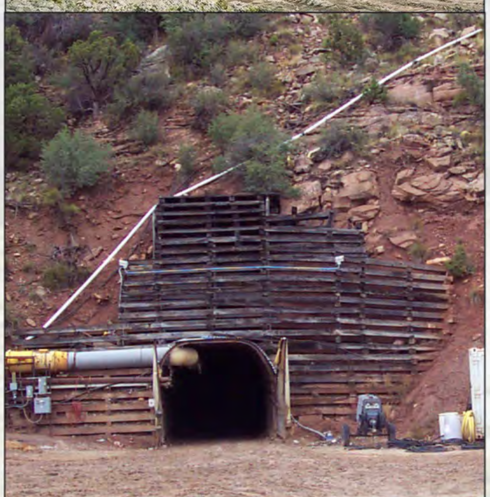

Final Uranium Leasing Program Programmatic Environmental Impact Statement

Volume 1: Chapters 1 through 4

DOE/EIS-0472
March 2014

U.S. DEPARTMENT OF ENERGY | Legacy Management

COVER SHEET

Lead Agency: U.S. Department of Energy (DOE)

Cooperating Agencies: The U.S. Department of the Interior (DOI), Bureau of Land Management (BLM); U.S. Environmental Protection Agency (EPA); Colorado Department of Transportation (CDOT); Colorado Division of Reclamation, Mining, and Safety (CDRMS); Colorado Parks and Wildlife (CPW); Mesa County Commission; Montrose County Commission; San Juan County Commission; San Miguel County Board of Commissioners; the Pueblo of Acoma; the Pueblo de Cochiti; the Pueblo de Isleta; the Navajo Nation; and the Southern Ute Indian Tribe

Title: Final Uranium Leasing Program Programmatic Environmental Impact Statement (DOE/EIS-0472)

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Abstract: The U.S. Department of Energy has prepared this *Final Uranium Leasing Program Programmatic Environmental Impact Statement* (ULP PEIS) pursuant to the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's (CEQ's) NEPA regulations (40 CFR Parts 1500–1508), and DOE's NEPA implementing procedures (10 CFR Part 1021) to analyze the reasonably foreseeable environmental impacts, including the site-specific impacts, of the range of reasonable alternatives for the management of the ULP. DOE's ULP administers 31 tracts of land covering an aggregate of approximately 25,000 acres (10,000 ha) in Mesa, Montrose, and San Miguel Counties in western Colorado for exploration, mine development and operations, and reclamation of uranium mines. There are currently 29 existing leases; two of the lease tracts are not leased. Site-specific information available on the 31 lease tracts (including current lessee information and status, size of each lease tract, previous mining operations that occurred, location of existing permitted mines and associated structures, and other environmental information) has been utilized as the basis for the evaluation contained in this ULP PEIS.

DOE has evaluated five alternatives that address the range of reasonable alternatives for the management of the ULP. These alternatives are as follows:

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

- *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.

- *Alternative 3:* DOE would continue the ULP as it existed before July 2007[1] with the 13 then-active leases, for the next 10-year period or for another reasonable period, and DOE would terminate the remaining leases.

- *Alternative 4:* DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period.

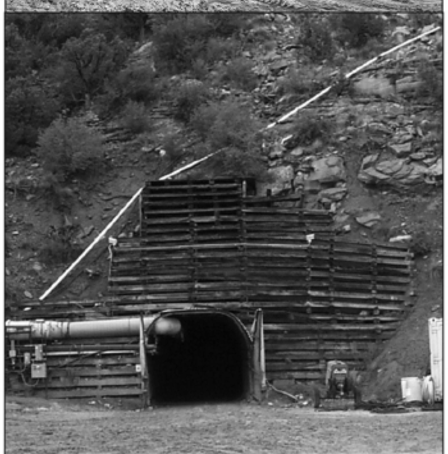
- *Alternative 5:* This is the No Action Alternative, under which DOE would continue the ULP with the 31 lease tracts for the remainder of the 10-year period, as the leases were when they were issued in 2008.

Preferred Alternative: DOE's preferred alternative is Alternative 4.

Public Participation: DOE encourages public participation in the NEPA process. A Notice of Availability (NOA) for the Draft ULP PEIS was published in the *Federal Register* on March 15, 2013 (78 FR 16483), and this began a 60-day public comment period that was to end on May 16, 2013. This comment period was later extended to May 31, 2013 (78 FR 23926), and it was subsequently re-opened on June 3, 2013 (78 FR 33090), with a closing date of July 1, 2013. Hearings were held on the Draft ULP PEIS in Grand Junction, Montrose, Telluride, and Naturita. The public comment period, including the extension and the re-opening, lasted 109 days. All comments received on the Draft ULP PEIS were considered in the preparation of the Final ULP PEIS.

Changes from the Draft PEIS: In this Final PEIS, vertical lines in the margin indicate where the Draft PEIS has been revised or supplemented. Deletions are not demarcated.

[1] In July 2007, DOE issued a programmatic environmental assessment and Finding of No Significant Impact for the ULP, which a U.S. District Court invalidated on October 18, 2011.



Final Uranium Leasing Program Programmatic Environmental Impact Statement

Volume 1: Chapters 1 through 4

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U.S. DEPARTMENT OF ENERGY | Legacy Management

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NOTATION

The following is a list of acronyms and abbreviations, chemical names, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
ACEC	Area of Critical Environmental Concern
ACHP	American Council on Historic Preservation
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
APE	area of potential effects
AQCR	Air Quality Control Region
AQRV	air-quality-related value
ATSDR	Agency for Toxic Substances and Disease Registry
AUM	animal unit month
BA	biological assessment
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	best management practice
BO	biological opinion
BOR	Bureau of Reclamation
CAA	Clean Air Act
CAAQS	Colorado Ambient Air Quality Standards
CASTNET	Clean Air Status and Trends Network
CCCD	Colorado Center for Community Development
CDA	Colorado Department of Agriculture
CDNR	Colorado Department of Natural Resources
CDOT	Colorado Department of Transportation
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CDRMS	Colorado Division of Reclamation, Mining, and Safety
CDWR	Colorado Division of Water Resources
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CNHP	Colorado Natural Heritage Program
COGCC	Colorado Oil and Gas Conservation Commission
CPW	Colorado Parks and Wildlife (formerly CDOW)

CRD	Comment Response Document
CRS	*Colorado Revised Statutes*
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
DCF	dose conversion factor
DEM	Digital Elevation Model
DNL	day-night average sound level
DOE	U.S. Department of Energy
DOE-LM	DOE Office of Legacy Management
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DPS	distinct population segment (USFWS)
DRI	Desert Research Institute
EA	environmental assessment
EDE	effective dose equivalent
EF	enhanced Fujita (scale)
EFR	Energy Fuels Resources
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
EPP	environmental protection plan
EPS	Economic and Planning Systems
ERNA	Ecological Research Natural Area
ESA	Endangered Species Act
FGR	Federal Guidance Report
FLM	Federal Land Manager
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FTW	full-time worker
GAO	Government Accountability Office
GHG	greenhouse gas
GIS	geographic information system
HA	herd area
HAP	hazardous air pollutant
HEAST	Health Effect Assessment Summary Tables
HFC	hydrofluorocarbon
HI	hazard index
HMA	herd management area
HMR	hazardous materials regulation (DOT)

HQ	hazard quotient
I-	Interstate (Highway)
ICRP	International Commission on Radiological Protection
IDA	intentional destructive act
IPaC	Information, Planning, and Conservation System (USFWS)
IRIS	Integrated Risk Information System
ISM	Integrated Safety Management
KOP	key observation point
KREX	KREX News Channel
L_{90}	sound level exceeded 90% of the time
LCF	latent cancer fatality
L_{dn}	day-night average sound level
L_{eq}	equivalent continuous sound level
Lg	surface wave
LHA	landscape health assessment
LR2000	Land and Mineral Rehost 2000 System (BLM)
LSA	low specific activity
M&E	Monitoring & Evaluation (List)
MLg	surface wave magnitude
MOU	Memorandum of Understanding
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standard(s)
NAICS	North American Industry Classification System
NCA	National Conservation Area
NCDC	National Climatic Data Center
NCRP	National Council on Radiation Protection
NED	National Elevation Data
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NLCS	National Landscape Conservation System (BLM)
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NP	National Park
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	*National Register of Historic Places*
NWCC	National Wind Coordinating Committee
NWI	National Wetlands Inventory

OAHP	Office of Archaeology and Historic Preservation (Colorado)
OHV	off-highway vehicle
OMP	operations and maintenance plan
ONA	Outstanding Natural Area
ORV	Outstanding Remarkable Value
PA	programmatic agreement
PEA	programmatic environmental assessment
PEIS	programmatic environmental impact statement
PFC	perfluorocarbon
PFYC	Potential Fossil Yield Classification
P.L.	Public Law
PLS	pure live seed
PM	particulate matter
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 µm or less
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 µm or less
PSD	Prevention of Significant Deterioration
QDEH	Queensland Department of Environment and Heritage
RCRA	Resource Conservation and Recovery Act
RfC	reference dose concentration
RfD	reference dose
RILOR	reclamation in lieu of royalties
RMP	resource management plan
RNA	Research Natural Area
ROD	Record of Decision
ROI	region of influence
ROW	right-of-way
SAAQS	State Ambient Air Quality Standard(s)
SDWA	Safe Drinking Water Act
SH	State Highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SJPLC	San Juan Public Lands Center
SRE	Slick Rock East
SRMA	Special Recreation Management Area
SRW	Slick Rock West
SVRA	sensitive visual resource area
SWCTR	Southwest Colorado Travel Region
SWMP	stormwater management plan
SWReGAP	Southwest Regional Gap Analysis Project

TDS	total dissolved solids
TEDE	total effective dose equivalent
THC	total hydrocarbons
TIS	traffic impact study
TMDL	total maximum daily load
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
UCC	Union Carbide Corporation
UDEQ	Utah Department of Environmental Quality
UDNR	Utah Department of Natural Resources
UDOGM	Utah Division of Oil, Gas, and Mining
UDOT	Utah Department of Transportation
UDWR	Utah Division of Wildlife Resources
UGS	Utah Geological Survey
ULP	Uranium Leasing Program
UMTRCA	Uranium Milling Tailings Radiation Control Act
UNSCEAR	United Nations Scientific Committee on the Effects of Radiation
US	U.S. Highway
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGRCRP	U.S. Global Research Change Research Program
USGS	U.S. Geological Survey
VOC	volatile organic compound
VRI	visual resource inventory
VRM	visual resource management
WA	Wilderness Area
WAPA	Western Area Power Administration
WHO	World Health Organization
WL	working level
WLM	working level month
WRCC	Western Regional Climate Center
WSA	Wilderness Study Area
WSR	National Wild and Scenic Rivers

CHEMICALS

CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
K-40	potassium-40
NO_2	nitrogen dioxide
N_2O	nitrous oxide
NO_x	nitrogen oxides
O_3	ozone
Pb	lead
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
U_3O_8	uranium oxide (triuranium octoxide)
V_2O_5	vanadium oxide (divanadium pentoxide)

UNITS OF MEASURE

ac-ft	acre-foot (feet)
bbl	barrel(s)
ºC	degree(s) Celsius
Ci	curie(s)
cm	centimeter(s)
cm^3	cubic centimeter(s)
d	day(s)
dB	decibel(s)
dBA	a-weighted decibel(s)
ºF	degree(s) Fahrenheit
ft	foot (feet)
ft^3	cubic foot (feet)
g	gram(s)
gal	gallon(s)

h	hour(s)
ha	hectare(s)
hp	horsepower
Hz	hertz
in.	inch(es)
in.^{3}	cubic inch(es)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
mGy	milligray
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mm	millimeter(s)
mo	month(s)
mph	mile(s) per hour
mrem	millirem
MW	megawatt(s)
pCi	picocurie(s)
ppb	part(s) per billion
ppm	part(s) per million
rem	roentgen equivalent man
s	second(s)
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
µg	microgram(s)
µm	micrometer(s)
µmho(s)	micromho(s)
µS	microsievert(s)

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CONVERSION TABLE
ENGLISH/METRIC AND METRIC/ENGLISH EQUIVALENTS

Multiply	By	To Obtain
English/Metric Equivalents		
acres	0.004047	square kilometers (km^2)
acre-feet (ac-ft)	1,234	cubic meters (m^3)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (ºF) –32	0.5555	degrees Celsius (ºC)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
miles per hour (mph)	1.609	kilometers per hour (kph)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.9072	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
yards (yd)	0.9144	meters (m)
Metric/English Equivalents		
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	0.00081	acre-feet (ac-ft)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (ºC) +17.78	1.8	degrees Fahrenheit (ºF)
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	short tons (tons)
kilometers (km)	0.6214	miles (mi)
kilometers per hour (kph)	0.6214	miles per hour (mph)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
metric tons (t)	1.102	short tons (tons)
square kilometers (km^2)	247.1	acres
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

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FINAL URANIUM LEASING PROGRAM PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

1 INTRODUCTION

The U.S. Department of Energy (DOE) has prepared the Uranium Leasing Program (ULP) Programmatic Environmental Impact Statement (PEIS) pursuant to the National Environmental Policy Act of 1969 (NEPA) (Title 42, Section 4321 and following sections of the *United States Code* [42 USC 4321 *et seq.*]), the Council on Environmental Quality's (CEQ's) NEPA regulations found in Title 40 of the *Code of Federal Regulations* (40 CFR Parts 1500–1508), and DOE's NEPA implementing procedures (10 CFR Part 1021) in order to analyze the reasonably foreseeable environmental impacts, including the site-specific impacts, of the reasonable range of alternatives identified in the ULP PEIS for the management of the ULP. DOE's ULP administers tracts of land located in Mesa, Montrose, and San Miguel Counties in western Colorado for the exploration, mine development and operations, and extraction of uranium and vanadium ores.

1.1 BACKGROUND

Congress authorized DOE's predecessor agency, the U.S. Atomic Energy Commission (AEC), to develop a supply of domestic uranium. In 1948, the Bureau of Land Management (BLM) issued Public Land Order 459, which stated, "Subject to valid existing rights and existing withdrawals, the public lands and the minerals reserved to the United States in the patented lands in the following areas in Colorado are hereby withdrawn from all forms of appropriation under the public-land laws, including the mining laws but not the mineral-leasing laws, and reserved for the use of the United States Atomic Energy Commission." Subsequently, other Public Land Orders increased or decreased the total acreage of the withdrawn lands. In addition, the Federal Government, through the Union Mines Development Corporation, acquired a substantial number of patented and unpatented mining claims, mill[1] and tunnel[2] site claims, and agricultural patents, until the aggregated acreage managed by AEC totaled approximately 25,000 acres (10,000 ha). The areas under consideration are located in western Colorado in Mesa, Montrose, and San Miguel Counties.

Beginning in 1949, the AEC and its successor agencies, the U.S. Energy Research and Development Administration and DOE, administered three separate and distinct leasing

[1] Mill sites are mining claims that may be located in connection with a specific placer or load claim for mining and milling purposes or as an independent/custom mill site. Mill sites are located by metes and bounds or legal subdivision and are up to 5 acres (2 ha) in size.

[2] A tunnel site is a mining claim that involves a tunnel to develop an underground vein or lode. It may also be used for the discovery of unknown veins or lodes. To stake a tunnel site, two stakes are placed up to 3,000 ft (900 m) apart on the line of the proposed tunnel. Recordation is the same as for a lode claim. A tunnel site can be regarded as more of a right of way than a mining claim.

programs during the ensuing 60 years, as summarized in Table 1.1-1. To put the production numbers in Table 1.1-1 in perspective, domestic annual uranium production peaked in 1980 at about 44 million lb (20 million kg), of which lease production that year represented about 2.5% of the total. In addition, today's world market produces approximately 100 million lb (45 million kg) of uranium annually and consumes twice that amount. Table 1.1-2 summarizes production rates between 1974 and 1994 and between 1996 and 2008.

In preparing for the 1974 leasing period, the AEC evaluated the potential environmental and economic impacts related to the leasing program. This evaluation was documented in *Environmental Statement, Leasing of AEC Controlled Uranium Bearing Lands* (AEC 1972). In 1995, DOE again evaluated the potential environmental and economic impacts related to the leasing program and documented its findings in the *Finding of No Significant Impact, Uranium Lease Management Program* (DOE 1995).

When the first leasing program ended in 1962, the AEC directed the lessees to close the mines (to prohibit unauthorized entry), but little was done to reclaim the mine sites. These mine sites became DOE's "legacy mine sites," discussed later in this section.

In 1974, the AEC initiated reclamation bonding requirements in its new lease agreements that ensured that all mine sites would be adequately reclaimed when lease operations ended. During this period, a new lessee could elect to incorporate an existing mine (from the previous leasing program) into its current operation. By so doing, the new lessee accepted the responsibility and liability associated with the ultimate reclamation of that mine site.

In October 1994, DOE initiated a mine-site reconnaissance and reclamation project on the lease tracts. Each lease tract was thoroughly inspected to identify all the abandoned mine sites that resulted from pre-1974 leasing activities. After this identification process, all the mining-related features associated with each site were quantified and assessed for their historic

TABLE 1.1-1 Summary of Three Leasing Programs Administered between 1949 and 2008

Years of Operation	No. of Leases	Lease Production (millions of lb)[a] U_3O_8	Lease Production (millions of lb)[a] V_2O_5	Royalties Generated (millions of $)
1949–1962	48	1.2	6.8	5.9
1974–1994[b]	43	6.5	33.0	53.0
1996–2008	15	0.3	1.4	4.0
Totals		8.0	41.2	62.9

[a] Uranium ore is generated as uranium oxide (U_3O_8) and vanadium ore is generated as vanadium oxide (V_2O_5).

[b] Mining operations peaked in 1980.

TABLE 1.1-2 Summary of Uranium Ore Production from 1974 to 2008

Lease Tract	Dates of Operation 1974–1994	No. and Sizes[a] of Mines in Operation within Lease Tract 1974–1994	Total Production (tons) 1974–1994	Dates of Operation 1996–2008	No. of Mines in Operation within Lease Tract 1996–2008	Total Production (tons) 1996–2008
5	5/77–6/90	1 (L)	100,318	Did not operate	0	Did not operate
5A	Did not operate	0	0	NA[b]	0	NA
6	5/76–8/80	1 (L)	91,859	9/04–2/06	1	14,773
7	7/79–5/81	2 (1 VL, 1 M)	12,441	Did not operate	0	Did not operate
8	Did not operate	0	0	6/05–2/06	1	9,236
8A	Did not operate	0	0	NA	0	NA
9	9/78–9/80	1 (M)	34,056	5/03–2/06	1	20,671
10	5/75–8/90	4 (1 M, 3 S)	66,623	NA	0	NA
11	9/75–12/80	2 (1 M, 1 S)	46,720	Did not operate	0	Did not operate
11A	Did not operate	0	0	NA	0	NA
12	8/77–12/79	1 (S)	7,287	NA	0	NA
13	6/75–10/84	3 (1 L, 2 S)	85,863	Did not operate	0	Did not operate
13A	12/75–10/80	1 (M)	38,158	Did not operate	0	Did not operate
14	Did not operate	0	0	NA	0	NA
15	9/76–4/80	3 (S)	4,646	Did not operate	0	Did not operate
15A	9/79–1/81	2 (S)	8,842	NA	0	NA
16	12/76–6/79	4 (S)	5,709	NA	0	NA
16A	8/75–11/80	3 (S)	3,503	NA	0	NA
17	Did not operate	0	0	NA	0	NA
18	2/80–9/80	1 (M)	6,654	3/05–1/06	1	20,085
19	7/74–7/90	1 (L)	920,018	NA	0	NA
19A	Did not operate	0	0	NA	0	NA
20	Did not operate	0	0	NA	0	NA
21	10/78–12/80	1 (M)	46,542	Did not operate	0	Did not operate
22	3/77–5/82	1 (S)	8,578	NA	0	NA
22A	10/79–7/82	1 (M)	21,369	NA	0	NA
23	5/77–12/81	2 (S)	9,867	NA	0	NA
24	Did not operate	0	0	NA	0	NA

TABLE 1.1-2 (Cont.)

Lease Tract	Dates of Operation 1974–1994	No. of Mines in Operation within Lease Tract 1974–1994	Total Production (tons) 1974–1994	Dates of Operation 1996–2008	No. of Mines in Operation within Lease Tract 1996–2008	Total Production (tons) 1996–2008
25	8/78–8/80	1 (M)	14,135	Did not operate	0	Did not operate
26	12/75–12/80	2 (S)	2,547	NA	0	NA
27	8/75–4/83	4 (S)	15,923	NA	0	NA
Totals		42[c]	1,551,658		4	64,765

[a] The sizes of the mines are noted with the following abbreviations: VL = very large; L = large; M = medium; and S = small.

[b] NA indicates not applicable, meaning the lease tract was not leased, and thus it was not available for operation or production.

[c] The total of 42 mines represents 1 very large mine, 4 large mines, 9 medium mines, and 28 small mines.

importance. In 1995, in the absence of specific guidance pursuant to the reclamation of abandoned uranium mine sites, DOE initiated discussions with BLM officials that culminated in the establishment of a guidance document, *Uranium Closure/Reclamation Guidelines* (BLM 1995) for such sites. DOE's objective in establishing this guidance document was to assure that DOE's lease tracts were reclaimed in a manner that was acceptable to BLM so that the lands could be restored to the public domain and managed by BLM. Subsequently, DOE's "legacy" mine sites were prioritized and systematically reclaimed.

In July 2007, DOE issued a programmatic environmental assessment (PEA) for the ULP, in which it examined three alternatives for the management of the ULP for the next 10 years (DOE 2007). In that same month, DOE issued a Finding of No Significant Impact (FONSI), in which DOE announced its decision to proceed with the Expanded Program Alternative, and also determined that preparation of an environmental impact statement (EIS) was not required. Under the Expanded Program Alternative, DOE would extend the 13 existing leases for a 10-year period and would also expand the ULP to include the competitive offering of up to 25 additional lease tracts to the domestic uranium industry.

In the fall of 2007, DOE, in preparation for the execution of new lease agreements for the active lease tracts and the bid-solicitation process for the inactive lease tracts, reviewed the status of its withdrawn lands to determine how to most efficiently and effectively manage those lands. After an extensive review process, DOE decided to realign the existing lease tract boundaries to incorporate those lands that recently reverted to the withdrawals. Concurrent with that action, DOE also decided to systematically assess, and then reclaim, the abandoned uranium mine sites and associated features located on those lands to mitigate the physical safety and environmental hazards associated with the sites. In 2008, following the execution of the new lease agreements, DOE, in accordance with Article XVI (Good Faith Negotiations), negotiated with its lessees to reclaim the abandoned uranium mine sites and associated features on their respective lease tracts in lieu of annual royalty payments due to the Government. These "reclamation in lieu of royalties" (RILOR) negotiations, executed with up to five lessees in any one year, included abandoned uranium mine sites and associated features on 19 lease tracts and took place over a 3-year period (2009–2011). Some features at some sites were left intact (barring imminent safety hazards) because they were considered historically significant. At the culmination of these activities, DOE determined that all legacy mine sites located on the lease tracts were completely and successfully reclaimed.

In 2008, DOE implemented the Expanded Program Alternative and executed new lease agreements with the existing lessees for their 13 respective lease tracts, effective April 30, 2008. In addition, DOE offered the remaining, inactive lease tracts to industry for lease through a competitive solicitation process. That process culminated in the execution of 18 new lease agreements for the inactive lease tracts, effective June 27, 2008. Since that time, two lease tracts were combined into one and another lease was relinquished back to DOE. Accordingly, there are 29 lease tracts that are actively held under lease and 2 lease tracts that are currently inactive.

Between 2009 and 2011, DOE approved seven exploration plans (one each for Lease Tracts 13A, 15A, 17, 21, 24, 25, and 26). These exploration plans primarily involved the drilling of at least one exploratory hole. To date, the approved exploration plans for Lease Tracts 15A and 17 have not been implemented. Exploration activities typically resulted in surface disturbance of less than 1 acre (0.4 ha). Disturbed lands were reclaimed by using polyurethane foam to plug holes, and by using surface soils and established seed mixtures. There was also one mine re-entry plan that was approved and implemented for Lease Tract 26. This plan included mine re-entry activities whereby information was collected within an existing mine and the mine was resecured. DOE also approved 20 reclamation plans to reclaim 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. All approved reclamation plans have been implemented. Reclamation activities addressed open drill holes and vents, land subsidences, and abandoned mine portals and adits. These exploration and reclamation activities are further discussed and evaluated in the cumulative impacts section (Section 4.7). In addition, for Lease Tract 13, a tamarisk removal activity was performed in lieu of the payment of royalties by the lessee.

1.2 CURRENT STATUS OF THE ULP

Colorado Environmental Coalition and three other plaintiffs filed a complaint against DOE in the U.S. District Court for the District of Colorado on July 31, 2008, in which the plaintiffs alleged, among other things, that DOE's July 2007 PEA and FONSI violated NEPA by failing to consider adequately the environmental impacts of expansion of the ULP, and violated the Endangered Species Act by jeopardizing endangered species. On October 18, 2011, the Court issued an Order in which it held, among other things, that DOE had violated NEPA by issuing its July 2007 PEA and FONSI instead of preparing an EIS. In that Order, the Court invalidated the July 2007 PEA and FONSI; stayed the 31 leases in existence under the ULP; enjoined DOE from issuing any new leases on lands governed by the ULP; enjoined DOE from approving any activities on lands governed by the ULP; and ordered that after DOE conducts an environmental analysis that complies with NEPA, the ESA, all other governing statutes and regulations, and the Court's Order, DOE could then move the Court to dissolve its injunction (Colorado Environmental Coalition v. DOE, No. 08-cv-1624 [D. Colo. Oct. 18, 2011]).

The Court later granted in part DOE's motion for reconsideration of that Order and amended its injunction to allow DOE, other Federal, state, or local governmental agencies, and/or the ULP lessees to conduct only those activities on ULP lands that are absolutely necessary: (1) to conduct DOE's environmental analysis regarding the ULP; (2) to comply with orders from Federal, state, or local government regulatory agencies; (3) to remediate certain dangers to public health, safety, and the environment on ULP lands; or (4) to conduct certain activities to maintain the ULP lease tracts and their existing facilities (Colorado Environmental Coalition v. DOE, No. 08-cv-1624 [D. Colo. Feb. 27, 2012]).

Currently, of the 31 ULP lease tracts, 29 have active leases and two do not; Lease Tracts 8A and 14 (Parcels 14-1, 14-2, and 14-3) are currently not leased. Lease Tract 8A is a small tract that is isolated and may be located entirely below (or outside) the uranium-bearing formation, which could indicate a lack of ore. Lease Tract 14 comprises three parcels (14-1, 14-2, and 14-3). There was some interest in Parcels 14-1 and 14-2 by potential lessees in the past; however, the third parcel (14-3, which lies east of 14-1) is located almost entirely within the Dolores River corridor and was never leased. Section 1.2.1 describes how DOE administers the

ULP; Section 1.2.2 summarizes the requirements in the current leases; and Section 1.2.3 presents site-specific information available on the 31 ULP lease tracts.

On June 21, 2011, DOE published the Notice of Intent (NOI) to prepare the ULP PEIS (see Volume 76, page 36097 of the *Federal Register* [76 FR 36097]). In the NOI, DOE stated that it had determined, in light of the site-specific information that DOE had gathered as a result of the site-specific agency actions proposed and approved pursuant to the July 2007 PEA, that it was appropriate for DOE to prepare a PEIS in order to analyze the reasonably foreseeable environmental impacts, including potential site-specific impacts, of a range of alternatives for the management of the ULP for the remainder of the 10-year period that was covered by the July 2007 PEA. After DOE published the NOI, it notified the ULP lessees that until the PEIS process was completed, DOE would not approve any new exploration and mining plans and would not require any lessees to pay royalties.

