydrologic changes, non-native species. Reclamation activities could affect wildlife by altering existing habitat characteristics and the species supported by those habitats, but overall, impacts on wildlife would be minor. Overall, impacts on aquatic biota from Alternative 1 would be negligible. Impacts on threatened, endangered, and sensitive species would be similar to, or the same as, impacts on other plant communities, habitats, wildlife, and aquatic biota.	Potential impacts on vegetation, wildlife, aquatic biota, and special status species under Alternative 2 would be the same as those under Alternative 1.	Exploration activities are expected to affect relatively small areas, and impacts on vegetation, wildlife, and aquatic biota would generally be minimal and short term. Impacts would be minor to moderate during mine development, operations, and reclamation. Impacts could include habitat loss, fugitive dust, erosion, sedimentation, hydrologic changes, and non-native species. Although wildlife impacts would be long term, they would be scattered temporally and, especially, spatially. Potential impacts on threatened, endangered, and sensitive species could range from small to moderate and short term to long term, depending on the location of the mines and amount of surface	Potential impacts on vegetation would be minor to moderate. Potential localized impacts on wildlife and aquatic biota would be negligible to moderate and would not affect the viability of their populations. Potential impacts on threatened, endangered, and sensitive species will be similar to those under Alternative 3. The types of impacts under Alternative 4 would be similar to those under Alternative 3, except that during the peak year of operations, up to 19 mines could be in operation (6 small, 10 medium, 2 large, and 1 very large); in addition, the mines could be located on any of the 31 lease tracts rather than on just 12 of them.	The types of impacts from exploration, mine development and operations, and reclamation under Alternative 5 would be similar to those under Alternative 3; however, a larger total area would be affected. Although exploration, mine development and operations, and reclamation are expected to be incrementally greater under Alternative 5 than under Alternative 3, impacts on wildlife and terrestrial threatened, endangered, and sensitive species are still expected to be negligible to minor for site exploration and minor to moderate for mine development, operations, and reclamation. Overall, impacts on aquatic biota are expected to be negligible during site	Loss of habitat for terrestrial biota (including vegetation, wildlife, and threatened, endangered, and sensitive species) is expected to be minor. Increased human activity might cause wildlife displacement away from the mill site. Impacts on aquatic biota (including sensitive species) are expected to be negligible to minor.	The disturbance of about 420 acres (170 ha) would be a moderate impact on vegetation and a minor to moderate impact on wildlife and sensitive species. Potential impacts on ecological resources from operations would be similar to those for the White Mesa Mill. Contents of evaporation ponds and tailing cells could be toxic to wildlife, including special status species. BMPs	About 24 acres (10 ha) of habitat for terrestrial biota (including vegetation, wildlife, and sensitive species) would be disturbed and is considered a minor reduction of habitat. Impacts on terrestrial biota and sensitive species are expected to be minor to negligible if proper management practices are implemented. Impacts on aquatic biota (including sensitive species) are expected to be

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Ecological resources (Cont.)			disturbance. Direct impacts could result from the destruction of habitats during site clearing, excavation, and operations. Indirect impacts could result from fugitive dust, erosion, sedimentation, and impacts related to altered surface water and groundwater hydrology. The USFWS concluded that implementation of the best management practices related to aquatic habitats and water quality will reduce water quality impacts to the extent that they are insignificant. Water withdrawals from the Upper Colorado River Basin to support mining activities may result in potentially unavoidable impacts on aquatic biota (particularly the Colorado River endangered fish species). For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the		exploration and minor to major during mine development and operations and reclamation. Potential impacts on threatened, endangered, and sensitive species could range from small to moderate and short term to long term, depending on the location of the mines and amount of surface disturbance. Direct impacts could result from the destruction of habitats during site clearing, excavation, and operations. Indirect impacts could result from fugitive dust, erosion, sedimentation, and impacts related to altered surface water and groundwater hydrology. The USFWS concluded that implementation of the best management practices related to aquatic habitats and water quality will reduce water quality impacts to the extent that they are insignificant. Water withdrawals from the Upper Colorado River Basin to support		would be utilized to exclude wildlife use of these areas. Impacts on aquatic biota (including sensitive species) are expected to be negligible to minor.	negligible to minor.

TABLE 4.7-12 (Cont.)