1.2.1 DOE ULP Administrative Process

DOE's administration of the ULP includes the actions needed to manage the activities conducted at the 31 lease tracts. Table 1.2-1 lists the 31 lease tracts with applicable acreage, current lessee, and the status of each. Figure 1.2-1 shows the locations of the 31 ULP lease tracts. These actions are undertaken to assure that the program's technical and administrative objectives are accomplished. These actions include the following:

- Offer the lease tracts to the domestic uranium industry through a competitive royalty-bid process that culminates in the award of each lease to the highest qualified bidder.

- Inspect and maintain lease tract boundary markers and monuments on the lease tracts. Establish and maintain records of survey control points for said markers and monuments.

- Review lessees' exploration and mining plans, in coordination with BLM and the Colorado Division of Reclamation, Mining, and Safety (CDRMS), to ensure that they are consistent with Federal, state, and local rules and regulations; existing environmental regulations; lease stipulations; and standard industry practices. Approve or deny each plan as warranted.

- Coordinate with other Federal agencies (e.g., BLM, U.S. Fish and Wildlife Service [USFWS], U.S Environmental Protection Agency [EPA]), state agencies (e.g., CDRMS, Colorado Division of Parks and Wildlife [CPW], Colorado Department of Public Health and the Environment [CDPHE]), local and tribal officials, and private entities as appropriate to address concerns that they may have. Routinely review each Memorandum of Understanding (MOU) established with BLM and CDRMS to ensure that the agreements remain up to date and reflect actual work practices.

TABLE 1.2-1 Summary of the 31 DOE ULP Lease Tracts in 2011

	Lease Tract No.	Acreage	Current Lessee	County	Status[a]
1	10	638	Golden Eagle Uranium, LLC	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
2	11	1,303	Cotter Corporation	San Miguel	One new underground mine permitted and developed; reclamation of previously disturbed areas needed.
3	11A	1,297	Golden Eagle Uranium, LLC	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
4	12	641	Colorado Plateau Partners	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
5	13	1,077	Gold Eagle Mining, Inc.	San Miguel	Three existing, permitted underground mines; reclamation of previously disturbed areas is needed.
6	13A	420	Cotter Corporation	San Miguel	Exploration plan (one hole) approved; drilling and reclamation of the explored area are completed.
7	14 (1, 2, 3)	971	Not applicable	San Miguel	Lease tract not currently leased.
8	15	350	Gold Eagle Mining, Inc.	San Miguel	One existing underground mine; reclamation of previously disturbed areas is needed.
9	15A	172	Golden Eagle Uranium, LLC	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
10	16	1,790	Golden Eagle Uranium, LLC	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
11	16A	585	Energy Fuels Resources Corp.	San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
12	5	151	Gold Eagle Mining, Inc.	Montrose	One existing, permitted underground mine; reclamation of previously disturbed areas is needed.

TABLE 1.2-1 (Cont.)

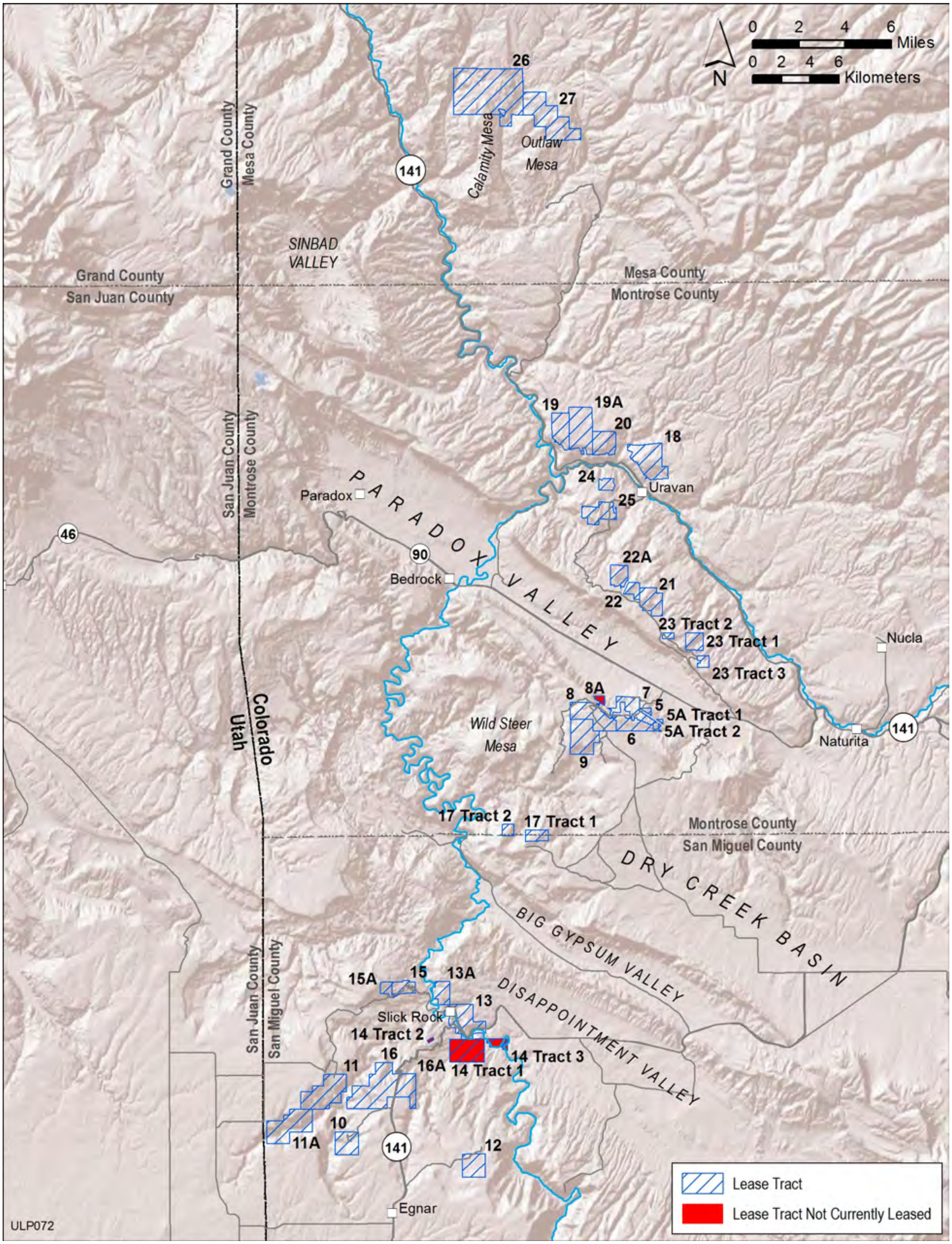
	Lease Tract No.	Acreage	Current Lessee	County	Status[a]
13	5A (1, 2)	25	Golden Eagle Uranium, LLC	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
14	6	530	Cotter Corporation	Montrose	One existing permitted underground mine; reclamation of previously disturbed areas is needed.
15	7[b]	493	Cotter Corporation	Montrose	Two existing permitted mines—one underground mine and one large open-pit mine; reclamation of previously disturbed areas is needed.
16	8	955	Cotter Corporation	Montrose	One existing permitted underground mine; reclamation of previously disturbed areas is needed.
17	8A	78	Not applicable	Montrose	Lease tract has not been leased.
18	9	1,037	Cotter Corporation	Montrose	One existing permitted underground mine; reclamation of previously disturbed areas is needed.
19	17 (1, 2)	475	Golden Eagle Uranium, LLC	Montrose and San Miguel	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
20	18	1,181	Cotter Corporation	Montrose	One existing permitted underground mine; reclamation of previously disturbed areas is needed.
21	19	662	Energy Fuels Resources Corp.	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
22	19A	1,204	Energy Fuels Resources Corp.	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
23	20	627	Energy Fuels Resources Corp.	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
24	21	651	Cotter Corporation	Montrose	Exploration plan (two holes) approved; drilling and reclamation of the explored area are completed; no area needs to be reclaimed under current conditions.

TABLE 1.2-1 (Cont.)

	Lease Tract No.	Acreage	Current Lessee	County	Status[a]
25	22	224	Golden Eagle Uranium, LLC	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
26	22A	409	Golden Eagle Uranium, LLC	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
27	23 (1, 2, 3)	596	Golden Eagle Uranium, LLC	Montrose	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
28	24	201	Energy Fuels Resources Corp.	Montrose	Exploration plan (eight holes) approved; drilling and reclamation of explored area are completed; no area needs to be reclaimed under current conditions.
29	25	639	Cotter Corporation	Montrose	Exploration plan (one hole) approved; drilling and reclamation of explored area are completed; no area needs to be reclaimed under current conditions.
30	26	3,989	Energy Fuels Resources Corp.	Mesa	Exploration plan (six holes) approved; drilling and reclamation of the explored area are completed; mine re-entry plan is approved, bulkhead partially removed, and assessment completed; portal is resecured; reclamation of previously disturbed areas is needed.
31	27	1,766	Energy Fuels Resources Corp.	Mesa	No recent (post-1995) activity conducted; no area needs to be reclaimed under current conditions.
Total		25,137			

[a] On October 18, 2011, a Federal district court stayed the 31 leases, and enjoined DOE from approving any activities on ULP lands. On February 27, 2012, the court amended its injunction to allow DOE, other Federal, state, or local governmental agencies, and the ULP lessees to conduct only those activities on ULP lands that are absolutely necessary, as described in the court's Order. See *Colorado Environmental Coalition v. Office of Legacy Management*, No. 08-cv-01624, 2012 U.S. DIST. LEXIS 24126 (D. Colo. Feb. 27, 2012).

[b] Least Tracts 7 and 7A were combined (February 2011 time frame) into Lease Tract 7.

1 

2 **FIGURE 1.2-1 Locations of the 31 ULP Lease Tracts in Colorado**

- Establish the amount of reclamation performance bonding appropriate for the amount of environmental disturbance anticipated based on an evaluation of the lessees' proposed activities, including site-specific access routes, exploration drill-hole locations, mine-site support facility locations, and proposed methods of reclamation.

- Monitor lessees' exploration, mine-development, and ore-production activities to ensure compliance with Federal, state, and local environmental regulations and lease stipulations. Identify adverse conditions that need to be addressed and advise the lessees accordingly.

- Review exploration drill-hole logs, drill-hole maps, mine maps, and quarterly reports submitted by the lessees to assess the lessees' progress and verify conditions witnessed during field inspections.

- Review Federal and state mine safety inspection records and reports to identify significant violations or adverse trends and determine whether actions are warranted.

- Monitor and track market prices (spot and long term) for uranium oxide (U_3O_8) and vanadium oxide (V_2O_5) (uranium ore is generated as uranium oxide and vanadium ore is generated as vanadium oxide) and keep abreast of activities occurring within the world uranium and vanadium industries.

- Develop and maintain procedures to process and maintain records of ores produced from the DOE lease tracts and delivered to a mill or other receiving station for processing. Calculate the resulting royalties due and payable to DOE. Ensure that royalty payments are submitted in accordance with the lease agreements. Maintain records associated with the number of miles traveled by ore trucks on Federal, state, and county roadways. Ensure that lessees' pulp ore samples are analyzed in accordance with lease agreement requirements.

- Maintain a record of and provide for the routine surveillance of concurrent surface activities (e.g., activities associated with oil and gas leases and special use permits) that are authorized by other agencies with surface-management jurisdiction.

- Evaluate sample plants to verify that they or other facilities receiving lease tract ores have adequate procedures for weighing, sampling, and assaying said ores and for reporting the results to DOE.

- Monitor lessees' reclamation activities to ensure that they comply with Federal, state, and local environmental regulations and lease stipulations. Ensure that these activities are consistent with existing exploration and mining plans and standard industry practices. Monitor post-reclamation sites for 3 to

5 years to assure that adequate vegetation is successfully re-established at the site.

- Oversee the relinquishment of lease agreements when requested by a lessee or the termination of lease agreements for cause when directed by DOE.

- Determine the eligibility of inactive, reclaimed lease tracts for restoration to the public domain under BLM's management. Prepare a Request to Relinquish Lands and submit it to the BLM Colorado State Officer for processing. Help BLM officials review the Request, and monitor its status until the restoration process is complete.

1.2.2 Lease Requirements

Facsimiles of two generic leases currently utilized for the DOE ULP are shown in Appendix A. (The leases could be modified in the future as a result of this ULP PEIS process.) These two generic leases are the same except for how the royalty payment is determined. Before conducting any exploratory or mining activity, the lessee is required to file a "Notice of Intent to Conduct Prospecting Operations" or "Reclamation Permit Application" with the Colorado Mined Land Reclamation Board for the review and approval of the CDRMS. The lessee is then required to submit three copies of a detailed Exploration Plan or Mining Plan to DOE. This plan must include a site-specific environmental analysis and a description of measures to be taken to assure compliance with all Federal, state, and local laws (including all potential impacts that could result in downstream or off-site environmental and/or resource degradation, and air quality or health-related impacts). In addition, the lessee in coordination with DOE must consult with all pertinent Federal, state, and local agencies—including, but not limited to, the BLM, USFWS, U.S. Army Corps of Engineers (USACE), EPA, CPW, State Historic Preservation Office (SHPO), and Indian tribal governments—to determine the presence and/or location of all endangered, threatened, and sensitive plant and wildlife species; known cultural resources; and floodplain and wetland areas. Plans are reviewed by DOE in coordination with BLM and CDRMS, and upon DOE's approval, the actions described in the plan can commence. DOE and other appropriate agencies must be notified in writing if the lessee wishes to change part of the plan, and no change can take place until approval is given. After the plan is approved, but before any ground-disturbing activity can commence, the lessee must file a performance bond (the amount is established by DOE) in coordination with CDRMS. This coordination is reflected in the MOU between DOE and CDRMS (DOE and CDRMS 2012).

Upon termination of the lease, the lessee has 180 days to reclaim and return the land to DOE, unless other arrangements have been agreed to in advance. The lessee is required to remove all equipment, stockpiles, and evidence of mining, unless the improvement is a structural support needed to maintain the mine.

1.3 SITE-SPECIFIC INFORMATION FOR THE ULP LEASE TRACTS

Information about the 31 lease tracts is presented in Table 1.2-1 (and Figure 1.2-1). Eight of these lease tracts (5, 6, 7, 8, 9, 11, 13, and 18) contain one or more existing mines that operated in the past under DOE's approval and are currently permitted by CDRMS. Please note that three additional lease tracts (13A, 21, and 25) have existing mine sites that have been fully reclaimed in accordance with existing environmental regulations and DOE lease stipulations; however, these mine sites currently remain permitted by CDRMS. Finally, Table 1.3-1 lists the estimated ore reserve that remains at each of the 31 lease tracts.

Site-specific information used as a basis for the ULP PEIS evaluation included mine permit amendment applications for existing mines on Lease Tracts 6, 8, 9,11, 13A, 18, 21, and 25 (Cotter Corp. 2011, 2012a–g). These documents contain site-specific information on climate, soils, and wildlife; wildlife mitigation measures; chemical evaluations; maps; monitoring data; stormwater management plans; environmental protection plans (EPPs); reclamation plans; emergency response plans; and geotechnical stability reports. CDRMS inspection reports were also reviewed for the ULP PEIS evaluation. The inspection reports include information on the conditions and characteristics of the mine sites. For example, inspection reports for several mines located within Lease Tract 13 contain information on observations for contaminants and noxious weeds, the presence and condition of mine facilities and stockpiles, potential erosion and stormwater runoff concerns, and so forth (CDRMS 2012a–c).

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). 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). These plans described reclamation work conducted in lieu of payment of royalties (or RILORs) and included work on mining-related features, such as open drill holes and vents, land subsidence features, and abandoned mine portals and adits.

1.3.1 ULP Lease Tract 5

On Lease Tract 5, the C-JD-5 mine is located in Sections 21 and 22, T 46 N, R 17 W, NMPM, in Montrose County, Colorado (see Figure 1.3-1). The original lease was executed effective June 12, 1974. A royalty bid of 12.00%, payable on ores containing 700,000 lb (318,000 kg) of U_3O_8, secured the lease.

A mining plan was submitted on June 10, 1976, proposing entry by a shaft 16-ft (4.9-m) in diameter and 320-ft (98-m) deep located in the northwest corner of the property. The lessee

TABLE 1.3-1 Estimated Remaining Ore Reserve at the ULP Lease Tracts

ULP Lease Tract	Remaining Ore Reserves[a] (lb U_3O_8)
5	230,000
5A	30,000
6	850,000
7	2,800,000
8	330,000
8A	30,000
9	630,000
10[b]	0
11	740,000
11A	300,000
12	160,000
13	330,000
13A	220,000
14	85,000
15	84,000
15A	250,000
16	44,000
16A	18,000
17	75,000
18	1,200,000
19[b]	0
19A	1,500,000
20	800,000
21	1,000,000
22	140,000
22A[b]	0
23	550,000
24	90,000
25	540,000
26	68,000
27	87,000
Total remaining ore reserves	13,000,000

[a] Amount shown equals the lease "bid quantity" minus the total production to date. Values have been rounded to two significant figures.

[b] The lease "bid quantity" has been produced from this tract; any additional reserves that may exist have not been quantified.

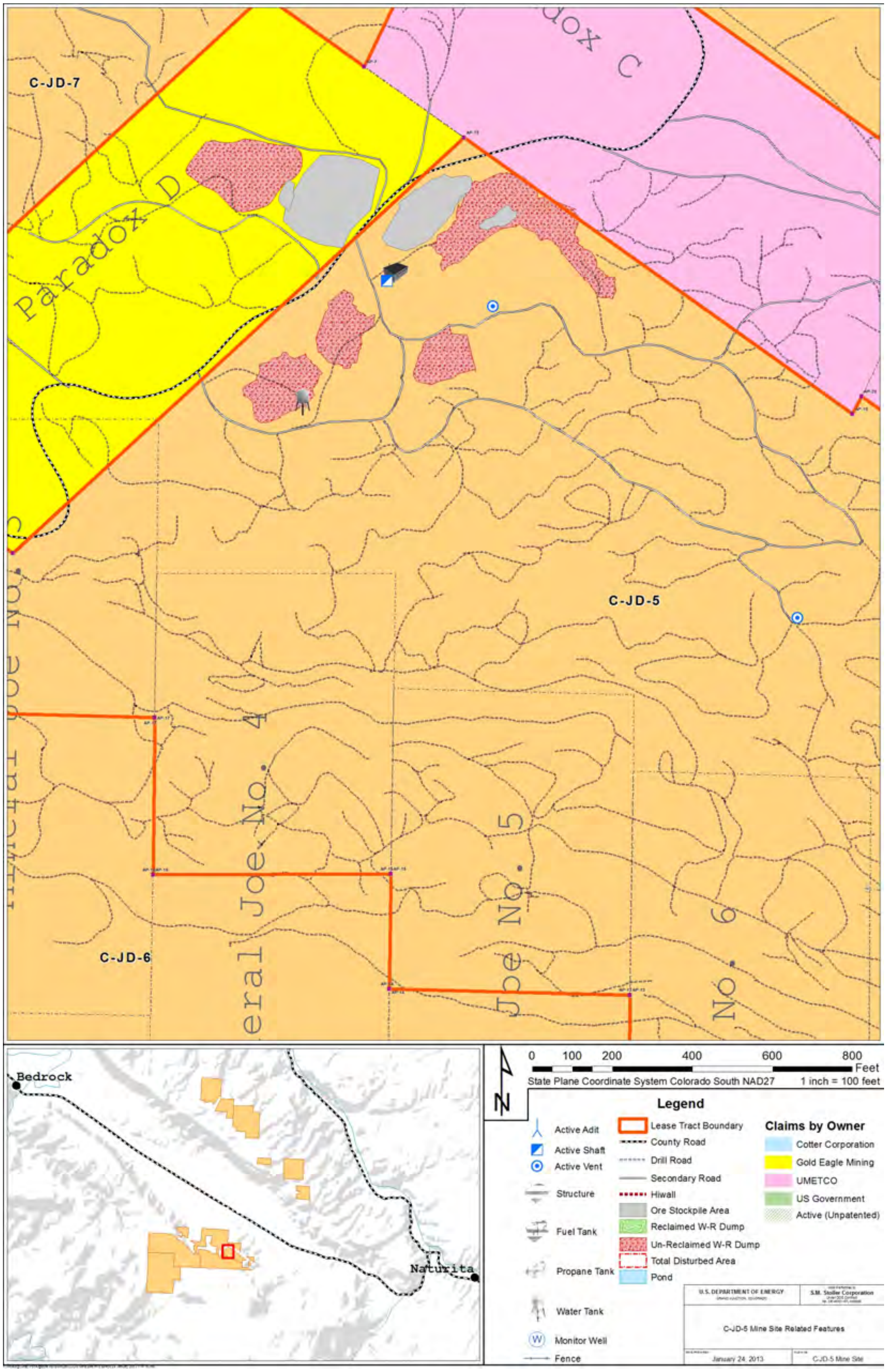


FIGURE 1.3-1 Location of C-JD-5 Mine on Lease Tract 5

began sinking the shaft shortly after the plan was approved, and the shaft was bottomed in early April 1977. The ore zone was encountered almost immediately, and the initial shipment of ore was made on May 26, 1977. As mining continued, a second level was developed that ultimately yielded the bulk of the mine's production. The mine was extended to the west and south and connected with the old Paradox D and Mineral Joe No. 4 mines, respectively; during this time, the mine maintained consistent ore production at approximately 3,000 tons (2,700 metric tons) per month. The mine was shut down in early 1980 due to a lack of economical ore reserves.

Mining resumed briefly in 1989 (as the mine's economics improved), and production continued through June 1990. In March 1998, Gold Eagle Mining, Inc. (GEMI), notified DOE of its intensions to resume operations at the mine. Subsequent to DOE's approval, GEMI upgraded the mine's entire infrastructure to current standards and code. Unfortunately, GEMI could not secure a milling agreement, and no ore production occurred. At that time, the mine was placed on standby status.

A total of 136,000 tons (123,000 metric tons) of ore, containing 466,000 lb (211,000 kg) of U_3O_8 and 1,812,000 lb (822,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $2,154,000.

1.3.2 ULP Lease Tract 5A

On Lease Tract 5A, the C-JD-5A mine is located in Section 22, T 46 N, R 17 W, WM, in Montrose County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 15.82% payable on ores containing 30,000 lb (14,000 kg) of U_3O_8 secured the lease.

During September two exploration plans were submitted, one for each tract of the unit, proposing 86 and 106 holes, respectively. Both plans were approved, and a total of 56 holes were drilled; 36 holes showed some mineralization. These areas were reclaimed during June 1980.

There have been no mining plans submitted for this lease tract, and consequently, no ore has been produced. Annual royalties paid for this lease tract total $24,700.

1.3.3 ULP Lease Tract 6

On Lease Tract 6, the C-JD-6 mine is located in Sections 21 and 22, T 46 N, R 17 W, NMPM, in Montrose County, Colorado (see Figure 1.3-2). The original lease was executed effective April 18, 1974. A royalty bid of 14.20% payable on ores containing 1,200,000 lb (544,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in September 1975 proposing access through the Duggan Adit, which is located on adjacent, privately held, unpatented claims. The plan was approved, and development work began the following April (1976). The first ore shipment from the mine was made on May 12, 1976; however, the true production cycle did not begin until August 1977.

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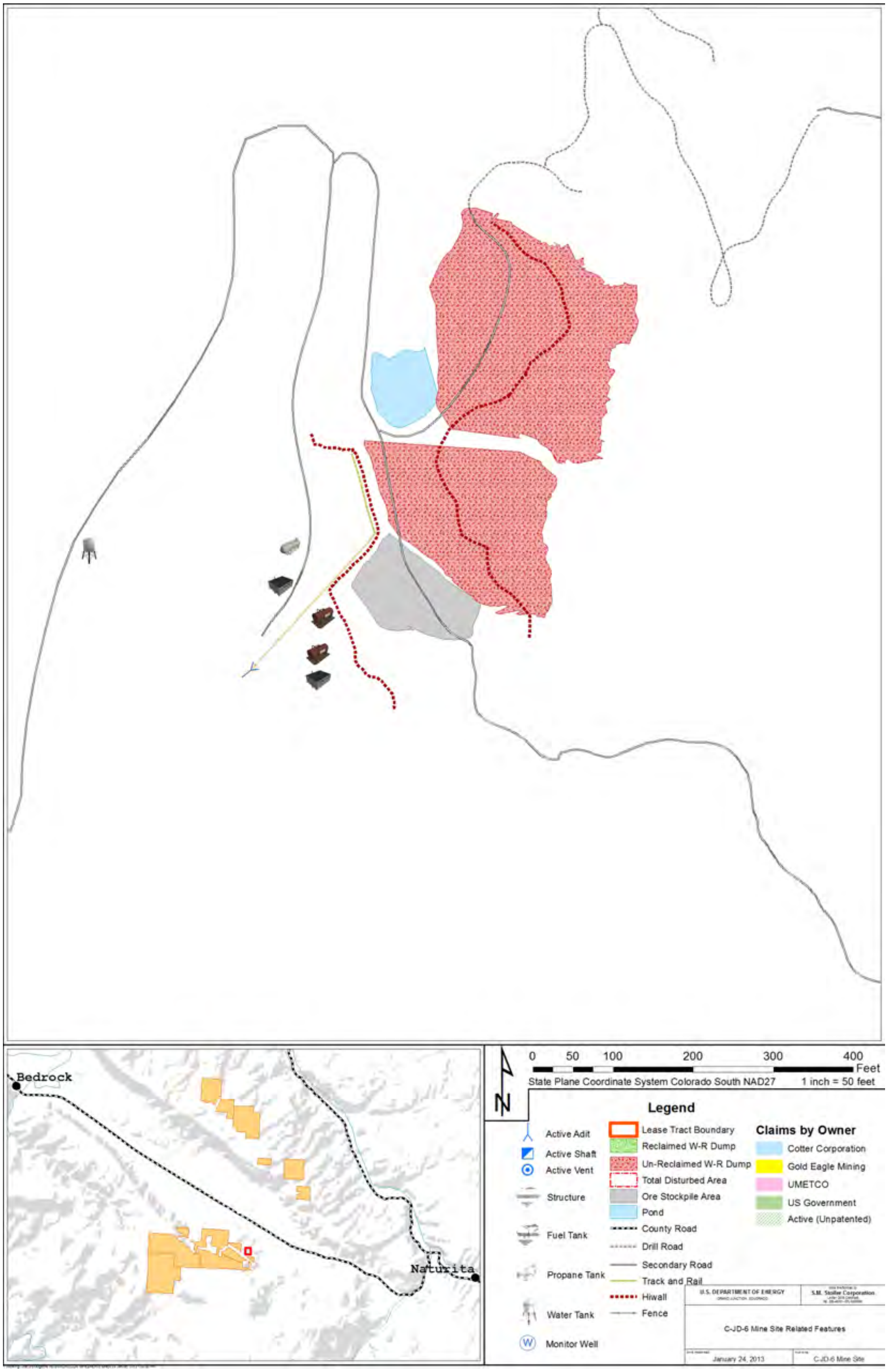

2 **FIGURE 1.3-2 Location of C-JD-6 Mine on Lease Tract 6**

Mining continued much the same way until May 1980, at which time Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980.

In May 2004, the lessee, Cotter Corporation, notified DOE of its intentions to resume operations at the mine. Subsequent to DOE's approval and following several weeks of site preparation, Cotter Corporation resumed mining activities on August 2, 2004. Production and/or ore shipments from the mine continued into 2006. In 2008, Cotter Corporation installed a lysimeter downgradient of the mine site to determine whether near-surface soils or rock formations contain moisture that could affect (or be affected by) the mine site. The lysimeter is monitored monthly.

A total of 107,000 tons (97,000 metric tons) of ore, containing 350,000 lb (159,000 kg) of U_3O_8 and 2,248,000 lb (1,020,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $2,946,000.

1.3.4 ULP Lease Tract 7

On Lease Tract 7, the C-JD-7 mine is located in Sections 16, 20, 21, and 22, T 46 N, R 17 W, NMPM, in Montrose County, Colorado (see Figure 1.3-3). The original lease was executed effective April 18, 1974. A royalty bid of 27.30% payable on ores containing 2,800,000 lb (1,270,000 kg) of U_3O_8 secured the lease.

An underground mining plan was submitted in November 1976 proposing entry through a 1,600-ft (490-m) decline in the northern portion of the tract. The plan was approved, and development work was initiated the following May. Following numerous delays, including the encountering of sugar sands, which require continuous support, the incline was finally bottomed in December 1978. Water was then encountered in the drift, and two evaporation ponds were constructed to support dewatering activities. The first ore was shipped in July 1979, and production continued through May 1980, at which time Cotter Corporation announced a temporary shutdown of underground mining operations effective May 22, 1980. In June 1980, the water treatment system was redesigned (another pond was built) to bring the mine-water treatment system into compliance with the existing National Pollutant Discharge Elimination System (NPDES) permit. In June 2005, Cotter Corporation notified DOE of its intentions to resume operations at the mine. Subsequent to DOE's approval, Cotter Corporation began rehabilitating the underground mine workings to support future production activities. This work continued through November 2005.

During May 1979, Cotter Corporation submitted an open-pit mining plan for the property that would require the removal of 13 million tons (12 million metric tons) of overburden and affect some 650 acres (260 ha). The plan was approved in November, and Cotter Corporation entertained bids on two separate contracts. The first contract was for the removal of the vegetation; that work was initiated in January 1980. The second contract was for Phase 1 of stripping the overburden, which began in April 1980. Phase 1 activities included utilizing the northern portion of Lease Tract 7A (also a Cotter Corporation lease tract) for the spoils pile. Stripping activities continued at a rate of 1,000,000 yd^3 (765,000 m^3) per month for 13 months,

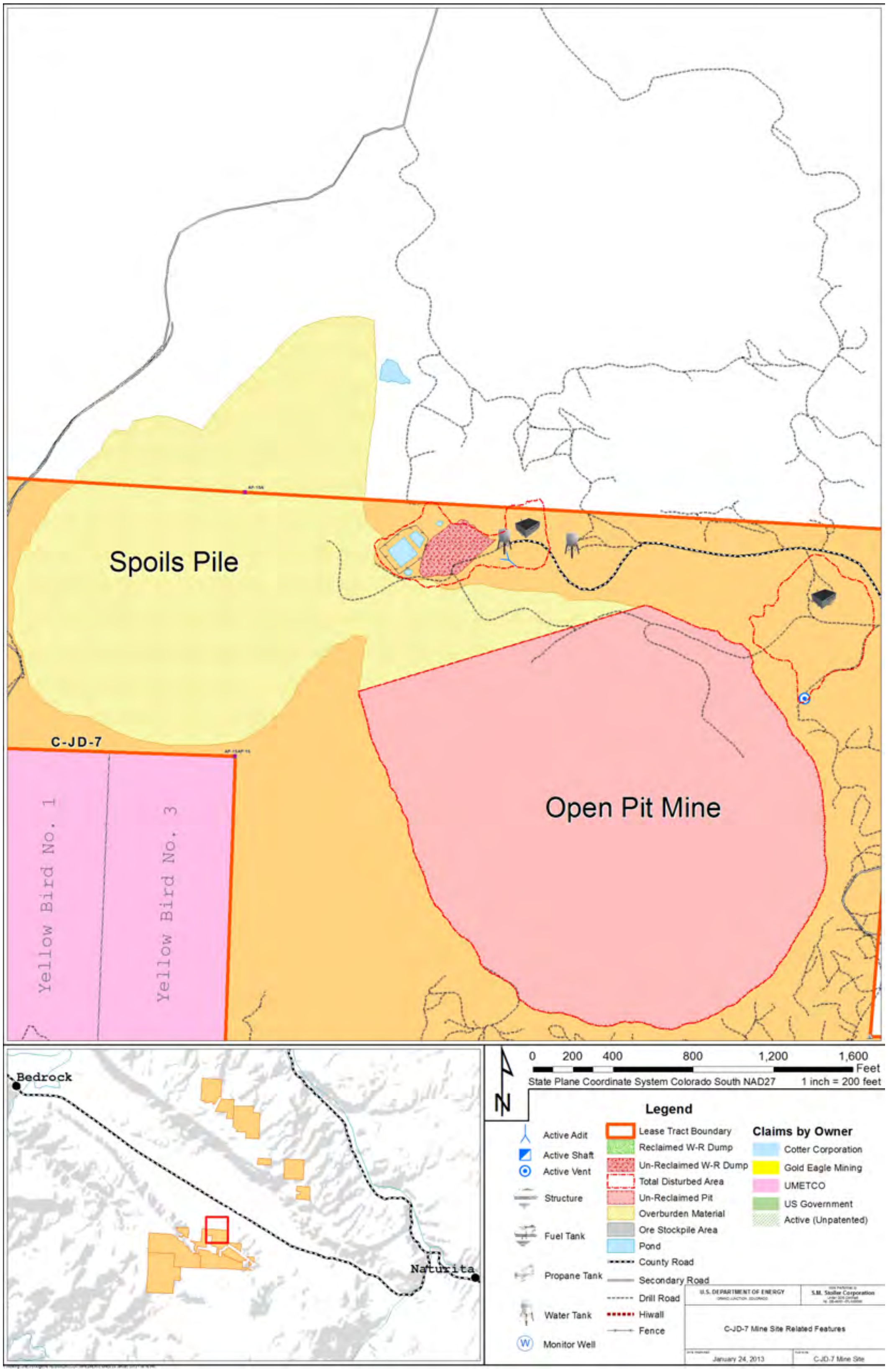

FIGURE 1.3-3 Location of C-JD-7 Mine on Lease Tract 7

until March 31, 1981, at which time the mine was placed on standby status due to declining market conditions. Mining activities subsequently resumed at the mine, which included in-pit development drilling from 1991 through 1993 and from 1996 through 2004 and other activities through the third quarter of 2011. Once in production, the operation was expected to produce 500 tons (450 metric tons) of ore per day, averaging 0.30% U_3O_8.

On February 16, 2011, DOE executed a modification to the lease that incorporated Lease Tract 7A into 7, recognizing that the two lease tracts were inseparable due to the open-pit mining operation.

A total of 12,000 tons (11,000 metric tons) of ore, containing 46,000 lb (21,000 kg) of U_3O_8 and 125,000 lb (57,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $1,442,000.

1.3.5 ULP Lease Tract 8

On Lease Tract 8, the C-JD-8 mine is located in Sections 17, 18, 19, and 20, T 46 N, R 17 W, NMPM, in Montrose County, Colorado (see Figure 1.3-4). The original lease was executed effective April 18, 1974. A royalty bid of 36.20% payable on ores containing 375,000 lb (170,000 kg) of U_3O_8 secured the lease.

In January 1984, a mining plan was submitted proposing access through the Opera Box Adit, which is located on an adjacent, privately held, patented claim. This plan was approved on November 18, 1985; however, it was never acted upon. A revised mining plan, updated to meet current requirements, was submitted in December 2004 and was approved January 21, 2005. Cotter Corporation enlarged the existing Opera Box portal and the main haulage drift to accommodate larger, more modern equipment. The first ore shipment was made in June 2005, and production and/or ore shipments continued into 2006. In 2008, Cotter Corporation installed a lysimeter downgradient of the mine site to determine whether near-surface soils or rock formations contain moisture that could affect (or be affected by) the mine site. The lysimeter is monitored monthly.

A total of 9,000 tons (8,000 metric tons) of ore, containing 46,000 lb (21,000 kg) of U_3O_8 and 178,000 lb (81,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $1,264,000.

1.3.6 ULP Lease Tract 8A

On Lease Tract 8A, the C-JD-8A mine is located in Section 17, T 46 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 26.22% payable on ores containing 30,000 lb (14,000 kg) of U_3O_8 secured the lease.

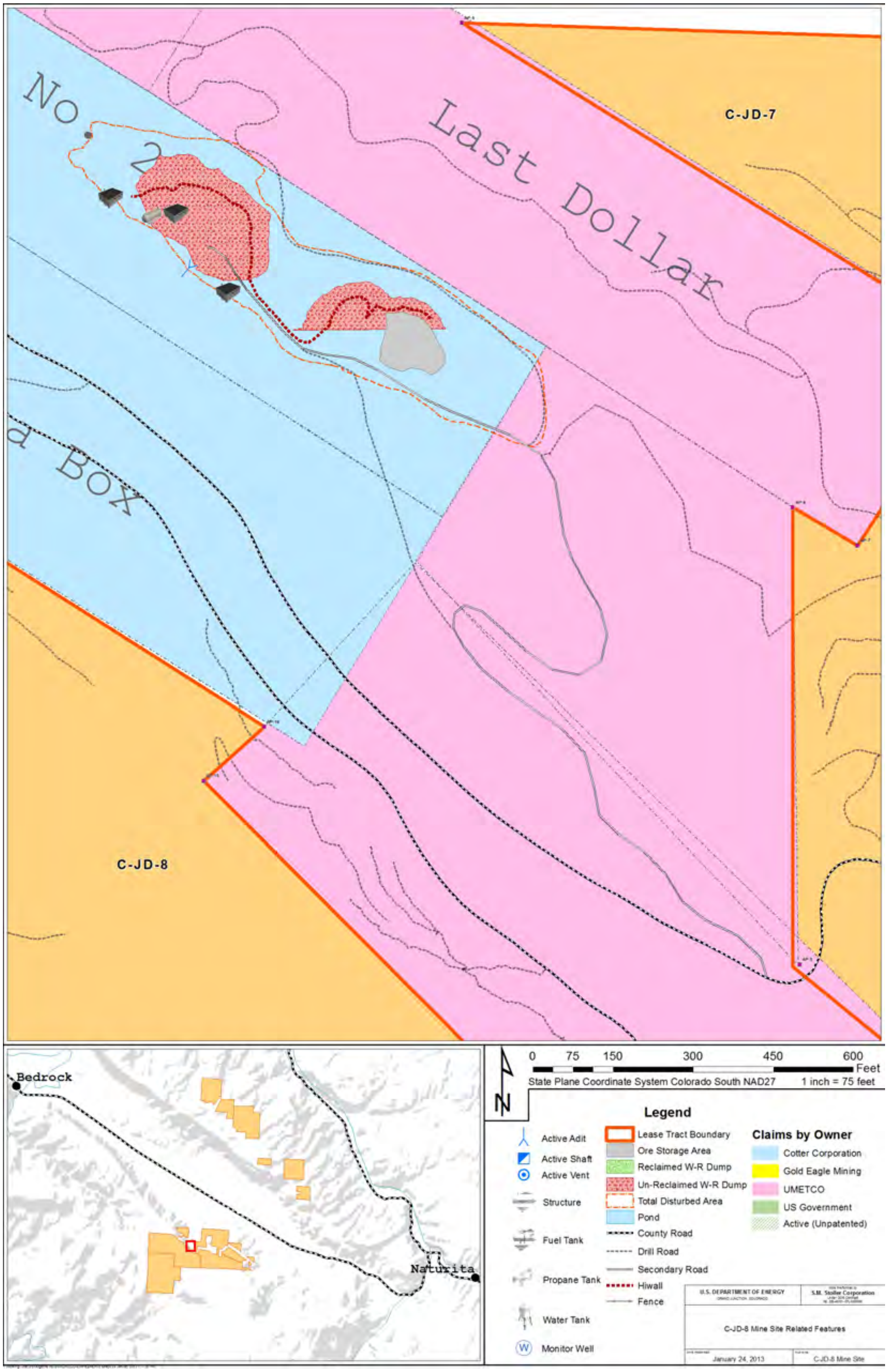

FIGURE 1.3-4 Location of C-JD-8 Mine on Lease Tract 8

In March 2008, DOE initiated a competitive bid process for the inactive tracts. This lease tract was put out to bid; however, there was no interest. Accordingly, this tract remains inactive indefinitely, and consequently, no ore has been produced.

1.3.7 ULP Lease Tract 9

On Lease Tract 9, the C-JD-9 mine is located in Sections 19, 29, and 30, T 46 N, R 17 W, NMPM, in Montrose County, Colorado (see Figure 1.3-5). The original lease was executed effective April 18, 1974. A royalty bid of 24.30% payable on ores containing 850,000 lb (386,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in February 1977 proposing entry through a 1700-ft (520-m) incline of –17.5% in the south-central portion of the tract. The plan was approved, and development work began in May. Numerous delays were encountered while sinking the decline; however, it was finally bottomed in March 1978, and development drift work continued toward different ore bodies. Water was soon encountered, and two evaporation ponds were constructed to support dewatering activities. Some ore was encountered in August 1978, and the initial ore shipment was made. The ore production rate soon increased, and ore shipments were made on a regular basis until May 1980, at which time Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980.

On April 28, 1998, Cotter Corporation submitted a plan to construct two new mine-water treatment ponds and decommission the existing pond system on top of Monogram Mesa. Construction of the ponds was completed, but the ponds were never lined or put into service, and the existing pond system was never decommissioned.

In March 2003, Cotter Corporation advised DOE of its plans to resume mining operations at the site. Following several weeks of site preparation, Cotter Corporation resumed production activities at the mine. The mine continued to produce and/or ship ore into 2006. In 2008, Cotter Corporation installed a lysimeter downgradient of the mine site to determine whether near-surface soils or rock formations contain moisture that could affect (or be affected by) the mine site. In addition, in December 2006, DOE approved the installation of a groundwater monitoring well downgradient of the mine site. The lysimeter and monitoring well are monitored and sampled monthly. In October 2008, Cotter Corporation notified DOE of a rockfall that had occurred at the mine, approximately 100 ft (30 m) down the main haulage drift from the portal. In discussions between DOE and Cotter Corporation, Cotter Corporation concluded that it would assess the situation and options.

A total of 55,000 tons (50,000 metric tons) of ore, containing 223,000 lb (101,000 kg) of U_3O_8 and 1,112,000 lb (504,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $2,586,000.

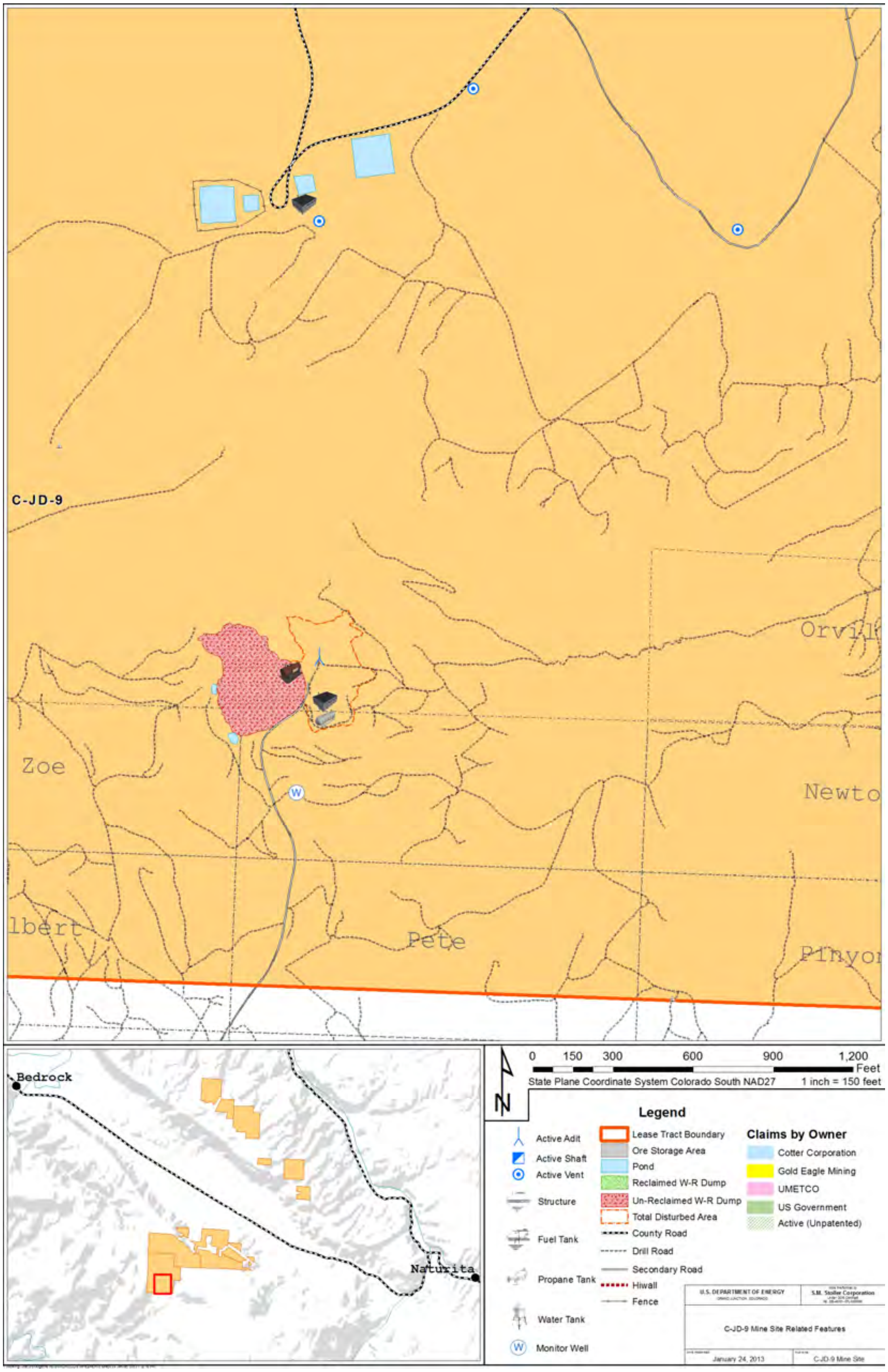

FIGURE 1.3-5 Location of C-JD-9 Mine on Lease Tract 9

1.3.8 ULP Lease Tract 10

On Lease Tract 10, the C-SR-10 mine is located in Sections 28 and 29, T 43 N, R 19 W, WM, San Miguel County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 21.76% payable on ores containing 110,000 lb (50,000 kg) of U_3O_8 secured the lease.

The first mining plan was submitted in January 1975 proposing entry through the Summit No. 21 incline controlled by Atlas. The plan was approved, and Russell Henderson mined continuously through November 1975. Then Charles W. Martin took over the operation and continued to mine through August 1976. The first ore was shipped from this operation to the Atlas mill in Moab, Utah, on May 1, 1975.

Energy Fuels Nuclear, Inc., submitted a mining plan during February 1979 proposing access through the Sam incline. This plan was approved, and development began in April and continued into June, when some unexpected ore was encountered and 400 tons were stockpiled for later shipment. The initial shipment of ore from this operation to the Energy Fuels mill near Blanding, Utah, was made during the summer of 1979, and production continued through October 1980, at which time the operation became uneconomical and was shut down. Mining resumed in January 1982 and continued throughout the year. Ore was stockpiled on the site until early December, when ore shipments resumed to the Blanding mill. Ore shipments continued through February 1983, at which time the 110,000th pound of U_3O_8 was shipped, thereby surpassing the bid quantity and making C-SR-10 the fourth lease tract to produce the bid pounds. In 2000, DOE acknowledged its satisfaction with the reclamation activities. The Colorado Division of Minerals and Geology (now known as the Colorado Division of Reclamation, Mining, and Safety or CDRMS), inspected the site and determined that Energy Fuels Nuclear, Inc., had met its obligations under Permit No. M–1979–027 and released it from further responsibility.

A total of 67,000 tons (61,000 metric tons) of ore, containing 273,000 lb (124,000 kg) of U_3O_8 and 2,324,000 lb (1,054,000 kg) of V_2O_5 had been produced and sold from the lease tract mines. Royalties paid for this lease tract (production royalties plus annual royalties) total $1,720,000.

1.3.9 ULP Lease Tract 11

On Lease Tract 11, the C-SR-11 mine is located in Sections 8, 17, and 18, T 43 N, R 19 W, NMPM, in San Miguel County, Colorado (see Figure 1.3-6). The original lease was executed effective June 12, 1974. A royalty bid of 11.67% payable on ores containing 900,000 lb (408,000 kg) of U_3O_8 secured the lease.

A number of different mining plans were submitted and approved for the lease tract, proposing re-entry into existing mines and resumption of mining activities through existing mine workings. However, only two operations have any significant bearing: the Brighton and Ike mines. The Brighton mine, located along the rim of Summit Canyon, was in production from

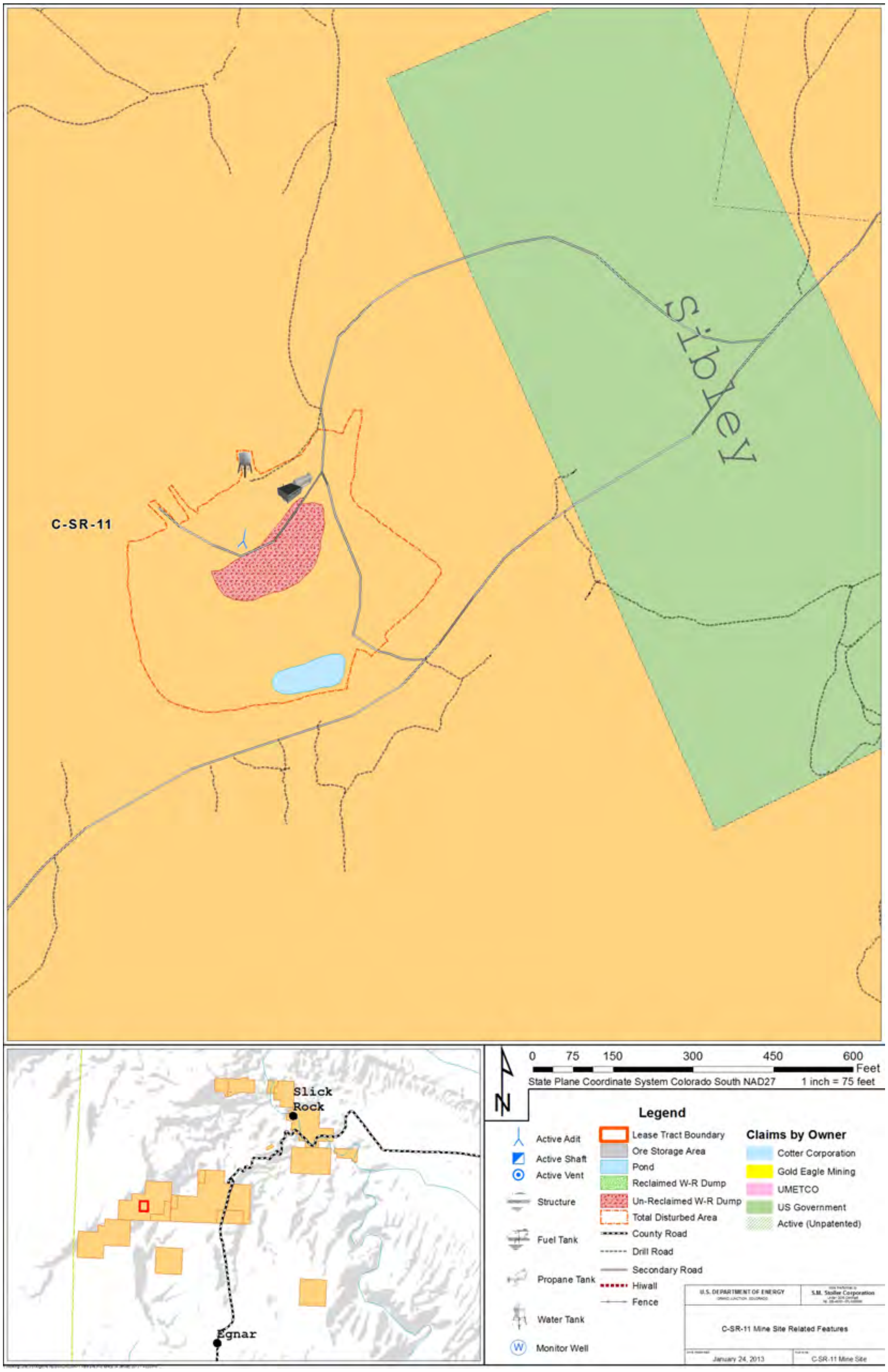

FIGURE 1.3-6 Location of C-SR-11 Mine on Lease Tract 11

December 1975 through April 1977. The Ike mine complex, mined through the Dawson incline, was in production from August 1975 through mid-December 1980. This operation included some initial work in the existing Ike No. 2 mine, in addition to development of and production from a nearby incline on the Radium No. 8 claim adjacent to the lease tract along the northeast corner. In December 1980, mining activities on the lease tract were suspended and the mines were placed on standby status. In 1999, Cotter Corporation initiated reclamation activities at the Brighton and Ike mines, as well as on legacy mine sites located on the lease tract. The mine portals and ventilation shafts were permanently sealed and closed; the mine waste-rock dumps were recontoured to blend in with the surrounding natural topography; and the disturbed areas were reseeded. These activities were completed in the fall of 2000.

In February 2005, Cotter Corporation proposed a new mine for the lease tract located in the south-central portion of the property. Entry was to be gained from a 1,300-ft (400-m) decline, and DOE approved the plan in June 2005. Mine development work began almost immediately and continued through November 2005. At that time, the decline had been advanced approximately 300 ft (90 m).

A total of 47,000 tons (43,000 metric tons) of ore, containing 162,000 lb (73,000 kg) of U_3O_8 and 925,000 lb (420,000 kg) of V_2O_5, have been produced and sold from the lease tract mines. Royalties paid for this lease tract (production royalties plus annual royalties) total $1,200,000.

1.3.10 ULP Lease Tract 11A

On Lease Tract 11A, the C-SR-11A mine is located in Section 19, T 43 N, R 19 W and Sections 23, 24, 25 and 26, T 46 N, R 20 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective July 23, 1974. A bid royalty of 36.20% payable on ores containing 300,000 lb (136,000 kg) of U_3O_8 secured the lease.

The initial exploration plan was submitted in October 1977 proposing a total of 68 holes to be drilled. A supplemental plan followed in August 1979 proposing 41 additional holes. Both plans were approved, and at least 87 holes were drilled during the program; only six holes showed any mineralization. Reclamation of drill sites has been completed.

There have been no mining plans submitted for this lease tract, and consequently, no ore has been produced. Annual royalties paid for this lease tract total $70,600.

1.3.11 ULP Lease Tract 12

On Lease Tract 12, the C-SR-12 mine is located in Section 32, T 43 N, R 18 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 11.74% payable on ores containing 180,000 lb (82,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in June 1976 proposing entry through an 1,170-ft (360-m) decline at 8% grade, located in the north-central portion of the tract. The plan was approved, and development began in October 1976. The incline was bottomed in ore in early August 1977, and the initial shipment of ore (93 tons [42 metric tons] at 0.18% U_3O_8) was made on August 30, 1977. Production continued through November 1979. Operations were ended on December 3, 1979. Reclamation of the SR-12 Mine was undertaken and was satisfactorily completed by May 29, 1986.