Resource Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
	ULP Alternatives							
Ecological resources (Cont.)			Colorado River endangered fish species and their critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further programmatic consultation is not required (Appendix E of the ULP PEIS). Reclamation activities under Alternative 3 would be similar to those described for Alternative 1.		mining activities may result in potentially unavoidable impacts on aquatic biota (particularly the Colorado River endangered fish species). For this reason, DOE determined in its May 2013 BA that ULP activities under Alternative 3 may affect, and are likely to adversely affect, the Colorado River endangered fish species and their critical habitat. The USFWS then concluded, in its August 2013 BO, that water depletions under Alternative 3 were not likely to jeopardize the continued existence of the Colorado River endangered fish species and not likely to destroy or adversely modify designated critical habitat; that a water depletion fee did not apply (under a 2010 BO that addressed small water depletions); and that further			

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Ecological resources (Cont.)					programmatic consultation is not required (Appendix E of the ULP PEIS).			
Land use	Under Alternative 1, mining activities would cease, but all other activities within the lease tracts would continue. As a result, impacts due to land use conflicts are expected to be minor.	Under Alternative 2, all the ULP lease tracts would be terminated, and DOE would restore the lands to the public domain under BLM's administrative control once reclamation activities were completed. As a result, impacts due to land use conflicts are expected to be minor.	Mining activities within the lease tracts would likely preclude some land uses, such as recreation or grazing. However, because many of the surrounding lands offer opportunities for these activities, impacts due to land use conflicts are considered to be minor.	Impacts would be similar to those under Alternative 3 but greater because they involve more lands.	Impacts under Alternative 5 would be the same as those under Alternative 4.	A total of 480 acres (200 ha) for the mill, tailings area, and roads would be altered. The 330-acre (140-ha) tailings area might be unavailable for further productive use when the mill area is reclaimed after operations cease, but the land might be returned to former grazing use after radiation levels are reduced to acceptable levels. Land use in surrounding areas might be affected, such as for	The project site would be unavailable for recreational or range and grazing use during construction and the 40-year operational period. No changes in land use would be expected for existing uranium mines in the region, but operations might result in resumed production of some regional uranium mines	Night lights and noise may disturb the landowner to the northwest.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Land use (Cont.)						increased residential and commercial development to serve mill-related population growth and mineral extraction in the vicinity.	that are on standby.	
Socio-economics	Reclamation would require 29 direct jobs during the year for field work and revegetation and would generate 16 indirect jobs.	Potential impacts on socioeconomics (including recreation and tourism) for Alternative 2 would be the same as those described for Alternative 1.	Exploration activities would directly employ 8 people during the peak year and would create an additional 9 indirect jobs under Alternative 3. Development and operational activities would directly employ 123 people during the peak year and would create an additional 98 indirect jobs. Reclamation would require a direct workforce of 29 people and would create 17 indirect jobs.	Exploration activities would directly employ 20 people during the peak year and would create an additional 16 indirect jobs under Alternative 4. Mining development and operational activities would create direct employment of 229 people during the peak year and would create 152 additional indirect jobs. Reclamation would require 39 direct jobs and 21 indirect jobs.	Exploration activities would directly employ 24 people during the peak year and would create an additional 28 indirect jobs under Alternative 5. Development and operational activities would create direct employment for 253 people during the peak year and would generate an additional 152 indirect jobs. Reclamation would require 39 direct jobs and create 25 indirect jobs.	About 8 jobs would be created to support operations of the mill.	As many as 538 direct and 664 indirect jobs could be created. Increased availability of local services could lead to expansion of recreation and tourism in the area. An association of negative impacts from mining and milling on recreation and tourism has not been demonstrated.	Potential impacts could be 10 to 24 full-time, year-round jobs, with most positions expected to be filled by local hires.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Environ-mental justice	Although potential impacts on the general population could result from the reclamation of uranium mining facilities, for the majority of resources evaluated, impacts would likely be minor. For the majority of resources, it is unlikely that there would be any disproportionate impacts to low income or minority populations.	Impacts on environmental justice associated with reclamation activities under Alternative 2 would be the same as those under Alternative 1.	Although potential impacts on the general population could result from exploration, mine development and operations, and reclamation under Alternative 3, for the majority of resources evaluated, impacts would likely be minor. Specific impacts on low-income and minority populations as a result of participation in subsistence or cultural and religious activities would also be minor and unlikely to be disproportionate.	The types of impacts related to mine development and operations under Alternative 4 would be similar to those described under Alternative 3, but the increase in the disturbed area under Alternative 4 could potentially increase the impacts. Impacts on environmental justice associated with the reclamation activities would be the same as those under Alternative 1.	The types of impacts related to exploration under Alternative 5 would be similar to those under Alternative 3. Under Alternative 5, there would be a total of 19 mines operating across the 31 DOE ULP lease tracts. The types of impacts related to mine development and operations under Alternative 5 would be similar to those under Alternative 4. Although potential impacts on the general population could result from exploration, mine development and operations, and reclamation under Alternative 5, for the majority of resources evaluated, the impacts would likely be minor and unlikely to have disproportionate impacts on low income or minority populations.	No information was available.	No information was available.	No environmental justice impacts were identified.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Transpor-tation	No transport of uranium ore would occur under Alternative 1. There would be no radiological transportation impacts. No changes in current traffic trends near the ULP lease tracts are anticipated.	No transport of uranium ore would occur under Alternative 2. There would be no radiological transportation impacts.	The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 3 would be 40 per day; 80 trucks per day would be expected to travel the affected routes. The nonradiological routine impacts associated with uranium ore transportation would be vehicle-related as a result of the increase in truck traffic on affected routes. Radiological impacts during routine conditions would be a result of human exposure to the low levels of radiation near the shipment. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.14 person-rem (8×10^{-5} LCF) for the peak year, and the truck drivers (transportation crew) would receive a dose of about	The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 4 would be 80 per day; 160 trucks per day would be expected to travel the affected routes. If all 160 trucks per day passed through Egnar, in the extreme case of all shipments going to the White Mesa Mill, there would be an increase of 64% in traffic in this area, but only a 3% increase at the most heavily travelled location in Monticello, Utah. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.28 person-rem (0.0002 LCF) for the peak year. The truck drivers (transportation crew) would receive a dose of about 1.4 person-rem	The estimated number of shipments from the operating uranium mines to the mills during the peak year of uranium mining under Alternative 5 would be 92 per day; 184 trucks per day would be expected to travel the affected routes. If all 184 trucks per day passed through Egnar, in the extreme case of all shipments going to the White Mesa Mill, there would be an increase of 74% in traffic in this area, but only a 3% increase at the most heavily travelled location in Monticello, Utah. The average external dose rate for uranium ore shipments is about 0.1 mrem/h at 6.6 ft (2 m), which is two orders of magnitude lower than the regulatory maximum. Collectively for the sample case, the truck drivers (transportation crew) would receive a dose of about 1.8 person-rem (0.001 LCF) during the peak year of operations	The traffic volume on area highways would increase substantially, increasing traffic congestion.	Average daily traffic on CO 90 and CO 141 would increase by 40%. CDOT does not consider the increase in traffic to be large. The condition of certain unimproved roads could worsen as a result of their use by an increased amount of mill traffic.	Increased traffic is expected on local roads. Increases of 14 light-duty vehicle round-trips and 9 heavy-duty vehicle round-trips per day are expected.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Transportation (Cont.)			0.71 person-rem (0.0004 LCF) during the peak year of operations. Potential transportation accident impacts for the peak year would not include any expected injuries or fatalities from traffic accidents. Impacts on the public and the environment from an accident involving a haul truck carrying uranium ore are expected to be minimal and short term.	(0.0009 LCF) during the peak year of operations from all shipments. Potential transportation accident impacts for the peak year would not include any expected fatalities and would include possibly one injury from traffic accidents.	from all shipments. The annual collective population dose to persons sharing the shipment route and to persons living and working along the route was estimated to be approximately 0.34 person-rem (0.0002 LCF) for the peak year. Potential transportation accident impacts in the peak year would include zero expected fatalities and potentially one injury from traffic accidents.			