A total of 7,000 tons (6,000 metric tons) of ore, containing 24,000 lb (11,000 kg) of U_3O_8 and 233,000 lb (106,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $191,000.

1.3.12 ULP Lease Tract 13

On Lease Tract 13, the C-SR-13 mine is located in Sections 29, 30, 31, 32, and 33, T 44 N, R 18 W, NMPM, in San Miguel County, Colorado (see Figure 1.3-7). The original lease was executed effective May 24, 1974. A royalty bid of 20.60% payable on ores containing 700,000 lb (318,000 kg) of U_3O_8 secured the lease.

The initial mining plan submitted in January 1975 proposed entry through the Burro Tunnel Mine. The mine portal and a portion of the main haulage drift are located on the lease tract but provide access to the Burro Mine complex, which is located immediately north of the lease tract on the privately held unpatented Burro claims. The plan was approved, and production began from an area along the northern boundary of the lease tract in an area of the Burro Mine complex where ore was showing in the heading. Production continued from there and extended southward toward the Ellison Mine. The initial shipment of ore was made in June 1975, and production continued through 1981, at which time the mine was placed on standby status. A second mining plan (the new Ellison Mine) was submitted in November 1978 proposing entry through a new decline into the area northeast of the existing Ellison Mine, with which it would connect for ventilation. The plan was approved, and development began in May 1979. The incline was bottomed in August 1980, and development continued through December of that year. Although ore is showing in several headings, the operation was limited to development, and no ore was produced. In March 1981, the mine was expanded to connect with the existing Ellison Mine, establishing a ventilation pathway and a secondary escapeway. Shortly afterward, operations ceased, and this mine was also placed on standby status. Other operations were conducted sporadically during this time and included mines such as Hawkeye and Herbert. However, ore shipments from these operations were small and relatively insignificant when compared with those from the operation at the Burro Mine complex. These smaller mine sites have since been reclaimed. The mine portals were gated to conserve bat habitat, or they were permanently sealed and closed; the mine-waste-rock dumps were recontoured to blend in with the surrounding, natural topography; and the disturbed areas were reseeded.

A total of 86,000 tons (78,000 metric tons) of ore, containing 323,000 lb (147,000 kg) of U_3O_8 and 2,766,000 lb (1,255,000 kg) of V_2O_5, have been produced and sold from the lease

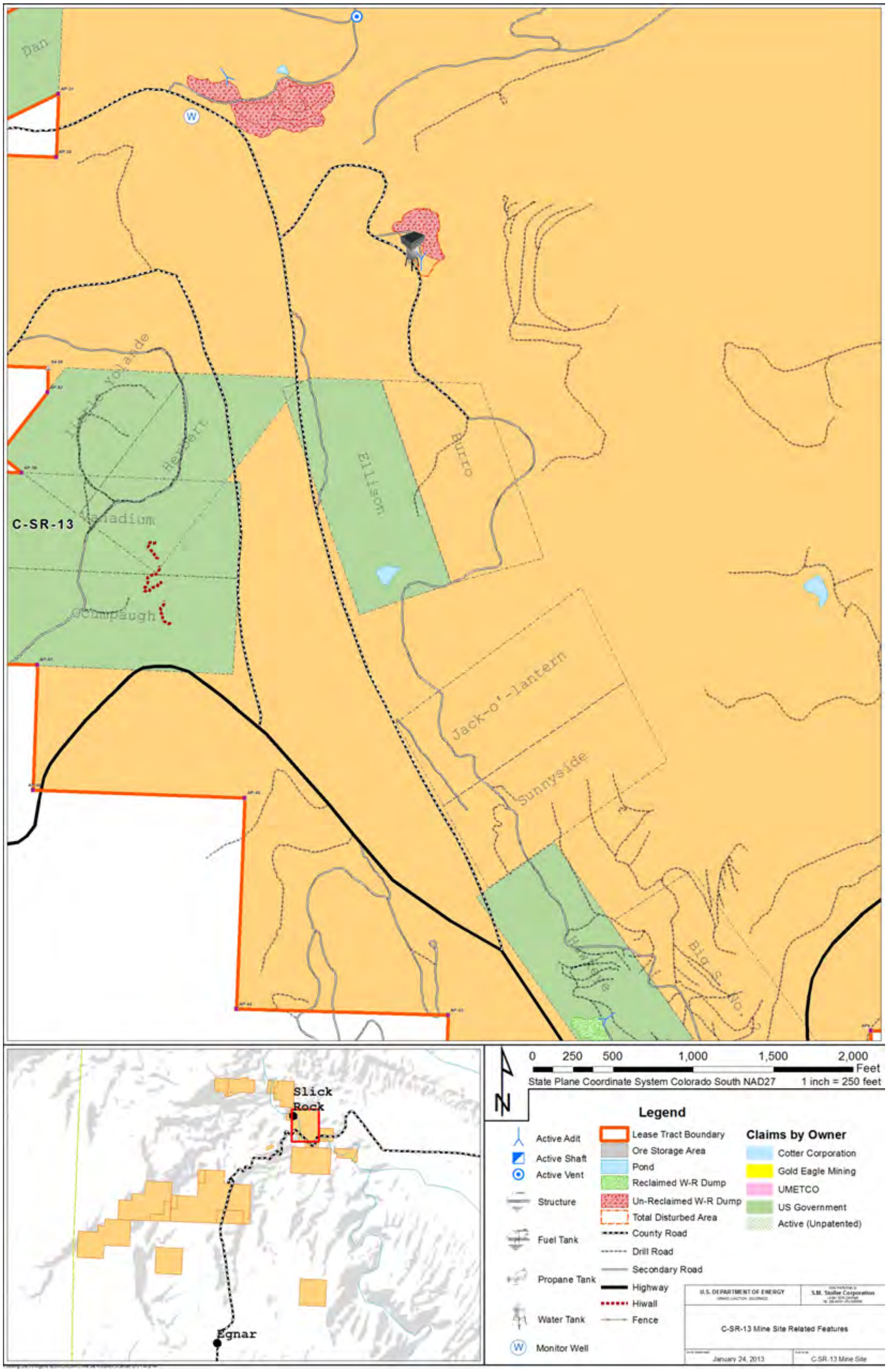

FIGURE 1.3-7 Location of C-SR-13 Mine on Lease Tract 13

tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $4,047,000.

1.3.13 ULP Lease Tract 13A

On Lease Tract 13A, the C-SR-13A mine is located in Sections 19 and 30, T 44 N, R 18 W and Sections 24 and 25, T 44 N, R 19 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective July 23, 1974. This tract differs from other DOE lease tracts in that a portion of the tract is patented land with surface rights held by other interests. A royalty bid of 36.20% payable on ores containing 350,000 lb (159,000 kg) of U_3O_8 secured the lease.

Early in 1975, Cotter Corporation submitted a tentative evaluation plan in which it proposed to revamp a portion of the Veta Mad Mine. This plan was approved, and Blake Mining Company (mining contractor for Cotter Corporation) began work in May. By November, the main haulage was widened and brought to a constant slope, and mining was ready to begin. The initial mining plan was submitted in April 1976 proposing entry through the Veta Mad Mine. The plan was approved; development work began in May and continued through December, during which time all ore encountered was stockpiled until the initial shipment of ore; the shipment was made to the Cotter Mill at Canon City, Colorado, on December 15, 1976. Production continued until May 1980, when Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980. The mine was reclaimed in 2003, and bat gates were installed in the Georgetto and Veta Mad portals.

In 2008, in accordance with Colorado law, CDRMS reclassified all uranium mines within the state as designated mining operations, requiring the submittal of an environmental protection plan (EPP) and a much more rigorous environmental review. Cotter Corporation has submitted its EPP to CDRMS.

A total of 38,000 tons (34,000 metric tons) of ore, containing 129,000 lb (59,000 kg) of U_3O_8 and 744,000 lb (337,000 kg) of V_2O_5, had been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) totaled $2,010,000.

1.3.14 ULP Lease Tract 14

On Lease Tract 14, the C-SR-14 mine is located in Sections 5 and 6, T 43 N, R 18 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective June 12, 1974. That portion of Tract 14 located in Section 4, T 43 N, R 18 W, NMPM (Tract 2), was not leased in 1974 (and has not been leased since) due to its proximity to the Dolores River corridor. A royalty bid of 26.00% payable on ores containing 55,000 lb (25,000 kg) of U_3O_8 secured the lease.

The preliminary exploration plan was submitted in October 1977. The plan was approved, and some 140 holes were drilled. Reclamation of drill sites has been completed.

There has been no mining conducted on this lease tract, and no ore has been produced. Annual royalties paid for this lease tract total $26,000.

1.3.15 ULP Lease Tract 15

On Lease Tract 15, the C-SR-15 mine is located in Sections 23 and 26, T 44 N, R 19 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 18.60% payable on ores containing 100,000 lb (45,000 kg) of U_3O_8 secured the lease.

A mining plan submitted in October 1975 proposed to screen any remaining ore from the waste dumps around the Cougar mining area. The plan also proposed that existing mines be reopened for examination and evaluation. A second mining plan was submitted in April 1976 proposing to mine through existing portals. Both plans were approved; however, it was not until August 1976 that operations started on the Alice claim and the initial shipment of ore was made to the Union Carbide mill at Uravan, Colorado. In September, a second operation located in the Cougar mining area went into production. Both mines operated until May 1977; they produced some 2,450 tons (2,200 metric tons) of ore for shipment to Uravan, including 240 tons (220 metric tons) of material screened from the dumps.

Activity resumed in August 1979 when two contract miners began mining again on the Alice claim. Production continued through April 1980, involving shipments from first one mine and then another as ore reserves were depleted from the different workings. Efforts to locate further reserves failed, and in April 1980, the mines were shut down. DOE approved reclamation activities which were completed in June 2001.

A total of 4,600 tons (4,200 metric tons) of ore, containing 16,000 lb (7,000 kg) of U_3O_8 and 93,000 lb (42,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid to date for this lease tract (production royalties plus annual royalties) total $183,000.

1.3.16 ULP Lease Tract 15A

On Lease Tract 15A, the C-SR-15A mine is located in Sections 17 and 22, T 44 N, R 19 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 23.00% payable on ores containing 275,000 lb (125,000 kg) of U_3O_8 secured the lease.

During September 1975, Walter Buchanan submitted the initial mining plan proposing entry through an incline just north of Angle Points 13 and 14. The plan was approved, with development work beginning in November and continuing until March 1976. A second mining plan was submitted by Buchanan in December 1976 proposing another incline located near the center of the Mildred F. claim. The plan was approved; however, only a small amount of disturbance occurred before operations ceased for a second time.

Early in 1979, Union Carbide Corporation (UCC) gave notice of its intent to repair and mine from the 1975 incline, and work began in April. It also submitted a revised plan for the 1976 incline, which abandoned the initial site in lieu of a site located on DOE Lease Tract C-SR-15, which adjoins the property on the east. The revised plan was approved, and development began in June. The abandoned site was reclaimed.

The initial shipment of ore was made in September 1979 when 368 tons was shipped to the UCC mill at Uravan, Colorado. Production from this incline continued through most of 1980, during which time the 1975 incline connected with the old DeLuxe workings and then the two inclines were also connected. Mining at the DeLuxe Mine (1975 incline, 1976/1979 incline, and the Old DeLuxe Mine) was terminated during December 1980 as uranium prices dropped. On September 1, 1993, Umetco Minerals Corporation (successor to UCC) began reclaiming lands disturbed by permitted mining operations on this lease tract. Reclamation consisted of backfilling the DeLuxe shaft by removing the collar and backfilling the opening with available waste-rock materials. The incline on the Mildred F. Claim and the 1975 incline portals were backfilled 25 ft (8 m) with available waste-rock material. The dumps were recontoured and seeded. All reclamation on this tract was completed on October 6, 1993.

A total of 8,800 tons (8,000 metric tons) of ore, containing 28,000 lb (13,000 kg) of U_3O_8 and 156,000 lb (71,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $351,000.

1.3.17 ULP Lease Tract 16

On Lease Tract 16, the C-SR-16 mine is located in Sections 10, 15 and 16, T 43 N, R 19 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 23.60% payable on ores containing 70,000 lb (32,000 kg) of U_3O_8 secured the lease.

The initial mining plan was submitted by Willis R. Kelly, DBA Skyline Mining Company (mining contractor for the lessee), in October 1976, proposing entry through an incline near the southwest corner of the Ann No. 1 claim. The plan was approved, and development began later that month. Production began in December and continued through the fall of 1977, at which time the mine was shut down for lack of ore.

A second mining plan was submitted in June 1977 proposing entry through an adit along the rim of Summit Canyon on the Nucles claim. This plan was approved, and C.L. Starks (contractor for the lessee) began development work immediately. Production began in August and continued sporadically through May 1979, at which time Anschutz chose to cease operations.

A third plan was submitted in October 1977 proposing entry through an incline near the southwest corner of the Easton B claim. This plan was approved, and Sickles and Farmer (contractors for the lessee) began development work in December. Production started in January 1978 and continued into 1979, when the mine was closed down for lack of ore.

A fourth plan was submitted in July 1979 proposing to reopen and mine from the old Michael Bray workings. This plan was approved, and the mine was reopened in August. Production began almost immediately and continued through February 1979, when the miners were moved to the Sheila Mine on DOE Lease Tract C-SR-12.

The fifth plan was also submitted in July 1978; it proposed to reopen and mine from the old Frankie Mine. This plan was approved, and the mine was reopened in August. Production began in September and continued through May 1979, at which time Anschutz chose to cease operations and reclaim the various mining operations. The reclamation was approved, and the bond was returned in May 1985.

A total of 5,700 tons (5,200 metric tons) of ore, containing 26,000 lb (12,000 kg) of U_3O_8 and 156,000 lb (71,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $255,000.

1.3.18 ULP Lease Tract 16A

On Lease Tract 16A, the C-SR-16A mine is located in Sections 11 and 14, T 43 N, R 19 W, NMPM, in San Miguel County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 27.37% payable on ores containing 30,000 lb (14,000 kg) of U_3O_8 secured the lease.

The initial mining plan was submitted in April 1975 proposing a small open-pit operation just north of the Keystone claim. The plan was approved, and development began in June. The initial shipment of ore was made to the General Electric ore-buying station near Naturita in August, and production continued for the next few months until the small ore body was mined out.

A second mining plan was submitted by S and Z Associates in October 1976 proposing two operations. The first operation would utilize an entry through an existing pit, and the second operation would gain entry through a new incline located east of the pit. The plan was approved, and development began in early November. Both mines continued in operation through September 1977, when production ceased due to a lack of developed ore reserves, and the mines were shut down. After Dynove Ltd. gained control, activities resumed from July to September 1978 and then again in October and November 1980.

A total of 3,500 tons (3,200 metric tons) of ore, containing 12,000 lb (5,400 kg) of U_3O_8 and 103,000 lb (47,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $138,000.

1.3.19 ULP Lease Tract 17

On Lease Tract 17, the C-WM-17 mine is located in Section 14, T 45 N, R 18 W, NMPM, in San Miguel and Montrose Counties, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 36.20% payable on ore containing 30,000 lb (14,000 kg) of U_3O_8 secured the lease.

The initial exploration plan was submitted in November 1976 proposing a total of 44 drill holes. Three supplemental plans followed, proposing 102 additional holes. All plans were approved, and each project was essentially completed. Reclamation of drill sites has been completed. In April 2010, DOE received an exploration plan proposing a single exploratory drill hole in the north-central portion of the lease tract. DOE approved the plan, but drilling activities have been suspended until after the ULP PEIS is completed.

There have been no mining plans submitted for this lease tract, and no ore has been produced. Annual royalties paid for this lease tract total $35,000.

1.3.20 ULP Lease Tract 18

On Lease Tract 18, the C-SM-18 mine is located in Sections 21, 22, 26, 27, and 28, T 48 N, R 17 W, NMPM, Montrose County, Colorado (Figure 1.3-8). The original lease was executed effective April 18, 1974. A royalty bid of 15.60% payable on ores containing 1,300,000 lb (590,000 kg) U_3O_8 secured the lease.

A mining plan was submitted in March 1978 proposing entry through a 1,540-ft (470-m) decline in the northwestern portion of the lease. The plan was approved, and development began in late May. After numerous delays, the incline was bottomed in September 1979, and production began in December of that year. The initial shipment of ore was made in February 1980. Production continued until May, when Cotter Corporation announced a temporary shutdown of operations effective May 22, 1980. The mine was placed on standby status and remained so until 1990 when its permit status was revised to be intermittently active. In October 2000, Cotter Corporation submitted a reclamation plan for a portion of its mining operations on Lease Tract 18. The plan was approved by DOE in January 2001, and reclamation activities were completed in February. The mine portal and ventilation shaft were permanently sealed and closed; the dump for mine waste rock was recontoured to blend in with the surrounding, natural topography; and the disturbed areas were reseeded. The maintenance shop building was left intact to support Cotter Corporation’s continuing operations on the lease tract.

In September 2004, Cotter Corporation submitted a new mining plan, proposing entry into the southern portion of the lease tract through the Wright Mine located on an adjacent, privately held, patented claim. DOE approved the plan in October 2004, and site preparation activities began almost immediately. Mining was initiated in the first quarter of 2005, and shipments of lease tract ore began in March. These shipments of lease tract ore from the mine continued into 2006. In 2008, Cotter Corporation installed a lysimeter downgradient of the mine site to determine whether near-surface soils or rock formations contain moisture that could affect (or be affected by) the mine site. The lysimeter is monitored monthly.

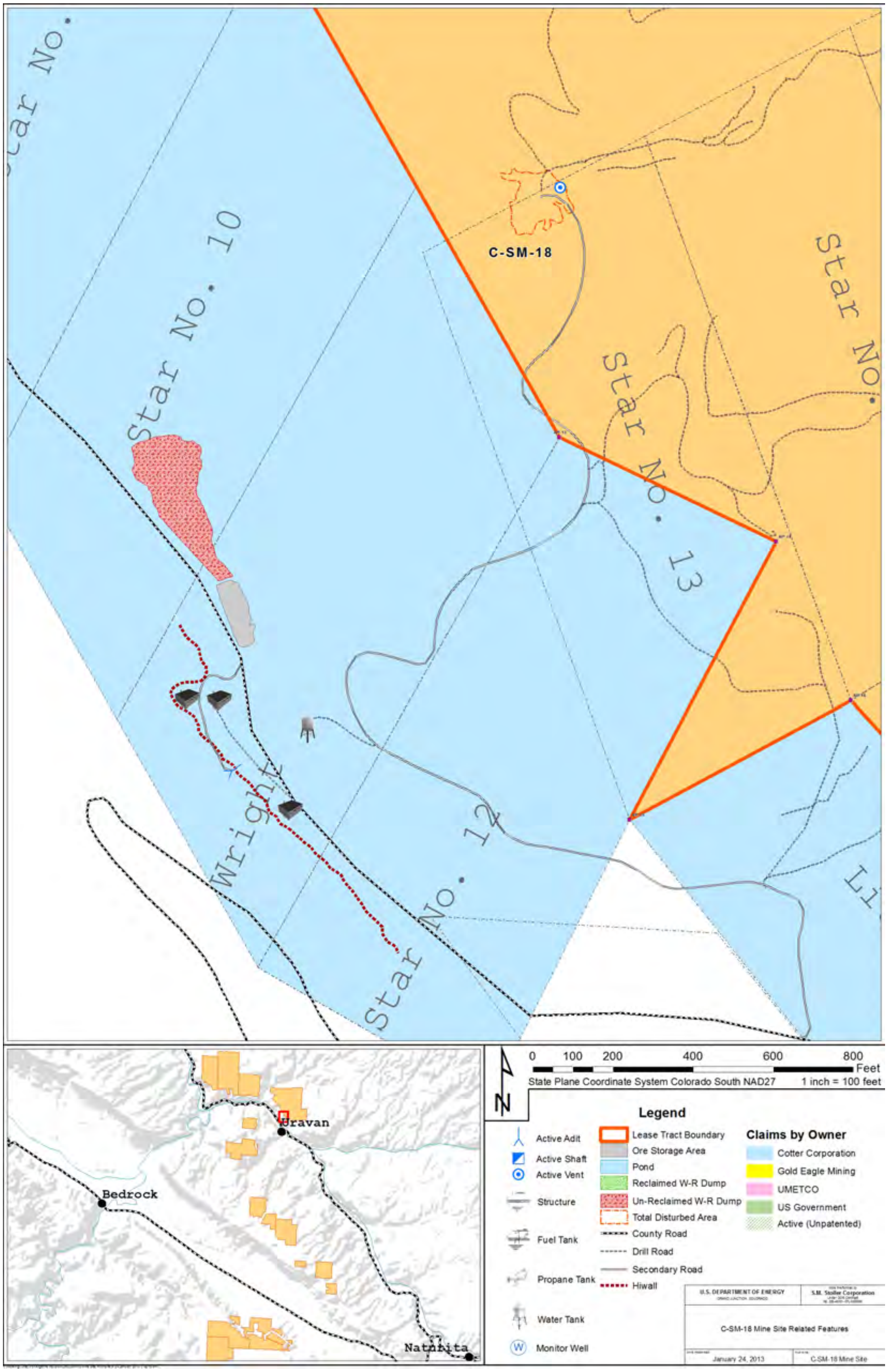

FIGURE 1.3-8 Location of C-SM-18 Mine on Lease Tract 18

A total of 27,000 tons (24,000 metric tons) of ore, containing 136,000 lb (62,000 kg) of U_3O_8 and 1,163,000 lb (528,000 kg) of V_2O_5, have been produced and sold from the mine. Royalties paid for this lease tract (production royalties plus annual royalties) total $1,950,000.

1.3.21 ULP Lease Tract 19

On Lease Tract 19, the C-AM-19 mine is located in Sections 13 and 24, T 48 N, R 18 W, NMPM, in Montrose County, Colorado. The original lease was executed effective April 8, 1974. A royalty bid of 27.76% payable on ores containing 2,800,000 lb (1,270,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in December 1974 proposing entry through a 1,200-ft (370-m) decline at 12%, located just within the southern boundary of the lease tract. The plan was approved, and development began in February 1975. The incline was bottomed in August 1976, and an escapeway was driven from the workings on the Fourth of July claim to the bottoming point. The new mine was called the King Solomon Mine. During 1977, the mine development to the north and west connected with the Worcester Mine and Cliff Dweller Mine, which lie adjacent to the unit on the southwest side.

Development work continued at the mine, as they drifted northward through the middle of the tract and along each side toward known ore bodies. Due to the vast area incorporated within the mine, 10 shafts that were 7 ft (2 m) in diameter were needed to provide adequate ventilation. Production continued uninterrupted through 1981. During 1982, production was reduced somewhat, while development continued on toward the north. Production continued sporadically through July 1990, at which time, mining ceased.

Following the termination of underground mining activities at the King Solomon Mine, two portals and 15 surface vent features associated with the mine complex were backfilled with waste rock and fully reclaimed during October and November 1997. In 1999, final reclamation and recontouring of waste-rock dumps associated with the King Solomon mine complex were completed. In April 2002, portions of the King Solomon Mine and Cliff Dweller Mine sites were reworked, pocked, and seeded. On August 11, 2005, final reclamation of the lease tract was approved by DOE, and the reclamation bond was returned in full.

A total of 920,000 tons (835,000 metric tons) of ore, containing 3,610,000 lb (1,640,000 kg) of U_3O_8 and 18,000,000 lb (8,200,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) totaled $30,000,000.

1.3.22 ULP Lease Tract 19A

On Lease Tract 19A, the C-AM-19A mine is located in Sections 18 and 19, T 48 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective

April 18, 1974. A royalty bid of 18.10% payable on ores containing 1,500,000 lb (680,000 kg) of U_3O_8 secured the lease.

The initial exploration plan was submitted in December 1975 proposing to drill a total of 144 holes. Two supplemental plans followed, proposing 90 additional holes. All plans were approved, and some 190 holes were drilled during the period from April 1976 to June 1979. Reclamation of drill sites has been completed.

There have been no mining plans submitted for this lease tract, and no ore has been produced. Annual royalties paid for this lease tract total $312,400.

1.3.23 ULP Lease Tract 20

On Lease Tract 20, the C-AM-20 mine is located in Section 20, T 48 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective April 18, 1974. A royalty bid of 19.60% payable on ores containing 800,000 lb (363,000 kg) of U_3O_8 secured the lease.

The initial exploration plan was submitted in August 1976 proposing a total of 157 holes to be drilled. Three supplemental plans followed, proposing 173 additional holes. All plans were approved, and some 177 holes were drilled during the period September 1976 through June 1980. Reclamation of drill sites has been completed.

There have been no mining plans submitted for this lease tract, and no ore has been produced. Annual royalties paid for this lease tract total $181,800.

1.3.24 ULP Lease Tract 21

On Lease Tract 21, the C-LP-21 mine is located in Sections 22 and 27, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective April 18, 1974. A royalty bid of 18.40% payable on ores containing 1,200,000 lb (544,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in March 1976 proposing entry through an 1,800-ft (550-m) incline at –15.5% located in the southwestern portion of the lease tract. The plan was approved, and Blake Mining Company (mining contractor for Cotter Corporation) began development in late May. The incline was bottomed in December 1977, with development continuing through August 1978. During this time, the mine workings were connected with workings on the Guadalcanal claim adjacent to the southern boundary line of the lease tract. The first ore was encountered in this area. The initial shipment of ore was made to Cotter Corporation’s sample plant at Whitewater, Colorado, in October 1978. Production continued until May 1980, when Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980. Blake Mining Company then increased production to ship all available ore.

In accordance with the terms of the lease, Cotter Corporation agreed to reclaim all pre-existing undesirable conditions resulting from activities conducted during prior leases. Cleanup work on the Virgin Shaft area was completed in December 1980.

In December 2002, Cotter Corporation submitted a reclamation plan for the C-LP-21 mine, which was approved with minor stipulations. Reclamation was completed the following year. On June 21, 2005, Cotter Corporation submitted a mining plan for Lease Tract C-LP-21, proposing to reopen the existing C-LP-21 mine. The plan was approved on August 1, 2005, and DOE established the reclamation performance bond for the operation at $48,000. To date, Cotter Corporation has taken no action on this proposal.

In 2008, in accordance with Colorado law, CDRMS reclassified all uranium mines within the state as designated mining operations, requiring the submittal of an EPP and a much more rigorous environmental review. Cotter Corporation submitted its EPP to CDRMS, and the document is currently being reviewed.

A total of 45,000 tons (41,000 metric tons) of ore, containing 176,000 lb (80,000 kg) of U_3O_8 and 1,236,000 lb (561,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $2,315,000.

1.3.25 ULP Lease Tract 22

On Lease Tract 22, the C-LP-22 mine is located in Sections 21 and 28, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 15.301% payable on ores containing 180,000 lb (82,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in September 1976 proposing entry through a 700-ft (210-m) incline at –7% located in the northwestern portion of the tract. The plan was approved, and development began in December. The incline was bottomed in March 1977, and a drift was advanced into the ore body. The initial ore shipment was made to the Atlas mill near Moab, Utah, on March 10, 1977. Mining continued through 1980, and the mine was connected with the First National Bank workings adjacent to the lease tract on the southwest side. Production continued as mine development progressed eastward toward other small ore bodies, but these were quickly depleted. The lack of ore reserves caused operations to cease on August 14, 1981. The C-LP-22 mine site was reclaimed later that year.

A total of 8,600 tons (7,800 metric tons) of ore, containing 40,000 lb (18,000 kg) of U_3O_8 and 203,000 lb (92,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $298,000.

1.3.26 ULP Lease Tract 22A

On Lease Tract 22A, the C-LP-22A mine is located in Sections 16, 17, 20, and 21, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 19.90% payable on ores containing 50,000 lb (23,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in July 1978 proposing entry through a 1000-ft (300-m) incline, collared in the northeast corner of the lease tract. The plan was approved, and Lark Washburn (mining contractor for Cotter Corporation) began development work in September. The incline was bottomed in January 1979, and development continued. The initial shipment was not made until October 1979 the ore was shipped to Cotter Corporation's sample plant at Whitewater, Colorado. Mining continued through May 1980, at which time Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980.

In April 1981, following the approval of the sublease by DOE, Mendisco Mining Company reopened the mine. Production began almost at once; however, all ore was stockpiled at the mine until arrangements were made to toll the ore through the Energy Fuels mill at Blanding, Utah. The ore was shipped in December 1981, and mining continued through June 1982, when the mining contract was terminated.

Cotter Corporation officials assessed the lease tract operations to determine what actions, if any, were warranted. On the basis of that assessment, they decided to abandon several of the company's lease tract operations. A reclamation plan for the C–LP–22A mine was submitted in preparation for relinquishment of the lease. The plan was approved, and reclamation activities were completed in September 2000.

A total of 21,000 tons (19,000 metric tons) of ore, containing 84,000 lb (38,000 kg) of U_3O_8 and 532,000 lb (241,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $768,000.

1.3.27 ULP Lease Tract 23

On Lease Tract 23, the C-LP-23 mine is located in Section 36, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 33.51% payable on ores containing 375,000 lb (170,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in September 1976 proposing entry through a 1,070-ft (330-m) incline of –14% collared in the east-central portion of the lease tract. The plan was approved, and development began in October. The incline was bottomed in February 1977, and production began almost at once. The initial shipment of ore was made to the Atlas mill near Moab, Utah, on May 5, 1977.

Production continued through June 1978. Then the miners were moved to another mine controlled by the lessee to do development work. During the next few weeks, a portion of the incline caved in, and it was not until October that the damage was repaired. In December 1978, the mine was shut down altogether for economic reasons. Some contract miners resumed production in early 1980, but after 3 months, it was found to be too costly to continue, and the mine was shut down for the second and final time.

Reclamation of the C-LP-23 mine site was undertaken by DOE as part of the 1994 hazard mitigation activities. The snow shed within the decline was burned, and the decline was subsequently backfilled with available materials. The site was recontoured, covered with available surface soil materials, and reseeded.

A total of 8,100 tons (7,300 metric tons) of ore, containing 24,000 lb (11,000 kg) of U_3O_8 and 117,000 lb (53,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $665,000.

1.3.28 ULP Lease Tract 24

On Lease Tract 24, the C-CM-24 mine is located in Section 32, T 48 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 11.13% payable on ores containing 90,000 lb (41,000 kg) of U_3O_8 secured the lease.

The initial exploration plan was submitted in January 1977. The plan was approved, and a total of 39 holes were drilled. In April 2009, Energy Fuels Resources submitted an exploration plan to DOE proposing eight exploratory drill holes: three in the central portion and five in the southwest corner of the lease tract. DOE approved the plan on August 17, 2009, and the holes were drilled later that month. Down-hole logging results indicated that in two holes, the mineralization was of sufficient grade and thickness for them to be considered ore holes; one hole was mineralized; and the other five holes were blank (contained no mineralization). Reclamation of drill sites has been completed.

In March 1979, a mining plan proposing entry through a vertical shaft some 260 ft (80 m) deep was submitted, but the plan was deemed incomplete, and no action was taken, and consequently, no ore has been produced. No further activity has occurred on the lease tract.

Annual royalties paid for this lease tract total $52,000.

1.3.29 ULP Lease Tract 25

On Lease Tract 25, the C-CM-25 mine is located in Sections 5 and 6, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 25.10% payable on ores containing 600,000 lb (272,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in March 1978 proposing entry through an incline located east of the lease tract on the Surprise No. 1 claim controlled by Union Carbide. The incline would connect with the existing workings on Union Carbide's Mill No. 2 and Mill No. 4 claims. These workings are connected to existing workings on the lease tract that resulted from mining under ML-11. The plan was approved, and Robert Taylor, DBA Taminco, Inc. (mining contractor for Cotter Corporation), began sinking the incline in March 1978. The development drift crossed the boundary line of C-CM-25, Lease Tract 2, in July. Some ore was encountered immediately. The initial ore shipment was made to the Cotter Corporation sample plant at Whitewater, Colorado, on July 28, 1978. Cleanup work on the Barkley Mine area was done in October 1977, and work on the Shattuck Denn Mine area was done in June 1980.

Production continued intermittently with development for the next two years, during which time the mine was expanded to connect with the existing LaSalle workings in the east-central portion of Lease Tract 1. In May 1980, Cotter Corporation announced a temporary shutdown of operations effective August 8, 1980. Following this announcement, Robert Taylor (DBA Taminco, Inc.) increased production to ship all available ore before the deadline.

In December 2002, Cotter Corporation submitted a reclamation plan for the C-LP-21 mine, which was approved with minor stipulations. Reclamation was completed the following year.

In 2008, in accordance with Colorado law, CDRMS reclassified all uranium mines within the state as designated mining operations, requiring the submittal of an EPP and a much more rigorous environmental review. Cotter Corporation submitted its EPP to CDRMS, and the document is currently being reviewed.

A total of 14,000 tons (13,000 metric tons) of ore, containing 62,000 lb (28,000 kg) of U_3O_8 and 256,000 lb (116,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $863,000.

1.3.30 ULP Lease Tract 26

On Lease Tract 26, the C-G-26 mine is located in Sections 5 and 6, T 47 N, R 17 W, NMPM, in Montrose County, Colorado. The original lease was executed effective July 23, 1974. A royalty bid of 25.10% payable on ores containing 600,000 lb (272,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in May 1975 proposing entry through an adit located just up the draw from the New Verde Mine area. The plan was approved, and development began in June. Production began some time thereafter, and the initial shipment of ore was made to the Union Carbide Mill at Uravan, Colorado, on December 1, 1975.

During 1976 a drift was driven from a portion of the old New Verde Mine toward two ore holes drilled during the previous exploration program. The drift crossed the boundary line onto the lease tract in October, but production was delayed by surveying errors. Production from this area began in July 1977 and continued through September, when operations ceased because of the lack of ore.

In September 2004, DOE completed the reclamation of the New Verde Mine site. The metal ore-bins were left intact, and the dump for mine waste rock was excavated back uphill out of the drainage (as much as practicable); recontoured to blend in with the surrounding natural topography; and then covered with surface soil materials and reseeded with a native seed mixture.

In September 2009, Energy Fuels Resources (EFR) submitted a reentry plan for the New Verde Mine to DOE, proposing entry through the small, northernmost portal. DOE approved the plan on October 9, 2009. On November 10, 2009, EFR personnel removed a small portion of the cinderblock bulkhead securing the portal, collected air-quality measurements for radon, and visually inspected the near-portal workings. In early August 2010, EFR submitted the Phase II reentry plan for the New Verde Mine to DOE for approval. DOE approved the plan on August 11, 2010. Later that month, EFR personnel removed a portion of the cinderblock bulkhead, securing the portal, and they visually inspected the applicable mine workings. EFR reported that the workings appeared to be in good condition. The portal was secured immediately after the assessment to preclude unauthorized entry.

When mining operations ceased on this lease tract, 1,231 tons (1,100 metric tons) of ore, containing 4,220 lb (1,900 kg) of U_3O_8 and 18,846 lb (8,600 kg) of V_2O_5, had been produced and sold from the lease tract mines. Royalties paid for this lease tract (production royalties plus annual royalties) totaled $12,878.

1.3.31 ULP Lease Tract 27

On Lease Tract 27, the C-G-27 mine is located in Sections 7 and 18, T 50 N, R 17 W, and Sections 12 and 13, T 50 N, R 18 W, NMPM, in Mesa County, Colorado. The original lease was executed effective June 12, 1974. A royalty bid of 10.231% payable on ores containing 140,000 lb (64,000 kg) of U_3O_8 secured the lease.

A mining plan was submitted in April 1975 proposing entry through the existing Mesa No. 5 Mine. Mining would be from the area west of the Mesa No. 5 and Ronnie No. 1 Mines, which were connected during previous operations. The plan was approved, and development began in mid-June. Production began in late June, and the initial shipment of ore was made to the General Electric ore buying station near Naturita, Colorado, on August 29, 1975. Production continued intermittently through July 1982.

A mining plan was submitted in September 1975 proposing to reopen and mine from the G-1 incline. The plan was approved, and the mine was reopened in early 1976. At that time, it was decided that the walls were too badly caved in to be of any use, and the project was terminated.

A mining plan for the area adjacent to the existing G-3 mine was submitted in July 1978. Entry was to be gained by a 700-ft (210-m) incline located northwest of the mine. The plan was approved, and development began in August. Following numerous delays, the incline was bottomed in ore during September 1980. Production began immediately and continued for the remainder of the year. During 1981 and 1982, production was sporadic, with development limited by the close proximity of the existing G-3 mine. In June 1982, the two mines were connected through a small opening; however, there was no production from the old mine because the grade of the ore was lower than expected.

A mining plan was submitted in July 1979 proposing to mine across the boundary from the Mineral Channel No. 12 claim located adjacent to the lease tract and controlled by the lessee. The plan was approved, and some production from this mine was noted in September.

In accordance with the terms of the lease, the lessee agreed to reclaim all pre-existing undesirable conditions resulting from the activities conducted. The contract included the G-1, 6-3, G-4, Ronnie No. 1, Ronnie No. 2, Calamity No. 14, Calamity No. 15, and Neglected Mine areas. Some cleanup work was performed during the summer of 1980.

A total of 16,000 tons (15,000 metric tons) of ore, containing 83,000 lb (38,000 kg) of U_3O_8 and 351,000 lb (159,000 kg) of V_2O_5, have been produced and sold from the lease tract. Royalties paid for this lease tract (production royalties plus annual royalties) total $490,000.

1.4 PURPOSE AND NEED FOR AGENCY ACTION

The underlying purpose and need for agency action is to support the implementation of the Atomic Energy Act (AEA), which authorized and directed DOE, among other things, to develop a supply of domestic uranium (42 U.S.C. § 2096), and “to issue leases or permits for prospecting for, exploration for, mining of, or removal of deposits of source material in lands belonging to the United States” to the extent that DOE deems it necessary to effectuate the provisions of the AEA (42 U.S.C. § 2097). Congress further recognized the importance of developing a supply of domestic uranium and other source material when it stated in the AEA, in its Congressional findings, that the processing of source material must be regulated “in order to provide for the common defense and security” (42 U.S.C. § 2012(d)). In addition, the Energy Policy Act of 2005 (Public Law [P.L.] 109-58) (EPAct) expressed a continued commitment to “decreasing the dependence of the United States on foreign energy supplies” (42 U.S.C. 16181(a)(3)); and to “[e]nhancing nuclear power’s viability as part of the United States energy portfolio” (42 U.S.C. § 16271(a)(1)). The ULP contributes to the development of a supply of domestic uranium consistent with the provisions of the AEA and EPAct. In support of these statutes, DOE needs to determine the future course of the ULP, including whether to continue leasing some or all of the withdrawn lands and other claims (referred to as “DOE-managed lands”) for the exploration and production of uranium and vanadium ores.

1.5 PROPOSED ACTION

DOE's proposed action is to decide whether to continue the ULP and, if it decides to continue the ULP, to determine which alternative to adopt in order to manage the ULP. DOE developed the range of alternatives by carefully considering DOE's underlying need for action and comments received during the public scoping period for the ULP PEIS.

1.6 SCOPE OF THE ULP PEIS

This ULP PEIS evaluates five alternatives for managing the ULP, for which there are 31 lease tracts located in Mesa, Montrose, and San Miguel Counties in western Colorado. These alternatives address the range of reasonable options, which involve (1) terminating the leases and conducting reclamation where needed, with DOE continuing to maintain oversight of the lands without uranium leasing; (2) terminating the leases and conducting reclamation where needed, relinquishing the lands for potential management by BLM and public domain lands, and terminating the DOE ULP; and (3) continuing the ULP with associated exploration, mine development and operations, and reclamation at some or all of the 31 lease tracts. At the time that the ULP PEIS was being prepared, 29 of the 31 lease tracts were actively held under lease, and the remaining 2 tracts had not been leased.

Of the 31 lease tracts, 11 are located in San Miguel County, 17 are located in Montrose County, 2 are located in Mesa County, and 1 is located in both San Miguel and Montrose Counties. The lease tracts vary in size from as small as 25 acres (10 ha) to as large as about 4,000 acres (1,600 ha).

The 29 active leases are held by five companies: (1) Golden Eagle Uranium, LLC; (2) Cotter Corporation; (3) Gold Eagle Mining, Inc.; (4) Colorado Plateau Partners; and (5) Energy Fuels Resources Corporation.

The ULP PEIS evaluates the three mining phases associated with the underground and surface open-pit mining methods. These phases are the exploration phase, mine development and operations phase, and reclamation phase. Resource areas evaluated are discussed in Chapter 2. The evaluation discussed in the ULP PEIS incorporates site-specific information available regarding the ULP lease tracts (e.g., current status, previous mining operations that occurred, and other environmental information). In addition, as of now, there have been no new mine plans (i.e., for exploration, mine development and operations, or reclamation) submitted to DOE by the lessees; the location of where new, future, potential mining would take place and other associated details are not currently known. Hence, the evaluation conducted in the ULP PEIS also incorporates assumptions for developing a reasonable scenario that could represent an upper bound level of possible future mining activity for each of the alternatives, as appropriate. These assumptions are discussed in Chapter 2.

1.7 NEPA PROCESS FOR THE ULP PEIS

During the preparation of the ULP PEIS, opportunities for public participation have been and are being provided (see Figure 1.7-1). After the ULP PEIS is completed and at least 30 days after the EPA issues a notice of availability of the Final ULP PEIS, DOE may issue a Record of Decision (ROD) announcing DOE's selection of an alternative for the continued management of the ULP. Section 2.6 of the ULP PEIS identifies DOE's preferred alternative (Alternative 4, to continue with exploration, mine development and operations, and reclamation on the 31 DOE ULP lease tracts for 10 years or another reasonable time period). After the ROD is issued, as plans (for exploration, mine development and operation, or reclamation) are submitted by the lessees to DOE for approval, further NEPA review for a given action would be conducted. The level of follow-on NEPA review to be done (e.g., categorical exclusion determination, environmental assessment, or environmental impact statement) would depend on the action being proposed by the lessees, as indicated in the plans submitted. For mining plans to be submitted for approval, DOE will require, at a minimum, an environmental assessment (EA) with appropriate public involvement to be prepared to further evaluate potential site impacts. This NEPA review would be conducted to inform DOE's decision on approval of the plans, including the conditions DOE would require to mitigate potential impacts. As discussed in Section 1.2.1 (where requirements of current leases are summarized), no activity can be undertaken by the lessees until DOE has approved the plans or otherwise acted on the plans. DOE's review would be conducted in consultation with Federal, state, local agencies, and tribal entities for site-specific actions, as appropriate. Public participation on the follow-on NEPA review would occur in a manner consistent with the level of review conducted and with DOE and CEQ regulations. Section 1.7.1 discusses the public scoping process for the ULP PEIS. Section 1.7.2 discusses the public comment process for the ULP PEIS.

FIGURE 1.7-1 NEPA Process for the ULP PEIS

1.7.1 Public Scoping Process

Consistent with CEQ requirements (40 CFR 1501.7) and DOE NEPA implementation procedures (10 CFR 1021.311), an early and open scoping process was carried out to determine the scope of the PEIS and identify significant issues related to the proposed action. An NOI was issued for public review, and a public scoping process was conducted. Public participation was also solicited for the review of the Draft ULP PEIS during the public comment period. NEPA requires that comments on the Draft PEIS be evaluated and considered during the preparation of the Final PEIS and that a response to comments be provided.

The NOI (76 FR 36097) to prepare the ULP PEIS was issued on June 21, 2011, and a supplemental notice (76 FR 43678) was issued on July 21, 2011, to announce the four public scoping meetings and their locations and to announce the extension of the public scoping period to September 9, 2011. Public scoping meetings were held in Montrose, Telluride, and Naturita in Colorado and in Monticello, Utah.

In addition to presenting comments at the scoping meetings, stakeholders were also able to mail comments directly to DOE or submit comments through the project web site (http://ulpeis.anl.gov/). A total of 287 unique “comment documents” were submitted by individuals, organizations, and government agencies to provide comments on the scope of the PEIS. A comment document is a written document, an e-mail submission, or an oral presentation given during a scoping meeting that provides comments on the scope of a PEIS. A single comment document may contain multiple comments on one or more issues. There were 61 comment documents provided at the scoping meetings; 164 were mailed to DOE (counting both e-mails and regular mail), and 62 were submitted electronically through the project web site. Of these comment documents, 8 were received from Federal, state, or local government agencies, with the remainder being from individuals or other organizations. Comment documents were received from 13 states; of the 262 comments for which a state of origin was identified, approximately 88% were from Colorado within the potentially affected areas.

Comments received during the public scoping period focused on whether or not the ULP or uranium mining at the lease tracts should be continued. Representative comments and DOE responses are provided as follows. The first set of comments (Section 1.6.2) consists of those comments determined to be within the PEIS scope, and the second set (Section 1.6.3) consists of those determined to be outside the scope of the ULP PEIS. A detailed discussion on the comments received is presented in Appendix B.

1.7.1.1 Comments Considered Within the ULP PEIS Scope

- *The current leases should be terminated and reclamation conducted, after which uranium mining should not be conducted on the lands. The lands could be restored to the public domain under BLM oversight and the DOE ULP terminated.*

  Alternatives 1 and 2 evaluated in the ULP PEIS address this comment. Under Alternative 1, all leases on the 31 lease tracts would be terminated, and reclamation would be conducted where needed. The lands would then be maintained per DOE oversight without leasing for uranium mining. Alternative 2 evaluated in the ULP PEIS is similar to Alternative 1, except once reclamation was completed by lessees, DOE’s jurisdiction would return to BLM, if approved by the U.S. Department of the Interior (DOI)/BLM (in accordance with 43 CFR § 2372.3). If approved, the land would be managed by BLM under its multiple use policies. DOE’s uranium leasing program would end.

- *DOE should continue with the ULP and continue to make the 31 lease tracts available for exploration, mine development and operations, and reclamation, as was the case before the preparation of the PEIS was initiated.*

  Alternatives 4 and 5 evaluated in the ULP PEIS address this comment. Under Alternative 4, DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period. Alternative 5 is similar to Alternative 4 except that the lease period is limited to the remainder of the current 10-year lease period, and the leases would continue exactly as they were issued in 2008.

- *DOE should prohibit any further mining or exploration until reclamation has been completed on existing or old leases.*

  As mentioned above, reclamation would be conducted where needed as part of the alternatives evaluated in the ULP PEIS. In addition, all legacy mine sites located on the DOE lease tracts have already been reclaimed.

- *DOE should stipulate protection of the Dolores and San Miguel River watersheds.*

  The preferred alternative includes a requirement for future mines to be at least 0.25 mi (0.40 km) from the Dolores River. The San Miguel River is about 0.3 mi (0.54 km) from the closest lease tracts. The evaluation for water quality discussed in the ULP PEIS (as summarized in Section 2.4) considers both the Dolores and San Miguel Rivers.

- *Potential impacts from uranium mining at the DOE ULP lease tracts on air quality, water quality, human health, socioeconomics, transportation, views from sensitive areas, and cultural resources should be evaluated.*

  Chapter 4 of the ULP PEIS analyzes the potential impacts associated with human health and environmental resource areas listed. Potential impacts on noise, soil resources, land use, ecology, environmental justice, and waste management are also analyzed.

- *DOE should undertake its duties under Section 7 of the ESA.*

  DOE engaged in consultation with the USFWS pursuant to Section 7 of the ESA. Both a biological assessment (BA) and a biological opinion (BO) have been completed and are presented in Appendix E. Chapter 6 of the ULP PEIS presents a summary of this consultation.

- *DOE should collaborate with other agencies, including the CDRMS, BLM, and EPA.*

  DOE is collaborating with various agencies, including CDRMS, BLM, and EPA, on this PEIS process. Section 1.10 presents a list of the cooperating agencies and the commenting agencies.

- *The review and approval process must include a site-specific NEPA review for each proposed mining operation.*

  The ULP PEIS utilizes site-specific data that are available and contains in Section 1.7 a discussion of the NEPA process that would be conducted once site-specific and project-specific mine plans were submitted by the lessees to DOE for review and approval.

- *Include impacts from the release of radioactive and other toxic materials into the atmosphere from mining and milling operations*.

  Chapter 4 of the ULP PEIS addresses the potential impacts from the release of material associated with the ore production. Although potential impacts of milling operations are outside the scope of the proposed action, the transportation of ore generated from the ULP lease tracts to the mills and the cumulative impacts from the mills are evaluated in Chapter 4.

- *Address the long-term impacts on human health, livestock, and wildlife, including food sources, both locally and regionally, due to mining and milling activities. The PEIS must consider health effects of mining and milling, including cancer incidence, on the human population in towns neighboring the mining operation, workers, and local residents.*

  The analyses of impacts on human health and ecological resources (on livestock and wildlife) address the concern about potential impacts from mining operations. The analysis of human health impacts in Chapter 4 considers the population within a 50-mi (80-km) radius of the lease tract. This region of influence (ROI) was selected to assess the potential impact on the population as a whole (i.e., for collective dose evaluation). At this distance, the individual doses would have dropped to negligible levels (<0.1–0.2 mrem/yr), which supports that the selection of 50 mi (80 km) as the ROI is conservative. The analysis for potential impacts on ecological resources addresses resources in the three counties that encompass the 31 lease tracts. The cumulative impacts evaluated in the ULP PEIS (see Section 4.7) address a 50-mi (80-km) radius of the lease tracts and include the White Mesa and Piñon Ridge Mills.

1.7.1.2 Comments Considered Outside the ULP PEIS Scope

- *Because of unstable uranium markets and the uncertainty of future commercial development of nuclear power facilities, uranium should be preserved for the future use by the American people until it becomes critical for national strategic energy purposes.*

  Analyses of future uranium markets, and the future commercial development of nuclear power facilities, are not within the scope of the purpose and need for DOE's action (described in Section 1.4 of the ULP PEIS). See also Section 1.7.3.6.

- *Analyze a No Action Alternative that would allow the leases to lapse with no reclamation conducted.*

  The option of not performing reclamation when leases lapse or are terminated is not consistent with the requirements of the leases, the ULP, and applicable laws and is therefore not considered a reasonable alternative to evaluate in the ULP PEIS.

- *Analyze the economic benefits of fully reclaiming and rehabilitating all Federal and state lands in the Uravan Mineral Belt and compare that to the economic benefit of maintaining the existing uranium leases over the next 5 years.*

  The economic study suggested is not relevant and is considered outside the scope of the ULP PEIS. It does not meet the purpose and need for DOE's action (described in Section 1.4 of the ULP PEIS).

- *Include an alternative that requires old, inactive, and/or abandoned mines to be reclaimed before new leases are granted or any new mines are established.*

  DOE has reclaimed all abandoned mines within its purview. The 29 leases that currently exist have been in place since 2008, and all mining activities are currently on hold until the completion of this PEIS process.

1.7.2 Public Comment Process

A Notice of Availability (NOA) for the Draft ULP PEIS was published in the *Federal Register* on March 15, 2013 (78 FR 16483), and this began a 60-day public comment period that was to end on May 16, 2013. This comment period was later extended to May 31, 2013 (78 FR 23926), and it was subsequently re-opened on June 3, 2013 (78 FR 33090), with a closing date of July 1, 2013. The public comment period, including the extension and the re-opening¸ lasted 109 days. All comments received on the Draft ULP PEIS were considered in the preparation of the ULP PEIS and are presented in Section I.4 of Appendix I.

An important part of the NEPA process involves giving the public the opportunity to provide input and comments on a Draft PEIS for consideration in the preparation of a Final PEIS. DOE issued the Draft ULP PEIS for review and comment by other Federal agencies, states, American Indian tribal governments, local governments, and the public. DOE distributed copies to those organizations and government officials known to have an interest in the PEIS and to those organizations and individuals who requested a copy. Copies were also made available on the project web site (http://www.ulpeis.anl.gov/), the DOE NEPA web site (http://energy.gov/nepa/), and in regional DOE public document reading rooms and public libraries. Announcements indicating the availability of the Draft ULP PEIS and the dates and times of the public hearings were published in local newspapers (see Table 1.7-1).

Each of the public hearings started with an open house that lasted about half an hour, with posters that explained the NEPA process and the alternatives and evaluations presented in the ULP PEIS. Copies of the Summary document and presentation were also made available to the public. Subject matter experts were on hand to answer any questions the public may have had as they viewed the poster display.

After the open house, DOE gave an overview of the Draft ULP PEIS, and attendees were given an opportunity to provide oral and written comments. Each oral comment presentation, recorded by a court reporter as part of the hearing transcript, was considered as a comment document. Written comments submitted by individuals during the hearings were likewise considered to be comment documents. The transcripts for the four hearings are posted on the project web site.

DOE received a total of 258 comment documents, which accounted for approximately 1,200 individual comments. Of the 258 comment records received, 18 were from organizations or Federal or state agencies and 240 were from private citizens. Written comments were received via letter, email, or through submission of a comment form provided at the public hearings or on the project web site. Oral comments are included in transcripts documenting each of the public hearings held on the Draft ULP PEIS. DOE has identified nine topics of interest based on the comments that were most frequently received and/or the comments that indicated a broad public concern. These topics are summarized in Section 1.7.3. See Appendix I for the complete comment response document.

TABLE 1.7-1 Draft ULP PEIS Public Hearing Locations in Colorado, Dates, and Attendance

Location	Date	Attendance
Grand Junction	April 22, 2013	52
Montrose	April 23, 2013	40
Telluride	April 24, 2013	54
Naturita	April 25, 2013	22

1.7.3 Nine Topics of Interest Based on Public Comments Received

The order in which topics are presented and discussed here does not indicate importance of one topic over another.

1.7.3.1 PEIS analyses need to be more site-specific and more robust in scope. Assumptions used need to be supported with citations.

Topic Summary: Commenters said that the analyses performed in the PEIS to estimate the impacts of the program were inadequate. Many commenters asserted that the assumptions made to support the analysis are arbitrary and not supported by citations. Commenters requested that more site-specific data be included and evaluated so that conclusions presented can better support site-specific decisions.

Many commenters were specifically concerned about the adequacy of the evaluations of the impacts on human health, air quality, noise, water quality and water supply, endangered species, socioeconomics, and transportation. Specifically, the concerns expressed were the following: (1) human health impacts from exposure to potentially uranium-contaminated "red-colored" dust some 50 or so mi (about 80 km) away from the ULP lease tracts; (2) climate change impacts; (3) the Colorado River Basin and the impacts of the proposed action on water quantity, water quality, and endangered Colorado River fish species; and (4) impacts on the recreational activities that many people in the area enjoy, and the effects from a boom-and-bust economy that might be created by the proposed action.