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Cultural resources	Direct impacts on cultural resources are not expected under this alternative. Indirect adverse impacts from vandalism could still occur in the lease tracts where reclamation is proposed, depending on the number and activities of workers engaged in reclamation.	Impacts on cultural resources would be the same as those discussed for Alternative 1.	In each of the exploration, development and operations, and reclamation phases, cultural resources could be disturbed as a result of activities in which the ground surface was disturbed, historic structures were damaged or destroyed, or pedestrian and vehicle traffic increased on the lease tracts and their access roads. These activities could also have adverse effects on traditional cultural properties, such as plant and animal species traditionally collected by Native Americans and on sacred or culturally significant places and landforms.	Under Alternative 4, impacts would be similar to those discussed under Alternatives 1, 2, and 3, except they would occur on a larger scale, since they could occur on all lease tracts.	Under Alternative 5, impacts would be similar to those discussed for Alternative 4, except they would be of shorter duration. Impacts from mine development and operations would be similar in nature to those described for Alternative 3, but on a larger scale. An estimated total of 23 cultural resource sites would likely be affected by the development of mining activities under Alternative 5. Impacts from reclamation activities would be the same as those discussed for Alternative 1.	Six historical sites were identified by a survey; of the five eligible for inclusion in the NRHP, one would be adversely affected by the mill and would require mitigation. No impacts on paleontological resources were identified.	Project would not be expected to affect any historic properties, and artifact surveys would be expected to continue as the facility is developed. There would be little potential for disturbance of known cultural sites or unanticipated discoveries during operations. No paleontological resource impacts were identified.	No impacts on cultural resources were identified, nor were any traditional cultural properties. However, there is a potential for discovering or damaging buried deposits that are not readily identifiable. There is also some potential for discovering or damaging vertebrate fossils within the Morrison Formation located within the mine.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Visual resources	Impacts resulting from reclamation can be produced through a range of direct and indirect actions or activities occurring on the lands contained within the lease tracts. These types of impacts include the following: vegetation and landform alterations; removal of structures and materials; changes to existing roadways; and changes in vehicular and worker activities.	Because the primary difference between Alternative 1 and Alternative 2 is in the administrative control of the lease tracts, the resulting visual impacts would be similar.	Visual impacts associated with exploration are generally minor and of short duration due to the quick time frame in which these activities are conducted. Impacts due to road construction, erosion, or other landform alterations or vegetation clearing in arid environments, however, might be visible for extended periods. Potential visual impacts that could result from mine development and operations would include contrasts in form, line, color, and texture. The types of impacts associated with mine reclamation would be similar to those discussed for Alternative 1.	Visual impacts generally would be the same under this alternative as those under Alternatives 1 and 3, except they would be on a larger scale.	Visual impacts would generally be the same for this alternative as those described for Alternatives 1 and 3. As stated for Alternative 4, the primary difference from Alternative 1 would be that activities would occur on all of the lease tracts.	Stack emissions would be visible to the public travelling on US 163, but the stack emissions would not be expected to be visible from major recreational areas in the vicinity.	Construction would not significantly affect the viewshed from Davis, Mesa, or CO 90, and impacts would be temporary. Facility features would be noticeable to travellers on CO 90 but would not dominate the view of the casual observer; existing open-pit mine overburden piles, waste-rock dumps, mine buildings, and access roads currently draw attention from CO 90. Visual impacts would be most prominent later in the 40-yr facility lifetime, when evaporation ponds would be completed to full capacity.	The mine can be seen from points of interest such as Palisade WSA and the La Sal Mountains and foothills; however, the mine does not dominate the view of the casual viewer.

TABLE 4.7-12 (Cont.)

Resource Area	ULP Alternatives: Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5	White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
Waste management	The potential impacts on waste management practices that would result from waste generated during reclamation activities under Alternative 1 would be expected to be minor.	The potential impacts on the ability to manage the waste generated from reclamation activities under Alternative 2 would be the same as those described for Alternative 1.	The potential impacts on waste management practices that would result from waste generated during exploration, mine development and operations, and reclamation would be expected to be minor. Because exploration and mine development and operations would be conducted in addition to reclamation under Alternative 3, the waste generated would be more than that generated under Alternatives 1 and 2.	Potential impacts on waste management practices under Alternative 4 would be small and similar to those under Alternatives 1, 2, and 3. The quantity of waste to be managed under Alternative 4 would be slightly larger than the quantity under Alternative 3 for the peak year of mine development and operations.	Potential impacts on waste management practices under Alternative 5 would be the same as those under Alternative 4.	A total of 2,000 tons per day of waste material (tailings) would be produced, for on-site deposition. Process water (310 gal or 1,200 L per minute) would be discharged to the tailings impoundment. There would be no discharge of liquid or solid effluents from the mill and tailings site.	No information was available.	No information was available.

[a] Taken from impacts discussed for the Whirlwind Mine.

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