Discussion: The evaluations conducted for the PEIS were based on site-specific information (see Section 1.3 for a summary of this information). The information is adequate to support the alternatives evaluated and for making fully informed decisions relative to any of the alternatives. Although site-specific information for future mines is not available until the lessees submit specific mine plans, information is available from past mining activities (e.g., cultural resources, threatened and endangered species, waste-rock and ore characteristics, and transportation practices and routes) and is sufficient for supporting the analyses of potential impacts from future mining activities for the five alternatives, including a thorough cumulative effects analysis.

The results of the evaluation (which incorporate site-specific information) are discussed in detail in Chapter 4 and summarized in Sections 2.4.2 to 2.4.13 and Tables 2.4-4 to 2.4-9). The PEIS was revised to add citations where necessary to indicate the sources for information used in the PEIS analyses, including the sources consulted for developing the assumptions that were used.

The human health analysis of the inhalation of dust pathway addressed potential impacts from dust that could originate from the lease tracts. The analysis took into account the emission potential and wind direction. This analysis (discussed in Section 4.3.5.3) indicates that inhalation of dust is not a significant pathway and does not pose a health concern; that is, the potential cancer risk to an individual in Telluride would be much lower than 1×10^{-6}/yr, based on the estimates of risks presented in the PEIS, at a distance of 3.1 mi (5,000 m) from the lease tracts and the much longer distance (greater than 3.1 mi [5,000 m]) from the lease tracts to Telluride.

Climate change was evaluated in the PEIS (see Sections 4.1.1, 4.2.1, 4.3.1, 4.4.1, and 4.5.1) in terms of greenhouse gases (GHGs) generated by the ULP proposed action for the five alternatives, respectively. The results indicate that under all alternatives, the maximum potential GHG emissions attributable to the ULP would be small. For perspective, ULP GHG emissions would comprise a very small percentage of both Colorado and U.S. GHGs generated (up to 0.03% and 0.0005%, respectively). U.S. GHG emissions account for about one-fifth of global GHG emissions, and GHG emissions from the ULP proposed action would contribute up to about 0.0001% more. The amount of GHGs generated is generally used as a measure of the potential impacts on climate change. ULP operations followed by power generation at nuclear power plants would result in considerably smaller amounts of criteria and toxic air pollutants and GHG emissions than would otherwise be released from fossil power plants. The text in the PEIS has been revised (see the same sections mentioned previously) to explain further how potential impacts from climate change were determined for the PEIS and what the results mean.

The evaluation of potential transportation impacts presented in this PEIS was done in consultation with the Colorado Department of Transportations as reflected in Chapter 4 (see Section 4.3.10 and Table 4.6-1).

The potential impacts to water depletion in the Upper Colorado watershed are evaluated in this PEIS; and DOE has consulted with the USFWS with regards to how this water depletion would potentially impact the Colorado four endangered fish species. PEIS text has been revised to be consistent with the BA and BO (see Appendix E and Section 4.3.6.4).

DOE has initiated programmatic consultation, in compliance with Section 106 of the NHPA, concerning DOE's management of the ULP. Section 106 of the NHPA requires Federal agencies to consider the effect of their undertakings on historic properties and to consult with the appropriate SHPO, American Council on Historic Preservation (ACHP), and other parties that have an interest in the effects of the undertaking on historic properties. For the ULP, per the procedure that has historically been and is currently still being carried out, DOE has addressed consultation through the BLM and the lessees on specific undertakings when ULP activities/plans have been proposed. However, since the NHPA allows for the utilization of a programmatic agreement (PA) to govern large or complex projects, and since PAs can be used when effects on historic properties are expected to be similar and repetitive or regional in scope or when these effects cannot be fully determined prior to approval of an undertaking, DOE has initiated the development of a PA for the ULP. DOE initiated discussion with the BLM and the Colorado SHPO on May 30, 2013. The PA will be revised to address input and review from the consulting parties, and then routed to the responsive parties for concurrence. DOE-LM plans to have the PA in place before issuance of the ULP PEIS ROD.

See also Section 1.7.3.2 for an additional discussion regarding the potential for creating a boom-and-bust economy from uranium mining in the area.

1.7.3.2 Support Alternative 1, which states that 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.

Topic Summary: Commenters requested that the ULP be terminated and that lessees be required to reclaim their operations on their respective lease tracts. Commenters cited concerns over natural resources, cultural resources, human health, transportation, and visual impacts of uranium mining in Colorado for Alternatives 3, 4, and 5.

Many commenters noted that uranium mining is hazardous for human health and the environment. They identified concerns about the radioactivity of waste rock piles and the safety of workers and nearby residents. They also noted that mining is harmful to the environment, likely to adversely affect air and water quality, and may disturb cultural resources. A few commenters also noted that mining conflicted with multiple use policies and should not take place on public lands.

They also noted that mining for uranium creates a boom-and-bust economic cycle and that it would be preferable to promote economic growth based on more sustainable resources (e.g., encourage tourism-based economic growth by promoting natural resources and aesthetics). Some other commenters expressed concerns about potential increases in traffic, noise, dust, and the carbon footprint.

Finally, some commenters asserted that additional uranium mining was unnecessary because the United States already has a robust supply of uranium and is able to import inexpensive uranium from countries like Canada and Australia.

Discussion: DOE has evaluated the range of reasonable alternatives to meet the purpose and need discussed in Section 1.4. After carefully considering all public comments and the results of the PEIS evaluation, DOE has retained Alternative 4 as the preferred alternative in this PEIS. See the detailed discussion regarding the purpose and need in Section 1.7.3.4 that follows.

The PEIS evaluation for potential impacts from the five alternatives as discussed in Chapter 4 (the impacts are also summarized in Section 2.4) concludes that potential impacts on the resource areas (including natural resources, cultural resources, human health, transportation, and visual impacts) evaluated for the five alternatives generally would be negligible to moderate and could be further minimized by implementing the compliance and mitigation measures and/or best management practices (BMPs) described in Section 4.6 and Table 4.6-1. All three phases of mining (exploration, mine development and operations, and reclamation) were evaluated for Alternatives 3, 4, and 5, while only reclamation was evaluated for Alternatives 1 and 2, since these two alternatives do not include continued future uranium mining. See also discussion in Section 1.7.3.1.

With regard to concerns about boom-and-bust economic cycles, the large-scale development of uranium resources in the three-county area could mean the in-migration of workers and their families from outside the region, producing a boom-and-bust scenario with rapid growth in the population and economy, followed by equally rapid economic contraction, unemployment, and out-migration. However, it is likely that all workers required for the mining and reclamation activities analyzed in the PEIS would come from within the three-county area. Thus, with no demographic impacts likely to occur, given the relatively small scale of development under each of the alternatives, no boom-and-bust scenario would be likely to affect either low-income and minority populations or the general population. In addition there is no evidence to suggest that activities under the proposed ULP would have a negative effect on recreation tourism.

1.7.3.3 Support Alternative 4, which is DOE's preferred alternative identified in the ULP PEIS. Under Alternative 4, DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period.

Topic Summary: Many commenters voiced support for Alternative 4, under which DOE would continue the ULP with the 31 lease tracts for the next 10-year period or for another reasonable period. DOE identified Alternative 4 as its preferred alternative. Commenters cited their support of uranium mining and the need to secure uranium resources. They also said that the jobs created by the mining industry were beneficial to the region and its inhabitants. They noted their support for the PEIS procedures and noted that the environmental impact analysis was robust. These commenters said that the uranium mining was safe and had a low environmental impact and that the lessees were good stewards of the environment. They mentioned that it would be preferable to mine uranium in the United States, where environmental regulations are stringent and enforced. Finally, they noted that nuclear energy is an important source of domestic energy production.

Discussion: DOE has carefully considered all public comments and the results of the ULP PEIS evaluation and has identified Alternative 4 as its preferred alternative in this ULP PEIS. The potential impacts discussed in Chapter 4 are summarized in Sections 2.4.1 to 2.4.13 and in Tables 2.4-4 to 2.4-9. See also the discussion in Section 1.7.3.1. DOE believes that uranium mining activities at the ULP lease tracts can continue to be conducted in a manner protective of the environment and public health, as supported by the ULP PEIS analyses and results obtained. For Alternative 4, mine development and operations could create about 229 direct jobs and 152 indirect jobs, generating about $14.8 million in income. Average unemployment for Mesa, Montrose, and San Miguel Counties for 2011 was reported to be about 10.3%, 11%, and 7.6%, respectively (see Section 3.8.1.1). See also the discussion in Section 1.7.3.4 that follows regarding concerns about the purpose and need discussed in Section 1.4 of the ULP PEIS.

1.7.3.4 Concern for NEPA-related issues, such as the appropriateness and adequacy of the purpose and need described in the ULP PEIS; the adequacy of the range of alternatives presented and evaluated; and the need for more specific information to assure that appropriate follow-on NEPA reviews will be conducted as specific mine plans are submitted for DOE approval.

Topic Summary: Many commenters identified NEPA issues in their submissions. Many commenters said that the purpose and need as identified in the PEIS was inadequate. For example, some commenters noted that DOE had oversimplified the Purpose and Need Statement, and, as such, the alternatives identified in the PEIS were not in compliance with Congressional legislation. Some commenters stated that the purpose and need requires an expansion of the scope of the PEIS. Other commenters noted that the alternatives identified in the PEIS did not support the Purpose and Need Statement or that the Purpose and Need Statement was inappropriate. For example, one commenter noted that the Purpose and Need Statement inappropriately focuses on the need to develop these reserves rather than on an analysis of whether it is the prudent time to develop these reserves. Commenters requested that the Purpose and Need Statement be clarified in the Final ULP PEIS.

Many other commenters mentioned that the alternatives identified in the ULP PEIS were inadequate. For example, some commenters requested that a reclamation alternative, in which the ULP is terminated and all disturbed areas are reclaimed, be added to the ULP PEIS. Other commenters requested that an alternative that would keep the uranium ore in place until demand is evident be included in the ULP PEIS. This alternative would call for current uranium demand and prices, as well as projections of future uranium demand and prices, to be considered in determining the number of lease tracts that are developed. Commenters requested that these alternatives be included in the Final ULP PEIS.

Some commenters said that the ULP PEIS fails to satisfy NEPA because additional follow-on NEPA review will not be required for future actions on the ULP lease tracts due to the categorical exclusions provided under the program. To protect Federal lands, these commenters requested that further NEPA reviews, or, at a minimum, an environmental assessment (EA), be performed for future action on the lease tracts. Commenters said that that site-specific data should be used to document the condition of the sites and the cumulative impacts of the program and that future NEPA reviews consider a detailed analysis of the site-specific conditions and foreseeable activities.

Other commenters voiced concerns about public participation in the ULP PEIS process. Some commenters said that the public was not given sufficient time to comment on the PEIS documents. Many commenters requested that the PEIS be re-done and re-released with these issues addressed.

Discussion: DOE does not agree with the comments alleging that the purpose and need for the proposed action requires expansion of the scope of the PEIS. As explained in PEIS Section 1.4, "Purpose and Need for Agency Action," the underlying purpose and need for agency action was established by the U.S. Congress in two provisions of the Atomic Energy Act (AEA): 42 U.S.C. § 2096, which authorized and directed DOE, among other things, to develop a supply of domestic uranium; and 42 U.S.C. § 2097, which authorized DOE "to issue leases or permits for prospecting for, exploration for, mining of, or removal of deposits of source material [including uranium ore] in lands belonging to the United States to the extent DOE deems necessary to effectuate the provisions of the AEA."

The purpose and need for agency action, as described in PEIS Section 1.4, is to support the implementation of those two AEA provisions. Section 1.4 recognizes that in order to support those provisions, "DOE needs to determine the future course of the ULP, including whether to continue leasing some or all of DOE's withdrawn lands and other claims . . . for the exploration and production of uranium and vanadium ores." PEIS Section 1.6, "Scope of the ULP PEIS," therefore describes the scope of its analysis as the evaluation of the five alternatives for managing the ULP, and the evaluation of "the three mining phases associated with the underground and surface open-pit mining methods," which "are the exploration phase, mine development and operations phase, and reclamation phase." Therefore, the AEA provisions are consistent with the present scope of the ULP PEIS, and do not require that the scope be expanded beyond the ULP to analyze the entire nuclear fuel cycle. Further, no DOE decision to be based on this PEIS would change the nation's use of nuclear fuels, including use of nuclear power reactors and management of associated radioactive materials. These and other aspects of the back end of the nuclear fuel cycle are the subject of numerous other NEPA reviews, including many EISs prepared by the Nuclear Regulatory Commission.

The DPEIS's Purpose and Need section, in addition to citing the AEA, also cited the Energy Policy Act of 2005, Public Law 109-58 (EPACT), and stated that EPACT "emphasized the reestablishment of nuclear power (Sections 601 through 657)." Comments alleged that the DPEIS thereby expanded the purpose of the proposed action "through a suggestion that the 2005 Energy Policy Act calls for more nuclear energy," and that the scope should be expanded to include the nuclear fuel cycle for that reason. It was not DOE's intent to make that suggestion in the DPEIS. The cited EPACT sections 601 through 657 constitute EPACT's Title VI, entitled "Nuclear Matters," which addressed various nuclear matters and amended several sections of the AEA. However, EPACT's Title VI did not "call for more nuclear energy," or amend the two provisions of the AEA that the DPEIS cited in the beginning of its Purpose and Need Section: 42 U.S.C. §§ 2096–2097. In order to avoid any confusion regarding the interpretation of the DPEIS's references to EPAct, DOE has amended the Purpose and Need section of this PEIS, in Section 1.4, to explain that Congress expressed, in EPAct, a continued commitment to "decreasing the dependence of the United States on foreign energy supplies" (42 U.S.C. 16181(a)(3)); and to "[e]nhancing nuclear power's viability as part of the United States energy portfolio" (42 U.S.C. §16271 (a)(1). The development of a supply of domestic uranium supports the provisions of the AEA and the EPAct. However, the development of a supply of domestic uranium is separate and distinct from the future utilization of nuclear energy during the entire nuclear fuel cycle. The ULP is related to uranium supply, rather than to future use, which is dependent upon the exact level of future demand for nuclear energy and is therefore uncertain and speculative. The development of a domestic uranium supply, as authorized and directed by Congress in the AEA, enables DOE to support future demand that is uncertain at the present time, whatever its exact level may turn out to be in the future.

Alternative 1 evaluated in the Draft PEIS does provide a localized, in depth analysis—this alternative involves the termination of the leases with reclamation at any areas requiring such. DOE's land withdrawal relates to the extraction of uranium and vanadium resources from the ULP lease tracts. As such, developing alternative energy is outside the scope of the ULP.

DOE does not agree with comments that the Purpose and Need Statement must specify the lessees' mitigation requirements; however, the PEIS does contain a robust discussion of mitigation requirements (see Section 4.6).

Regarding comments about follow-on NEPA reviews, the Draft PEIS stated in Section 1.7: "After the ROD [Record of Decision] is issued, as plans (for exploration, mine development and operation, and reclamation) are submitted by the lessees to DOE for approval, further NEPA review for a given action would be conducted. The level of follow-on NEPA review to be done (e.g., categorical exclusion determination, environmental assessment, or environmental impact statement) would depend on the action being proposed by the lessees, as indicated in the plans submitted. This NEPA review would be conducted to inform DOE's decision on approval of the specific plans, including the conditions DOE would require to mitigate potential impacts." Based on the comments received, Section 1.7 has been revised to state that for all future mining plans submitted for approval, DOE will require, at a minimum, an EA with appropriate public involvement to be prepared to further evaluate potential site-specific impacts. DOE will issue categorical exclusion determinations for classes of actions such as routine maintenance activities that DOE has determined by regulation do not have the potential to result in significant environmental impacts. DOE makes its categorical exclusion determinations publicly available on the internet.

Although some commenters said the public was not given sufficient time to comment on the Draft PEIS, DOE provided over twice the mandatory duration. The 60-day comment period initially provided exceeded the required 45-day comment period. The comment period was extended twice, so that the final comment period lasted for 109 days.

After deliberation, DOE determined that re-issuing of the ULP PEIS is not necessary. DOE has adequately evaluated the range of reasonable alternatives, and the information and analysis in the PEIS are adequate for all of the alternatives (see Chapter 4). DOE has reviewed the public comments and, while DOE has made revisions to the document in response to comments, DOE has not made substantial changes to the proposed action and no new significant information has been discovered so as to warrant issuing a revised Draft ULP PEIS.

1.7.3.5 Reclaim and clean up previously mined sites; conduct reclamation of mined locations during long periods of inactivity.

Topic Summary: Many commenters said that previously disturbed mining sites should be reclaimed before any new mining moves forward. Commenters said that cleanup would provide the region with many more jobs and lead to higher economic growth than that realized from uranium mining. Some commenters voiced a preference for these types of jobs over jobs from the mining industry.

Discussion: Reclamation of all legacy mines under DOE's oversight within the ULP has been completed. There are currently 12 existing mines on eight lease tracts that will ultimately be reclaimed under the ULP. Other mines in the region are not under the ULP and not under DOE's oversight or authority to reclaim. With regard to the number of jobs that could be generated from the reclamation of the currently 12 existing mines on the ULP lease tracts, the estimates provided in Alternative 1 (which evaluates reclamation of these 12 existing mines) indicate that up to 29 direct jobs and 16 indirect jobs could be generated.

Reclamation is required by Federal and state law and by provisions of the lease. Consistent with state requirements, one lease holder has filed environmental protection plans (EPPs), and another lease holder has submitted reclamation plans. State law requires lease holders to enter Temporary Cessation (TC) if inactive for more than 180 days for an initial period of 5 years. A second 5-year TC may be granted by the state. However, under no circumstances shall the TC period be longer than 10 consecutive years. If TC reaches the 10-year maximum, or a second 5-year period is not granted, an operator is required to either reactivate for a year or fully comply with reclamation and EPP requirements.

1.7.3.6 Maintain mined uranium ore from the ULP lease tracts as a domestic supply.

Topic Summary: Many commenters noted in their submissions that they would prefer that uranium mined in the United States not be exported to foreign governments. Some commenters voiced concerns over national security interests, saying that uranium should not be sold to foreign governments to prevent them from engaging in uranium enrichment activities as part of a program to develop nuclear weapons. Other commenters voiced concerns over energy policy interests, saying that uranium should not be exported to foreign governments because domestic nuclear energy needs take precedence.

Other commenters requested that the uranium supply be maintained in the ground. These commenters explained that there is no need to generate additional uranium supply because there are already sufficient supplies of uranium stockpiled for domestic use. Few commenters said that there was no market for uranium and others noted that this country already has a robust supply of uranium. Commenters said that uranium ores should be kept in the ground until the time comes when the stockpiled domestic supply needs to be augmented.

Discussion: DOE's proposed action in the PEIS does not address uranium ore exports, over which the NRC, not DOE, has authority; and the scope of analysis in the PEIS does not analyze the possibility that uranium ore from the ULP may be subject to export. The possibility that uranium or uranium ore from the ULP may be subject to being exported does not undermine the

PEIS's stated purpose and need, and does not require that the PEIS's scope be expanded to analyze the export of uranium or uranium ore. Any export of domestic uranium or uranium ore from any source within the United States, including the ULP lease tracts, is strictly regulated by the NRC under the terms of the AEA and the NRC regulations, which impose requirements that must be satisfied before the NRC will grant a license to export any domestic uranium or uranium ore. See AEA, 42 U.S.C. §§ 2099, 2151–2160d; NRC regulations, 10 C.F.R. §§ 110.19–110.46. For example, 42 U.S.C. § 2099 forbids the NRC from licensing any person to export from the United States any uranium ore, or other source material, if the issuance of such a license "would be inimical to the common defense and security" or the health and safety of the public; 42 U.S.C. § 2155 gives the Executive Branch the authority to veto any export of uranium ore. Many more specific requirements are imposed in the other above-cited provisions of the AEA and the NRC regulations.

In addition, the possibility that uranium ore from the ULP may be subject to export, after a prospective exporter goes through the process of applying for and receiving the necessary permission from the NRC, does not undermine the stated purpose and need for agency action: to support the AEA provisions which authorized and directed DOE to develop a supply of domestic uranium, and to issue leases or permits for prospecting, exploration, mining, or removal of deposits of uranium ore in lands belonging to the United States to the extent DOE deems necessary to effectuate the provisions of the AEA (42 U.S.C. §§ 2096–2097). An active ULP program will be more successful in meeting that need than would an inactive program.

1.7.3.7 Use the ULP lease tracts for generating renewable energy instead of uranium ore production.

Topic Summary: Some commenters said they would prefer that the land within the ULP lease tracts be used to generate renewable energy. They noted that solar or wind resources were plentiful in the region and that DOE should be doing more to promote renewables over nuclear energy. Commenters noted that renewable energy resources such as solar and wind have less of an impact on the region's environment and the health of area residents.

Discussion: The evaluation of the use of the ULP land for development of solar energy or renewable energy is outside the scope of the PEIS; and is not consistent with the "Purpose and Need" discussed in Section 1.4 of the PEIS. However, surface use of a majority of the ULP land for such purposes is not excluded by the ULP Program. Although out of scope in this PEIS, DOE oversees numerous programs that are investigating and supporting a wide variety of energy production technologies, including many based on renewable sources.

1.7.3.8 Although a long list of mitigation measures is presented in the ULP PEIS, some are inadequate, and additional measures need to be included. The ULP PEIS lacks a discussion on the effectiveness of the measures presented. It is also not clear if some of these measures would be required and how they would be implemented.

Topic Summary: Commenters pointed out that mitigation measures identified in the ULP PEIS were inadequate or requested that additional mitigation measures be added to the ULP PEIS. Several commenters said that the buffer zone around the Dolores River was inadequate and requested that it be expanded. Commenters noted several other mitigation measures that needed to be strengthened or modified. For example, one commenter noted that to mitigate radionuclides from blowing onto residences, it would be necessary not only to cover the waste rock piles with soil but also to spray the soil with water or some other barrier. Commenters were also concerned about the enforceability of the mitigation measures. They noted that resources would best be protected if lessees were required to undertake the identified mitigation measures.

Discussion: As indicated in Section 4.6, measures that are identified as compliance and mitigation measures would be implemented because they are required by law (compliance measures) or have been identified to minimize potential impacts (mitigation measures) as included in the leases. The ULP PEIS also indicates that mitigation measures that are currently not in the leases would be included as leases are modified. Implementation of the compliance and mitigation measures would be under the oversight of the corresponding oversight agencies. DOE is responsible for assuring that lease requirements are met and thus would enforce mitigation measures in leases.

1.7.3.9 The cumulative impacts analysis does not cover enough area and does not address some projects in the region of cumulative impacts, such as the oil and gas wells present in the area. The conclusions or determinations of negligible to minor potential cumulative impacts need to be re-evaluated.

Topic Summary: Many commenters said that the cumulative impacts analysis was inadequate. Commenters noted that some information was not included in the cumulative impacts analysis, such as the impacts that could result from climate change and oil and gas activities. Other commenters noted that the cumulative impacts analysis did not address the impacts from the Piñon Ridge Mill. Commenters said the ULP PEIS lacked a detailed cumulative impacts study; excluded an investigation of long-term economic development, transportation corridors, and public health; and failed to consider the combined impacts of all past and present uranium activities in this region. Commenters requested that these analyses be performed for the final issuance of the ULP PEIS.

Discussion: DOE has reviewed the analysis of cumulative impacts in light of these comments to ensure that it is adequately comprehensive to provide a basis for informed, environmentally sound decision making.

GHG emissions would be small (see discussion in 1.7.3.1).

Oil and gas projects within the 50-mi (80-km) ROI considered in the PEIS are discussed and evaluated in Section 4.7.2.4. A total of 3,121 wells are located within the ROI studied, as shown in Figure 4.7.2. Table 4.7-8 summarizes potential impacts in the ROI during exploration and future development of oil and gas lease parcels. The cumulative impacts evaluation in Section 4.7.2.2 did analyze all past and present uranium activities within the 50-mi (80-km) ROI. The proposed Piñon Ridge Mill is also evaluated relative to cumulative impacts, since it is within the 50-mi (80-km) ROI addressed in this PEIS. Section 4.7.1.1 describes the Piñon Ridge Mill project and its potential impacts on the environment and human health as discussed in reports prepared by Energy Fuels. This information was then incorporated into Section 4.7.4 to determine the cumulative impacts for this ULP PEIS.

Studies on long-term economic development, transportation corridors, and public health as suggested by these commenters are not within the scope of this ULP PEIS. However, this ULP PEIS does conservatively analyze the time frame for addressing the life-cycle of the proposed action (i.e., considered the 10-year or longer time that mining activities could occur under the lease terms), and it considers cumulative impacts from all reasonably foreseeable future actions with the 50-mi (80-km) ROI under cumulative impacts.

1.8 OTHER RELATED, SIMILAR, CONNECTED, OR CUMULATIVE ACTIONS

Consistent with NEPA requirements, the identification of related, similar, connected, or cumulative actions to the ULP proposed action was conducted. There are other uranium mining projects planned by other entities for areas near the ULP lease tracts (e.g., Sunday Mines [see Section 4.7.2.2.5]). Although these actions are similar in type of activities conducted and potential impacts on the environment and human health, they are not considered connected to the ULP proposed action, because these other uranium mining projects could or would occur regardless of the ULP proposed action. These projects are, however, included in the cumulative impacts evaluation discussed in Section 4.7 of the ULP PEIS, because they could occur within the ROI for cumulative effects and at the same time frame considered for the ULP proposed action.

The proposed or ongoing uranium ore milling activities at the proposed Piñon Ridge Mill and at the existing White Mesa Mill could be considered related but not connected to the ULP proposed action. That is, the ore generated from the ULP proposed action could be processed at these nearby mills; however, the White Mesa Mill can continue operating as it currently does and the proposed Piñon Ridge Mill can be constructed and operated regardless of the ULP proposed action. Similar to the uranium mining projects discussed above, the impacts or potential impacts from these two mills are also included in the cumulative impacts evaluation discussed in Section 4.7 of the ULP PEIS.

In its capacity as a cooperating agency for the ULP PEIS process, CPW provided the following information on an activity that could be related to the ULP proposed action and alternatives evaluated. CPW has been participating in the Dolores River Dialogue (DRD), a coalition of diverse interests whose purpose is to explore management opportunities and build support for and take action to improve the ecological conditions downstream of McPhee Reservoir on the Dolores River. The DRD also seeks to honor water rights, protect agricultural and municipal water supplies, and facilitate the continued enjoyment of rafting and fishing on the Dolores River. A subcommittee of the DRD is the Lower Dolores River Working Group (LDWG), a group that was formed specifically to explore alternatives to the National Wild and Scenic River Act (WSRA) designation. This group identified a "National Conservation Area" (NCA) as its alternative to the current Federal identification of the Dolores River as suitable for WSRA designation. Establishment of an NCA requires Congressional action. Since July of 2010, a legislative subcommittee appointed by the LDWG has been working to define the parameters and goals of the legislation while ensuring the protection of identified Outstandingly Remarkable Values under the WSRA. Part of this effort has contemplated a Federal mineral withdrawal within 0.25 mi (0.4 km) of the Dolores River that could affect the DOE ULP and the ULP PEIS.

1.9 CONSULTATION

DOE is complying with Executive Order (E.O.) 13175, Section 7 of the ESA, and Section 106 of the National Historic Preservation Act (NHPA) by engaging in consultations with respective tribes, government agencies, and local historical groups. Sections 6.1, 6.2, and 6.3 describe the consultation efforts undertaken to date.

The government-to-government relationship with Indian tribes was formally recognized by the Federal Government with E.O. 13175 on November 6, 2000, and DOE is coordinating and consulting with Indian tribal governments, Indian tribal communities, and tribal individuals whose interests might be directly and substantially affected by activities on the ULP lands. As part of this consultation, DOE has contacted 25 Indian tribal governments to communicate the opportunities for government-to-government consultations by participating in the planning and resource management decision-making throughout the ULP PEIS process. Five are participating as cooperating agencies, and four are participating as commenting agencies (see Section 1.10).

In the NOI (76 FR 36097) to prepare the ULP PEIS, DOE stated that it is preparing to enter into consultation with the USFWS, in compliance with Section 7 of the Endangered Species Act, concerning DOE's management of the ULP. Section 7 requires Federal agencies to consider the effect of their undertakings on species listed under the Act and to consult with the USFWS to ensure that the action or actions that they fund, authorize, or permit are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the critical habitat of such species. DOE and the USFWS initiated the informal consultation, and DOE submitted the Final BA to the USFWS on May 14, 2013. The USFWS issued a BO on August 19, 2013. Details are discussed in Section 6.2 of the ULP PEIS.

DOE has initiated programmatic consultation, in compliance with Section 106 of the NHPA, concerning DOE's management of the ULP. Section 106 of the NHPA requires Federal agencies to consider the effect of their undertakings on historic properties and to consult with the appropriate SHPO, American Council on Historic Preservation (ACHP), and other parties that have an interest in the effects of the undertaking on historic properties. For the ULP, per the procedure that has historically been and is currently still being carried out, DOE has addressed consultation through the BLM and the lessees on specific undertakings when ULP activities/plans have been proposed. However, since the NHPA allows for the utilization of a programmatic agreement (PA) to govern large or complex projects, and since PAs can be used when effects on historic properties are expected to be similar and repetitive or regional in scope or when these effects cannot be fully determined prior to approval of an undertaking, DOE has initiated the development of a PA for the ULP. Details are discussed in Section 6.3.

1.10 COOPERATING AND COMMENTING AGENCIES

DOE invited various Federal, state, and county agencies and tribal nations to participate either as a cooperating agency or commenting agency in the preparation of the ULP PEIS. Since January 2012, monthly, as appropriate, telephone conferences have been held between DOE and the cooperating agencies to develop the ULP PEIS. The following government agencies and tribal groups are participating as cooperating agencies by providing their expertise and required knowledge:

1. *BLM:* Jurisdictional responsibilities in land use planning, designations, or restrictions on and surrounding DOE-withdrawn lands; and an understanding of the potential impacts from increased mining and oil and gas exploration and development. An MOU between the BLM and DOE (BLM and DOE 2010a) is currently in place that identifies the individual and shared roles and responsibilities of DOE and the BLM with respect to the DOE ULP (see Section 5.4 for a summary of this MOU).

2. *EPA:* Expertise in addressing the protection of human health and the environment (e.g., water quality, air quality, and radiation protection).

3. *Colorado Department of Transportation (CDOT):* Knowledge of local and regional transportation systems including primary and secondary highways.

4. *CDRMS:* Expertise in mining and reclamation and the safety requirements attendant to these activities. An MOU between DOE and CDRMS (DOE and CDRMS 2012) is currently in place for the purpose of promoting coordination between DOE and CDRMS to result in efficient and effective oversight of uranium and vanadium mining on the DOE ULP lease tracts (see Section 5.4 for a summary of this MOU).

5. *CPW:* Expertise in addressing the protection of wildlife.

6. *Mesa County Commission:* Expertise in identifying limits to mitigate potential impacts that energy development activities, such as uranium mining, would

have on the county's economy, residents, and the environment, including its primary and secondary roadways.

7. *Montrose County Commissioners:* Expertise in socioeconomic, transportation, and water quality issues related to the county.

8. *San Juan County Commission:* Expertise in identifying limits to mitigate potential impacts that energy development activities, such as uranium mining, would have on the county's economy, residents, and the environment, including its primary and secondary roadways.

9. *San Miguel County Board of Commissioners:* Expertise in identifying limits to mitigate potential impacts that energy development activities, such as uranium mining, would have on the county's economy, residents, and the environment, including its primary and secondary roadways and land use and planning.

10. *Navajo Nation:* Knowledge of cultural resources in the area.

11. *Pueblo of Acoma*: Knowledge of cultural resources in the area.

12. *Pueblo de Cochiti*: Knowledge of cultural resources in the area.

13. *Pueblo de Isleta*: Knowledge of cultural resources in the area.

14. *Southern Ute Indian Tribe:* Knowledge of cultural resources in the area.

The following agencies and tribal groups chose to participate as commenting agencies, and they were included in the project distribution list and received the Draft ULP PEIS for review and comment:

1. USFWS,

2. U.S. Nuclear Regulatory Commission (NRC),

3. CDPHE,

4. Utah Department of Transportation (UDOT),

5. Hopi Nation,

6. Ute Indian Tribe,

7. Ute Mountain Ute Tribe, and

8. White Mesa Ute Community.

1.11 ORGANIZATION OF THE ULP PEIS

The remainder of the ULP PEIS is composed of the following chapters and appendices:

- Chapter 2 describes the alternatives evaluated in the ULP PEIS and compares them with regard to their potential environmental and human health impacts.
- Chapter 3 presents a discussion of the affected environment for each of the resource areas analyzed in the ULP PEIS utilizing site-specific information.
- Chapter 4 provides the results of the evaluation of potential environmental and human health impacts based on site-specific information and assumptions, as appropriate.
- Chapter 5 summarizes applicable requirements relative to the proposed action.
- Chapter 6 summarizes all consultation activities conducted for the proposed action.
- Chapter 7 presents an index for the ULP PEIS.
- Chapter 8 lists references cited in the preparation of the ULP PEIS.
- Appendix A provides examples of leases.
- Appendix B provides a summary of comments received during the public scoping period.
- Appendix C describes the assumptions for the impacts analyses.
- Appendix D describes the methodology used for the impacts analyses.
- Appendix E contains the correspondence between DOE and the USFWS regarding the Endangered Species Act (ESA, Section 7) consultation and (provides the BA and BO for the ULP).
- Appendix F contains the letters of consultation.
- Appendix G provides the list of preparers for the ULP PEIS.
- Appendix H provides the contractor disclosure statement.
- Appendix I presents the comment response document.

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2 PROPOSED ACTION AND ALTERNATIVES

Consistent with the purpose and need discussed in Chapter 1, DOE has evaluated five alternatives that address the range of reasonable options for managing the ULP. These options range from terminating all the leases and conducting reclamation where needed, with DOE continuing to maintain oversight of the lands without uranium leasing; terminating the leases and conducting reclamation where needed, restoring the lands to the public domain by the DOI and if approved, placing the lands under BLM's administrative control and terminating the DOE ULP; and continuing the ULP with associated exploration, mine development and operations, and reclamation at some or all of the 31 lease tracts. Table 1.2-1 in Chapter 1 lists the 31 lease tracts and provides information on the current status of each.

DOE developed the range of alternatives by carefully considering DOE's underlying need for action and comments received during the public scoping period for the draft version of the ULP PEIS. The five alternatives are as follows:

1. *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.

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.

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.[1]

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.

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.

In the ULP PEIS, DOE has evaluated each alternative for its potential impacts on the following 13 human health and environmental resource areas using available site-specific information (e.g., Cotter Corp. 2011, 2012a–g) in combination with assumptions, as appropriate (see Figure 2-1):

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[1] In July 2007, DOE issued a programmatic environmental assessment and finding of no significant impact for the ULP, which a U.S. District Court invalidated on October 18, 2011.

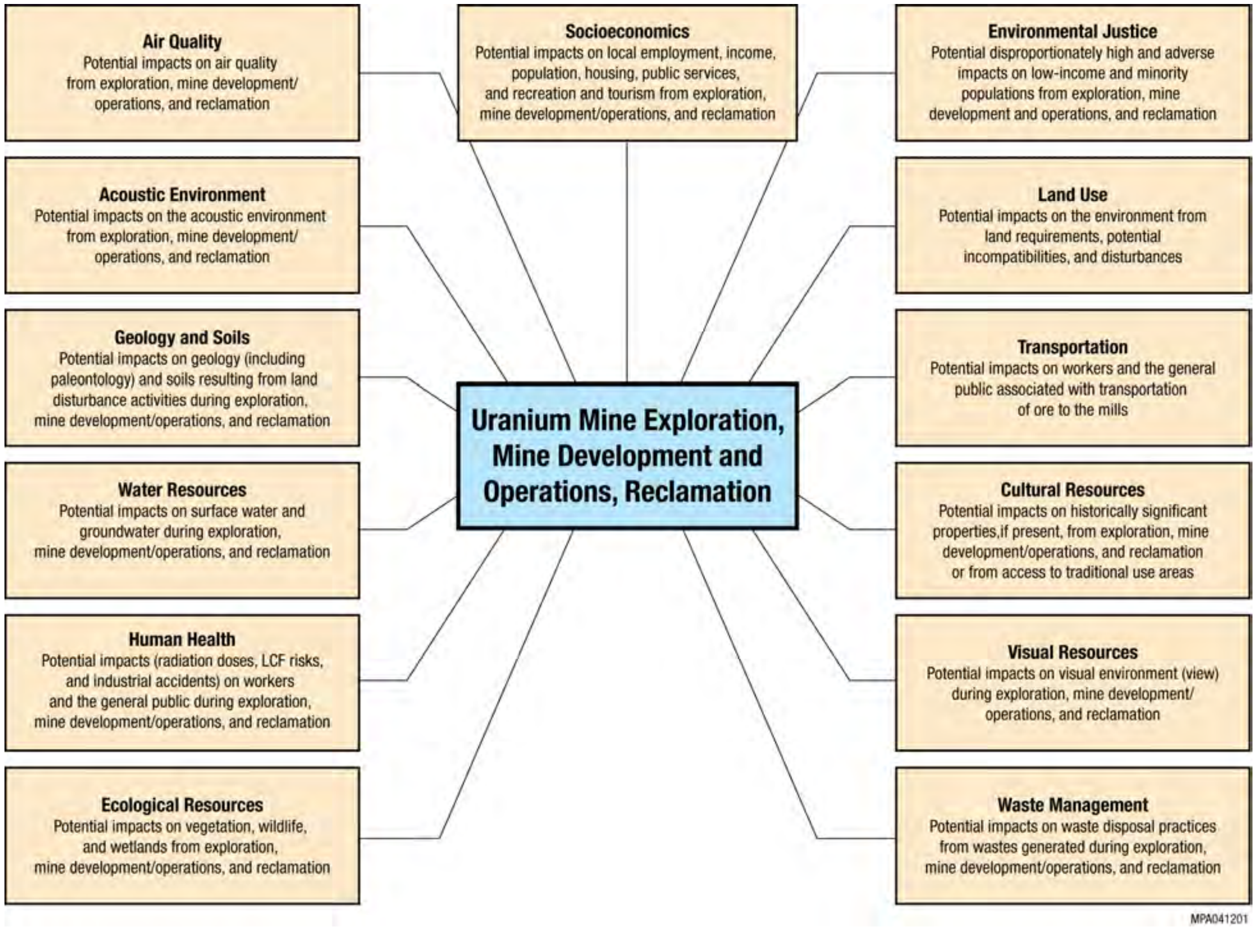


FIGURE 2-1 Thirteen Human Health and Environmental Resource Areas That Are Evaluated for Potential Impacts from Exploration, Mine Development and Operations, and Reclamation

1. Air quality,
2. Acoustic environment,
3. Geology and soils,
4. Water resources,
5. Human health,
6. Ecological resources,
7. Land use,
8. Socioeconomics,
9. Environmental justice,
10. Transportation,
11. Cultural resources,
12. Visual resources, and
13. Waste management.

In addition to the above resource areas, DOE has evaluated cumulative impacts (see Section 4.7) that could occur when potential impacts from the proposed action are considered with past, present, and reasonably foreseeable future actions in the region of influence (ROI) for cumulative impacts for the ULP PEIS. The five alternatives are also analyzed for the three phases of uranium mining: exploration; mine development and operations; and reclamation, as applicable to the given alternative. Section 2.1 discusses the three phases of mining, and Section 2.2 describes each alternative and the associated assumptions developed as basis for the evaluation. Section 2.3 provides the discussion on alternatives considered but not evaluated in detail. Section 2.4 summarizes the potential impacts discussed in Chapter 4. Section 2.5 discusses the irreversible and irretrievable commitment of resources that result from the five alternatives; and Section 2.6 discusses the preferred alternative.

2.1 URANIUM MINING METHODS AND PHASES

The uranium mining methods that have been used on the DOE ULP lease tracts have included both underground and surface open-pit mining. However, underground mining was used most often in the past and is expected to be the primary method used in the future. The mining activities are conducted in three phases as follows: (1) exploration; (2) mining development and operations; and (3) reclamation. These three phases are described in Sections 2.1.1 through 2.1.3. For the purpose of providing relevant information about where the ore generated from the DOE ULP could be milled or processed, Section 2.1.4 presents descriptions of the two mills that could be available to process the ore generated from the DOE ULP lease tracts: the White Mesa Mill and the proposed Piñon Ridge Mill. The processing of the ore generated at the DOE ULP is outside the scope of the ULP PEIS (see Section 2.3). However, the impacts of ore transportation from the lease tracts to the mills and the potential cumulative impacts of the two mills to the ULP proposed action are evaluated (see Section 4.7).

2.1.1 Exploration

The exploration phase is considered a pre-production activity. This phase is typically conducted in a relatively short period of time (i.e., several weeks); however, it can occur annually over the course of several years. It involves planning, obtaining access to the lease tracts, constructing temporary roads as required, and performing exploratory drilling. Exploration holes are drilled to determine the exact location and grade of uranium ore present. A temporary access road is typically prepared to give a drill truck, a pipe truck, and a water truck access to the location identified for exploration; such temporary roads are generally less than 20 ft (6.1 m) in width.

During the exploration phase, surface disturbance would be limited to the minimum area required to obtain a grade and provide for the safe transportation of drilling equipment and personnel. The surface area disturbance would typically include the removal of vegetation and the leveling of high points in the rights-of-way (ROWs). Excavated surface soil material would be stockpiled for use during reclamation. Borrow ditches, crowning, waterbars, culverts, side-slope stabilization measures, and riprap would be used, as necessary, to control erosion.

Typically, access to a drilling location is established first, and then a site that is about 15 × 50 ft (4.6 × 15 m) is leveled to allow a drill rig to operate. Typically four to six exploration holes are drilled by a driller and an assistant. This activity is carried out by the two workers essentially over a short period of time (two days to two weeks). The exploration holes are typically about 6 in. (15 cm) in diameter and can vary in depth from shallow (tens of feet), to moderate (hundreds of feet), to deep (greater than 1,000 feet). During drilling, grab samples are collected from the drill cuttings for every 5 ft (1,5 m) and saved for geologic study. After the exploration holes have been drilled, a probe truck operated by one worker is brought to the site to gamma-log the hole to determine the depth to and width of the ore zone and ore grade. The ore grade is determined by the chemical assay results for the grab samples sent to the laboratory for analysis. After probing is completed, reclamation via plugging of the exploration holes is performed. However, the temporary roads may or may not be reclaimed immediately. This approach allows exploration to be repeated in the same area if necessary, depending on the results of the probe or grab samples. Reclamation of the temporary roads typically involves contouring the surface, followed by revegetation.

Before this phase can be conducted, an exploration plan must be submitted by the lessees to the DOE for review and approval (see Section 4.7.2.2.7). In addition, a "notice of intent for prospecting" must be submitted to the CDRMS for approval. The exploration plans are to include descriptions of: (1) the specific areas to be explored and the designated proposed access roads (existing or new) to be used, accompanied by maps and aerial photos, as available; (2) the exploration method to be employed; (3) how compliance with NEPA or other applicable environmental requirements is being achieved; and (4) the reclamation to be conducted on the disturbed areas.

In addition, the lessees would be required to obtain authorization for access to the lease tracts. BLM would administer off-lease access, while DOE would administer on-lease access. The lessees are also responsible for obtaining authorizations from any private, local, and state landowners where oversight is not held by the BLM or DOE.

2.1.2 Mine Development and Operations

As previously mentioned, the most commonly used mining methods for recovering uranium and vanadium ore in the area where the DOE ULP lease tracts are located have been either underground or surface open-pit mining. In situ leaching (ISL) method is not considered to be a viable method because of the location of the ore in "dry" sedimentary strata (see Section 2.4). It is expected that most future mining on the DOE ULP lease tracts would be done by using the underground method because of the location of the anticipated ore resources in the area. Activities common to both underground and surface open-pit mining include accessing the ore deposits, controlling possible pollutants, conducting mine maintenance, hauling ore and waste rock, and transporting ore to the mills for processing.

When the underground mining method is used, the ore and waste rock from the mine workings are transported through adits (almost horizontal mine entrances) and drifts (mine tunnels) to the aboveground storage and waste-rock pile areas by using rubber-tired (trackless) equipment. The ore and mine waste rock can also be transported by similar means to the ore skip and hoisted to the surface through the main production shafts. Some amount of waste-rock material may be placed back or “gobbed” into the mine workings after the ore has been completely mined and in which no groundwater issues have been demonstrated to exist.

When the surface open-pit mining method is used, overburden consisting of mudstone, shale, and sandstone is removed first to expose the ore deposit. This material is considered mine waste rock and is removed with conventional heavy equipment (such as excavators or shovels, front-end loaders, scrapers, bulldozers, and haul trucks), and transported and stockpiled at an area designated for such material. The waste-rock pile that remains on the surface eventually is graded and vegetated as part of the reclamation activities. The ore is also removed by using similar equipment.

Before mining, lessees would be required to submit mine plans to DOE for review and approval. Mine plans would include descriptions of the operational activities to be conducted. These operational activities typically involve (1) surface-plant area construction and (2) mine development and operations. These two activities are discussed in more detail in Sections 2.1.2.1 and 2.1.2.2. In addition, a “Reclamation Permit Application” (plan of operations) must be submitted to CDRMS for review and approval.

2.1.2.1 Surface-Plant Area Construction and Operations

The following types of infrastructure are typically located at the plant area of a surface mine site (applicable for both underground and open-pit mining methods): buildings; other structures; utilities; a service area; a storage area; mine water discharge and treatment ponds; a mine waste-rock pile; and other waste containment areas. These make up the infrastructure that supports mining operations. This surface area footprint could take up to 25 acres (10 ha), depending on the size of the mine in operation. The surface mine plant configurations would vary depending on the specific project needs and locations of the lease tracts. Figures 2.1-1 through 2.1-4 show the surface mine plant configurations that are present or were formerly present at several lease tracts. Figure 2.1-5 is a schematic of a generic mine plant surface configuration.

Buildings to be constructed could vary, from offices to maintenance shops to storage sheds. They would be constructed and maintained in accordance with Federal, state, and local regulations. Utility needs could include electricity, air, and water. Electricity to operate mining equipment, lighting, and ventilation fans could be supplied by aboveground lines or through generators. Air compressors would be used to supply the air needed for drilling equipment and tools. Water would be hauled to the mine site from a water supplier. Sewage and wastewater would be disposed of through a septic system or a portable facility.

A service area would also be developed to service vehicles, bulldozers, water trucks, and other heavy equipment used for the mining operations. Fuel storage tanks, water tanks, and 55-gal (210-L) oil barrels, if needed for the operations, would be located in this area. As part of maintenance activities, hoses, fuel lines, tank exteriors, and equipment parts stored in the service

FIGURE 2.1-1 Photograph of Mine Plant Surface Configuration at Lease Tract 5

FIGURE 2.1-2 Photograph of Mine Plant Surface Configuration at Lease Tract 7 (JD-7 Underground Mine)

FIGURE 2.1-3 Photograph of Mine Plant Surface Configuration at Lease Tract 8

FIGURE 2.1-4 Photograph of Former Mine Plant Surface Configuration at Lease Tract 13A

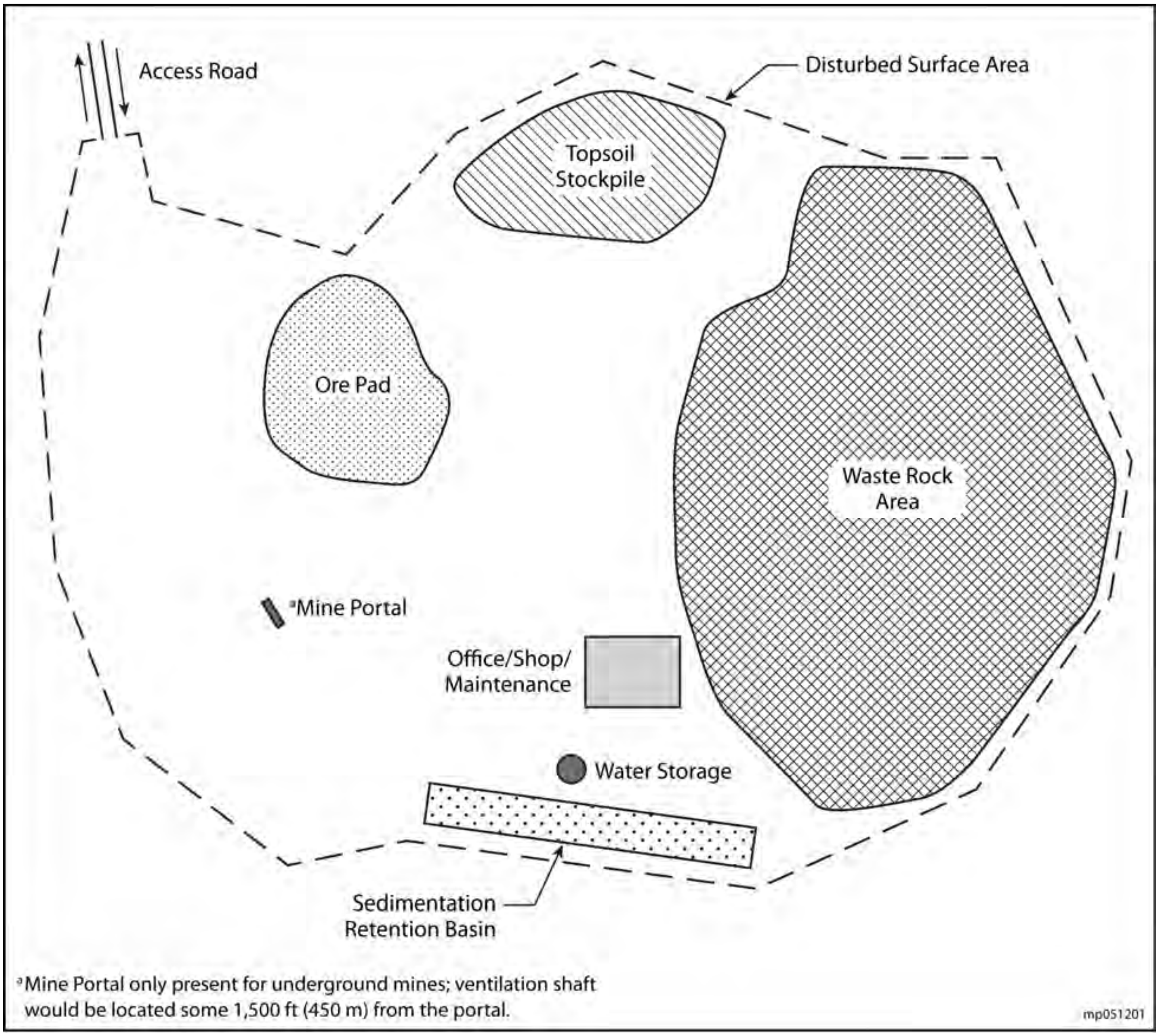


FIGURE 2.1-5 Schematic of a Generic Mine Plant Surface Configuration

area would be routinely inspected by the lessee or mine operator. In addition, berms and secondary containment for gasoline, solvent, and oil storage facilities would be installed. If there was a petroleum spill or leak that required notification of Federal and state agencies, the lessee or mine operator would be required to conduct containment and cleanup activities that were consistent with spill prevention and control provisions in the approved mine plan.

Materials and chemicals needed for mine operations would be stored in compliance with Federal, state, and local regulations. Chemicals would primarily include solvents, oils, degreasers, and other substances used to maintain vehicles. Explosives would also be stored away from areas where volatile substances were located. The approved mine plan would also contain a contingency plan that would outline which types of stored material spills would be reported. Emergency equipment (e.g., first-aid supplies, liquid spill response supplies, and fire extinguishers) would also be kept on hand. Emergency equipment, such as mine rescue equipment, would be maintained on site in a centralized location that would allow for quick response times in accordance with Mine Safety and Health Administration (MSHA) requirements.

Mine water discharge and/or treatment ponds for receiving discharge water from the mines might have to be built. Before construction, the lessees would have to consult with the USFWS to address any concerns that the agency might have. CDRMS requires water treatment ponds to be adequately designed by a certified engineer, lined, provided with a secondary containment, and equipped with a leak monitoring system, as needed. Regulations might require that the ponds be adequately lined, fenced, and netted to ensure that wildlife and livestock and the surrounding environment would not be adversely affected. Water would be pumped into discharge ponds from mine sumps constructed in mine areas where there was an accumulation of water. Mine water would be treated to meet applicable discharge standards, as necessary. Water would then be allowed to flow into a settling pond, where it could be evaporated or discharged to the environment at a discharge location specified per a state water discharge permit and National Pollutant Discharge Elimination System (NPDES) requirements. The state permits are issued and enforced by the CDPHE, Water Quality Control Division. Maintenance of these ponds would include replacing the liners and, when required, reclaiming the ponds after removing the precipitated sediments and liners. Sediment and liners would be disposed of at a state-approved disposal facility. Pond inspection would be conducted by CDPHE as part of its enforcement of the permit. CDRMS also inspects water treatment and stormwater containment structures as part of its permit for maintenance and proper use.

The surface-plant area would also hold a mine waste-rock pile. Mining operations (both underground and surface open-pit) would involve the removal of rock materials to allow access to the ore deposits of interest. This would result in large amounts of mine wastes. As mentioned previously, some amount of waste rock might be gobbed back into the mine workings after the ore had been completely mined out where no groundwater issues have been demonstrated to exist. Because it is impractical to separate the waste-rock materials, they could contain small quantities of miscellaneous mining-related debris (remnants of mine timbers, drill steels, and other materials used during the ore removal process). Most of the waste-rock pile, however, would be composed of large fractions of coarse rock. The uranium content of the waste-rock pile would be minimal (0% to 0.05% of uranium). State requirements stipulate that any material containing more than 0.05% of uranium be considered radioactive material and be handled accordingly. In this case, the lessees would take the material to the mills for disposition. Colorado State regulations require lessees to construct diversion channels and berms around the waste-rock piles to prevent stormwater runoff from entering or leaving the piles. Rainwater percolating through the coarse rock would not leach significant amounts of uranium. CDRMS regulations require the construction of stormwater diversion ditches as part of the EPP (e.g., Cotter Corp. 2011, 2012a–g). The design for the stormwater diversion ditches has to be approved by an engineer.

Lastly, mining operations would also generate various types of other waste, including domestic trash (e.g., from lunch rooms, used timbers, old mining equipment, empty 55-gal (208 L) petroleum barrels, and other mining debris). These waste materials would be contained temporarily on the surface plant until taken off site to a disposal facility. In addition, the lessee would be required to store and dispose of any hazardous waste that was generated. Similar to the nonhazardous waste, the hazardous waste would also be taken off site for disposal per Federal, state, and local requirements.

2.1.2.2 Mining Method – Underground Mining

Underground mining would typically be accomplished by a random room-and-pillar method. This method involves leaving random pillars of ore and waste rock in place to provide support while ore material is removed. Two different techniques could be used to mine the ore: (1) the drill, blast, and then muck technique (muck refers to the loading and removal of ore or mine waste rock from the mine); and (2) the continuous-miner technique.

The first technique could include the use of jackleg drills or similar devices to drill holes 2 in. (5 cm) in diameter and 6- to 10-ft (1.8- to 3.0-m) deep in the rock face. The holes would then be filled with explosives that would be detonated. The broken material would be removed with shuttle equipment, such as multi-ton haul trucks or buggies. Split-shooting might also be used in areas with narrow ore seams. With this technique, waste rock would be drilled, blasted, and mucked. The same process would then be used to remove the ore seam. After this, shot-creting, rock-bolting, chain-link fencing, or other methods would be used to support the mined areas.

The continuous-miner technique would use a machine referred to as a “miner” that removes ore and waste rock without disturbing the surrounding host rock. The miner would deliver the ore and the waste rock directly to haul trucks for removal. The mined-out areas would then be supported in a manner similar to that used for the conventional method just discussed.

Water would be needed during mining operations. For example, water would be required for underground drilling to suppress airborne dust and to remove cuttings from drill bits. Most underground mines are dry, but some mines, depending on their location, receive seepage from nearby shallow aquifers. This seepage could be one of the sources of water supply for these mines; other sources could include nearby municipal water supplies and other approved sources. If water was not available on site, it would be obtained from the closest available source and hauled to the mines by using water trucks. The amount of water needed would depend on the level of mining activity and the number of workers involved. Applicable Federal, state, and local agency requirements would be met, and permits would be obtained, as appropriate.

During underground mining operations, the safety of mine workers and protection of the environment would be of primary concern. MHSA regulations would require the lessees to do the following:

- Routinely monitor the mine for air quality and noise level. Ventilation shafts to the surface or other ventilation systems would be constructed, as needed, to ensure that the air quality was protective of the workers.

- Protect the workers from cave-ins by using steel or timber sets and other cribbing materials to brace mine walls, backs (or ceilings), and other surfaces.

- Secure mine entrances during periods of temporary shutdown and during periods of daily inactivity. Only authorized individuals would be allowed to enter the mines; the public and wildlife would be discouraged from entry by means of fences, gates, posting, and other barriers.

2.1.2.3 Mining Method – Surface Open-Pit Mining

With the exception of the large surface open-pit mine that exists on Lease Tract 7 (which could resume operations in the future to include a potential increase in the current footprint of the open pit mine area), the surface open-pit mining that could be conducted at the ULP lease tracts would consist of relatively small mining operations and would generally use a trenching method. This method involves the removal of small amounts of waste rock to expose the ore. The ore would then be removed by conventional techniques.

Larger operations would generally be conducted via a traditional, benched open pit. The depth and size of the ore deposit would dictate the surface dimensions of the pit and benches and the amount and size of equipment used. Underground mines could be used to access ore deposits around the periphery of the main deposit. The maintenance required for the open-pit mine operations would be done primarily to maintain the side walls of the pit, since they are subject to slope failure and erosion from stormwater runoff.

2.1.3 Reclamation

When mining activities were completed and no future intended lease activities remained, the lessee would be required to initiate reclamation activities consistent with the reclamation provisions included in the approved mining plan. The reclamation provisions would be consistent with BLM's reclamation closure guidelines (BLM 1995) and CDRMS regulations. Mine permit and mine permit amendment applications are required to include reclamation plans. The following information is partly abstracted from reclamation plans prepared by Cotter Corp. (2011, 2012a–g).

Reclamation would include recontouring the land to restore it to its original topography as closely as practicable, replacing surface soil, implementing erosion-control measures, and revegetating disturbed areas with appropriate native and adapted species (a seed mix has been developed for the ULP; see Table 4.1-9 for the list of species included in the seed mix). Surface-plant improvements would be removed in accordance with DOE and other agency requirements. Open shafts, adits, and declines would be closed. Mine waste-rock piles would be graded to a slope (e.g., 3:1 slope or shallower) determined to provide stable soils and where vegetation could grow to desired standards, contoured, covered with surface soil, and seeded in accordance with an approved reclamation plan. Residual ores and other radioactive materials inherent to the site but not taken to the mill for processing would be placed back into the mine workings as part of the portal closure process. Effort would be made to retain all topsoil material removed from the area and stockpiled for use in reclamation. In areas where stockpiled surface soil material was insufficient, surface soil might be borrowed from other areas of the lease tract or from areas preapproved by the BLM. CDRMS would require additional permitting up to and including a possible new permit for any “borrow area” unless it is within the approved CDRMS permit boundaries. DOE would monitor reclamation success each year and would require the lessee to correct problems until the reclamation met state and DOE requirements.

At mine sites, debris and waste (other than waste rock) would be managed according to waste management procedures defined in the mine plans (e.g., waste would be transported to permitted landfills or licensed disposal facilities, as in the case of waste containing low-level radioactivity). Consideration would be given to recycling or returning the materials to the manufacturers, as appropriate. Lessees would be required to comply fully with applicable U.S. Department of Transportation (DOT) requirements (49 CFR Parts 100−180).

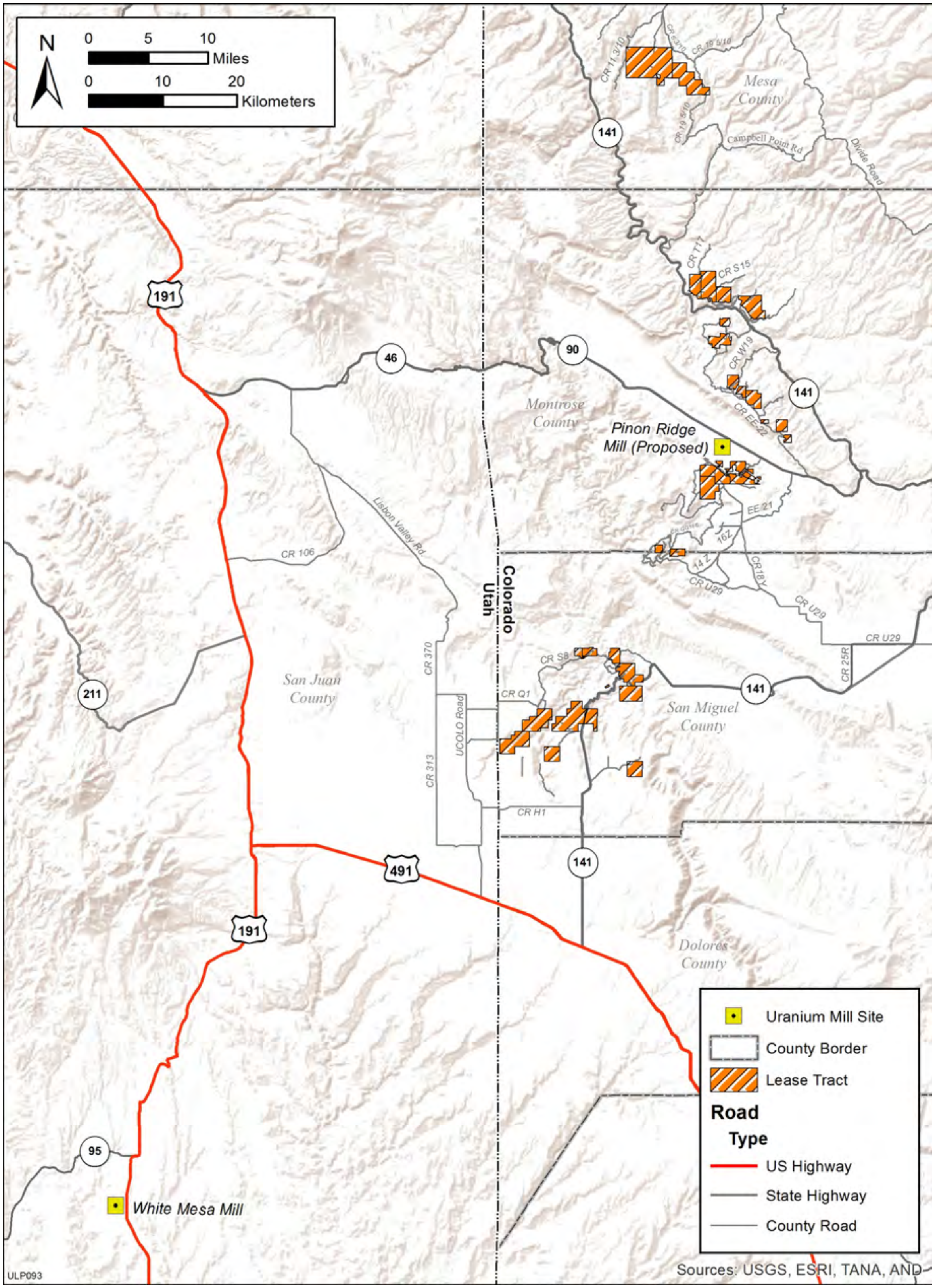
Appropriate agencies (e.g., CPW, USFWS, BLM) would be contacted before reclamation activities began to assure that wildlife species that might have taken up residence (e.g., bat or bird species listed as sensitive) would not be adversely affected by permanent shutdown activities. Ecosystem concerns associated with wetland areas would be addressed if a determination was made that wetlands were created as a result of mining operations.

2.1.4 Ore Processing

The ore generated from the DOE ULP lease tracts could be taken to two mills for processing—the Proposed Piñon Ridge Mill and the White Mesa Mill (see Figure 2.1-6). The discussion here for the two mills is to provide information about the mills; ore processing is not part of the ULP proposed action. However, as mentioned previously, the impacts of ore transportation from the lease tracts to the mills and the potential cumulative impacts of the two mills (see Section 4.7) to the proposed action are evaluated.

2.1.4.1 Piñon Ridge Mill

Energy Fuels Resources Corporation has planned to construct the Piñon Ridge Mill (a conventional uranium mill) in Paradox Valley, between Naturita and Bedrock in Montrose County, Colorado. In early 2011, the Colorado Department of Public Health and Environment (CDPHE) issued a final radioactive materials license to Energy Fuels Resources Corporation (which is an asset of Ontario’s Energy Fuels, Inc., located in Lakewood, Colorado), following CDPHE’s preparations of a decision analysis and environmental impact analysis (CDPHE 2011d). A group of plaintiffs then challenged that license by filing a lawsuit against CDPHE in Colorado’s District Court for the City and County of Denver. On June 13, 2012, the court issued a decision in which it held that the CDPHE had unlawfully issued the license without conducting the necessary administrative procedures. The 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

1 

2 **FIGURE 2.1-6 Locations of White Mesa Mill and Proposed Piñon Ridge Mill**

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.

The proposed Piñon Ridge Mill would process uranium and vanadium into uranium oxide concentrate (yellowcake) and vanadium oxide concentrate, respectively, by using the solvent extraction process (Energy Fuels Resources 2012a; Edge Environmental, Inc. 2009). 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 Resources (CDNR 25 2012; Energy Fuels Resources 2009; Edge Environmental, Inc. 2009).

The proposed Piñon Ridge Mill would be constructed on approximately 400 acres (160 ha) of an 880-acre (360-ha) property boundary. Facilities at the mill will consist of mill buildings, including a stockpile pad, mill/leach tank building, boiler building, solvent extraction building, and drying/packaging building; maintenance buildings; waste management facilities such as tailing cells and evaporation ponds; and ancillary facilities, including access roads, an administration building, secondary mill buildings (warehouse, offices, and laboratory), parking facilities, power and heating systems, a fueling station, water pumps, a septic system, and a fence. Construction is anticipated to last 21 months and employ between 125 and 200 workers at its peak. Upon opening, the mill is projected to employ approximately 85 people, working three 8-hour shifts, 24 hours per day, 7 days per week, for 350 days per year. Operations are expected to last for 40 years (Piñon Ridge Mill 2012; Edge Environmental, Inc. 2009).

Host rock will be mined mostly from existing operations (owned and operated by Energy Fuels Resources Corporation) throughout southwestern Colorado and southeastern Utah. Ore would be shipped to Piñon Ridge Mill and received and stored at the ore stockpile pad. From here, the ore will be crushed, mixed with water to create a fine slurry, and then leached with sulfuric acid, resulting in the precipitation of uranium oxide concentrate (yellowcake) and vanadium oxide concentrate, produced at a rate of 500 tons per day. Uranium oxide concentrate would then be shipped to a conversion plant, while the vanadium oxide concentrate would be shipped to a plant that produces ferro-vanadium products (Edge Environmental, Inc. 2009). Energy Fuels is also the lessee for several of the DOE ULP lease tracts.

2.1.4.2 White Mesa Mill

The White Mesa Mill is the only conventional uranium mill operating in the United States. The mill, under the operation of Denison Mines/Energy Fuels Resources Corporation, is located off SH 191, 6 mi (10 km) south of Blanding, Utah. It processes ore from the Colorado Plateau and Arizona Strip as well as from alternate feeds. The mill uses sulfuric acid leaching and solvent extraction to precipitate uranium oxide concentrate (yellowcake) and vanadium oxide concentrate. In addition, the White Mesa Mill is licensed to process 18 different uranium-bearing alternate feed materials, which are processed parallel to conventional uranium ore.

Alternate feed materials are uranium-bearing materials other than conventional ores, which are classified as waste products by the generators of the materials (Denison 2012a).

The mill was originally licensed to Energy Fuels, Inc., by the NRC on March 31, 1980, and was renewed in 10-year increments in 1987 and 1997. The State of Utah took over regulatory oversight of the mill in 2004, and the mill license was reissued as a State of Utah Radioactive Materials License on February 16, 2005. In addition, the mill possesses 15 license amendments that allow it to process 18 different alternative feed sources. White Mesa Mill also operates under a groundwater discharge permit and an air quality approval order. Air quality, groundwater, surface water, soil, and vegetation monitoring are conducted at regular intervals, and the results of radiometric scans are reported biannually (Denison 2012a).

Denison Mines took ownership of the mill in December 2006. In February 2007, Denison Mines submitted a formal application and all required documents for license renewal to the Utah Department of Radiation Control, which is currently reviewing public comments received during the public review process. The license remains valid during the license renewal process (UDEQ 2012b; Denison Mines 2012a). In April 2012, Energy Fuels Resources announced the purchase of all Denison Mines' U.S. assets, including the White Mesa Mill. The transaction closed in August 2012, allowing Energy Fuels Resources immediate access to the mill (UDEQ 2012b).

White Mesa Mill is licensed to process an average of 2,000 tons of ore per day and produce 8.0 million lb (3.6 million kg) of uranium oxide per year (Denison 2012a). The mill began processing conventional ore in November 2011, after years of processing only alternate feeds. In 2011, the mill produced approximately 1.0 million lb (0.5 million kg) of uranium oxide and 1.3 million lb (0.6 million kg) of vanadium oxide (Denison 2012b). In full operation, the mill employs approximately 150 people (Denison 2012a).

2.2 FIVE ALTERNATIVES EVALUATED

As discussed previously at the beginning of this chapter, DOE evaluated five alternatives for the ULP PEIS; these alternatives are similar to those presented in the NOI (76 FR 36098).

2.2.1 Alternative 1

Alternative 1 would involve terminating the existing leases, of which there are currently 29, and conducting reclamation as needed. Two of the 31 lease tracts are not leased. There are currently no ongoing operations on any of the lease tracts, so no ongoing operations would need to be terminated. Reclamation would need to be conducted at 10 of the 31 lease tracts. These 10 lease tracts (5, 6, 7, 8, 9, 11, 13, 15, 18, and 26) shown on Figure 2.2-1 have areas that were disturbed in the past either for exploration or from operations. Table 2.2-1 presents a list of these lease tracts, the lessees, and the approximate acreage that would have to be reclaimed at each lease tract. Existing structures that would have to be removed during reclamation are also listed. Reclamation plans submitted to DOE for review and approval would have to be consistent with

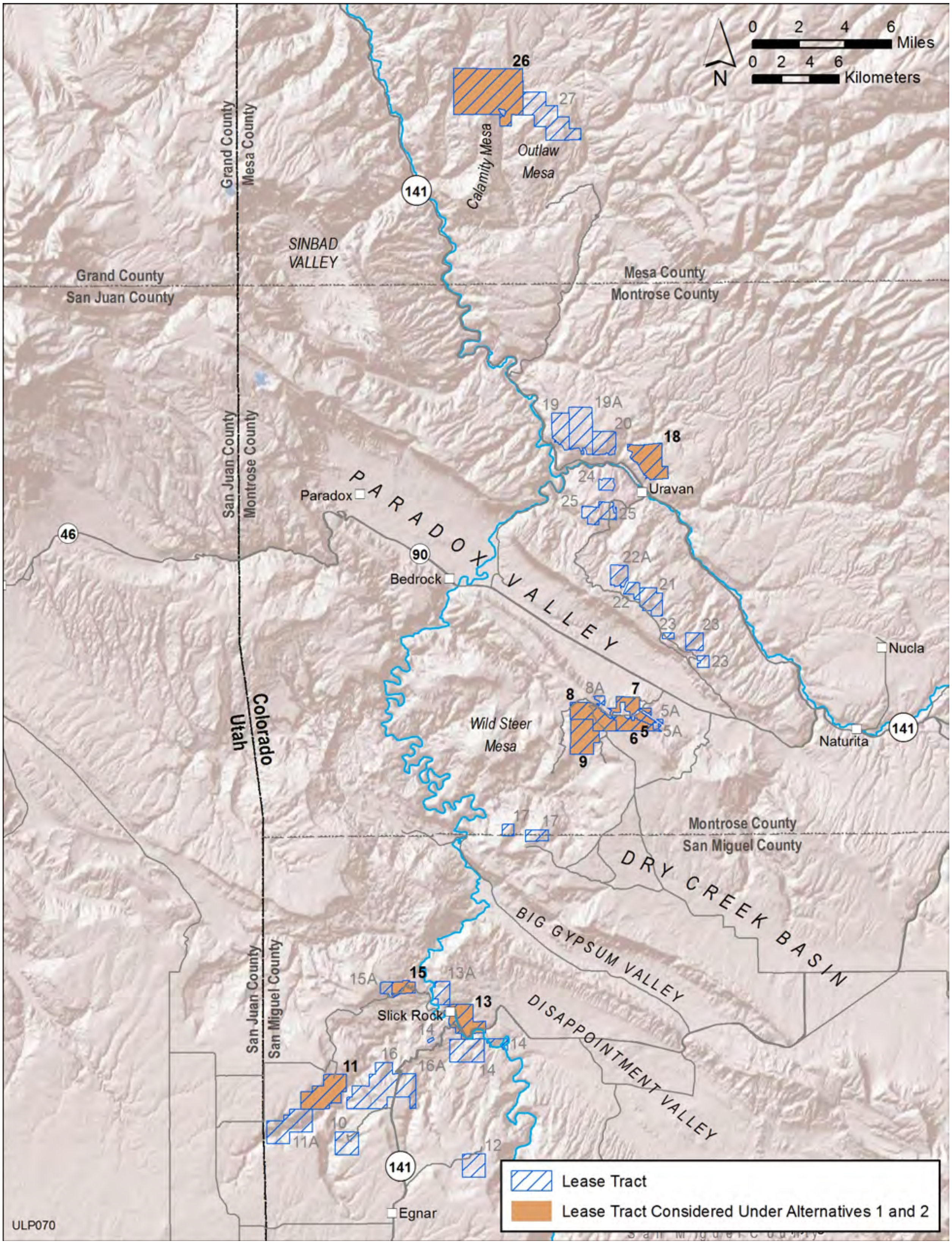


FIGURE 2.2-1 Locations of Lease Tracts Evaluated under Alternatives 1 and 2

TABLE 2.2-1 Lease Tracts Evaluated under Alternatives 1 and 2

Lease Tract	Lease Tract Acreage[a]	Approximate Acreage of Mine Site Surface To Be Reclaimed	Structures That Need To Be Removed or Reclaimed	Lease Holder
5	151	7	Head frame, hoist house, vent fan, timbered ore bins	Gold Eagle Mining, Inc.
6	530	8	Two vent fans	Cotter Corporation
7	493	210	Small and large shop buildings, three water treatment ponds, 6,000-gal water tank, vent fan, substation	Cotter Corporation
8	955	5	None	Cotter Corporation
9	1,037	8	Shop building, four water treatment ponds, three vents, hoist house, pump house, substation	Cotter Corporation
11	1,303	5[b]	Office trailer, 6,000-gal water tank	Cotter Corporation
13	1,077	8	Grated vent	Gold Eagle Mining, Inc.
15	350	1	None	Gold Eagle Mining, Inc.
18	1,181	4	Shop building, vent fan	Cotter Corporation
26	3,989	1	None	Energy Fuels
Total		257		

[a] Indicates total acreage for the lease tract; only disturbed areas need to be reclaimed as listed in the next column.

[b] In early November 2005, when construction of the decline was temporarily suspended, Cotter Corporation had disturbed just less than 5 acres (2 ha) and had advanced the decline approximately 300 ft (90 m). The development of the decline created a small mine waste-rock dump at the site, which is how conditions remain to date.

CDRMS requirements. CDRMS requires that reclamation plans take into account existing and planned structures before a permit is issued. The reclamation of these structures is approved prior to the issuance of the permit. Any changes not consistent with the approved plans would require a revision to the CDRMS permit.

After the leases were terminated and reclamation was completed, DOE would continue to manage the withdrawn lands and not lease these lands for uranium mining purposes. Under Alternative 1, after reclamation was complete, essentially no activity would occur on the lease tracts aside from continued maintenance to assure conditions would remain consistent with Federal, state, and local requirements. Surface rights would continue to be held by the BLM, and current activities approved or permitted by the BLM would continue under BLM oversight.

2.2.1.1 Basis for Impacts Analyses for Alternative 1

The affected environment for resource areas evaluated in the ULP PEIS is discussed in Sections 3.1 through 3.13. Impacts discussed in Chapter 4 are based on assumptions summarized in this section and in Appendix C.

It is assumed that the 29 leases would be terminated and that reclamation would commence on the lease tracts where it was needed. Currently, there are 14 reclamation permits on developed leases on the ULP issued by CDRMS, and reclamation would be conducted per existing permits, as appropriate. However, since reclamation plans have not been updated recently for any of the lease tracts, assumptions regarding how reclamation would be accomplished have been developed for the purposes of the evaluations presented in the ULP PEIS. Under current lease requirements, it is assumed that reclamation would span a 3-year period, with field work assumed to be completed for all 10 lease tracts within 1 year in order to analyze a "peak year" that could represent the most potential impacts within a given year. An additional time period of about 2 years is incorporated in the assumption to allow an adequate amount of time for the re-seeding to take hold and for the subsequent final approval and release from the state. A workforce of 29 workers would be employed for 1 year to perform the reclamation field work. It is assumed that a team of five workers would be employed for about 3 to 4 months to conduct the reclamation needed per lease tract. After completing one lease tract, the teams would then proceed to reclaim the remaining lease tracts. Hence, three teams of five workers each are assumed for the reclamation of the nine lease tracts, excluding Lease Tract 7, where the JD-7 mine is located. It is assumed that an additional 14 workers would be required to complete the reclamation of JD-7 in 1 year. It is also assumed that field work associated with all reclamation would be conducted during the day to mitigate potential noise concerns. This approach is consistent with current lease requirements that reclamation commence and be completed within 180 days of the termination of a given lease.

Reclamation undertaken for Alternative 1 would require various types of equipment, including front-end loaders, backhoes, dump trucks, bulldozers, flat-bed trailers with a tractor, pick-up trucks, large track hoes, and scrapers (see Appendix C for details).

Existing waste-rock piles present in some lease tracts would be graded to a slope consistent with the surrounding area (e.g., a 3:1 slope or shallower), covered with surface soil materials (soil or dirt material originally excavated from the lease tract itself), and seeded.

A seed mix for revegetating the disturbed surface areas, including the graded waste-rock piles, has been developed. The list of species included in the seed mix was developed in consultation with the BLM and has been used within the Slick Rock, Naturita, Uravan, and Gateway, Colorado, areas. Seed selection criteria were based on climate and elevation ranges within these areas. Because surface soil conditions, nutrients, and available moisture can vary within these areas, the successful establishment of six or more of the 12 species is considered adequate. The species making up the seed mix are presented in Table 4.1-9. Revegetation efforts on the disturbed areas would be considered satisfactory when soil erosion resulting from the operation was stabilized and when a vegetative cover representative of the vegetation that was present before the disturbance was reestablished.

2.2.2 Alternative 2

Under this alternative, the same 29 leases addressed in Alternative 1 would be terminated. The primary difference between Alternative 1 and 2 is that under Alternative 2, after reclamation was completed by the lessees on the 10 lease tracts listed in Table 2.2-1 and shown on Figure 2.2-1, DOE would relinquish all the withdrawn lands for potential management by BLM in accordance with 43 CFR § 2372.3. DOE's uranium leasing program would end. The land would then be under BLM's administrative control, and DOE would terminate the ULP.

Under BLM management, private parties could establish new uranium mining claims under the 1872 mining law. The potential impacts from any future potential uranium mining under BLM management would likely be similar to those discussed in the ULP PEIS (e.g., those discussed for Alternatives 3 through 5, depending on the level of mining activity). If BLM determines that the relinquished lands cannot be managed as public domain lands, the General Services Administration (GSA) would evaluate potential management and disposition options.

2.2.2.1 Basis for Impacts Analyses for Alternative 2

The basis for the analysis of impacts for Alternative 2 in the ULP PEIS is the same as that for Alternative 1 (discussed in Section 2.2.1). Activities that could contribute to potential impacts would primarily result from the reclamation activities that would need to be conducted. Therefore, resource needs (e.g., number of workers, equipment) for Alternative 2 are assumed to be the same as those indicated for Alternative 1. Reclamation achieved by DOE's lessees for this alternative is expected to meet the reclamation requirements of DOE, BLM, and CDRMS.

2.2.3 Alternative 3

Under Alternative 3, DOE would continue with exploration, mine development and operations, and reclamation at the 13 lease tracts for which leases existed prior to July 2007. The leases on the remainder of the lease tracts would be terminated. The 13 leases before July 2007 were on Lease Tracts 5, 6, 7, 7A, 8, 9, 11, 13, 13A, 15, 18, 21, and 25. Lease Tracts 7 and 7A (separate tracts at that time) were since combined (February 2011) into Lease Tract 7 (held by Cotter Corporation). The lease tracts, which now number 12 (as shown in Figure 2.2-2), either have approved exploration drill holes and/or have existing inactive mines or permits for new underground mines. Of the 12 lease tracts, 9 are leased to Cotter Corporation, and the remaining 3 are leased to Gold Eagle Mining, Inc. Table 2.2-2 presents a list of the lease tracts evaluated under Alternative 3. Other relevant information about these lease tracts is also presented.

This alternative assumes future mine development and operations would occur on the 12 lease tracts for the next 10 years or for another reasonable period of time, with subsequent reclamation to be conducted after the operations were considered complete. Leases could be extended after the 10-year period was met. It is expected that all mines to be developed at the 12 lease tracts would be underground mines, with the exception of Lease Tract 7, where an open-pit mine currently exists and would likely be operated. This expectation is consistent with the current status of the 12 leases summarized in Table 2.2-2. Notwithstanding the existing, permitted mines located on the lease tracts (that would be expected to resume operations), no new project-specific plans have been submitted to DOE by the lessees. Accordingly, for the

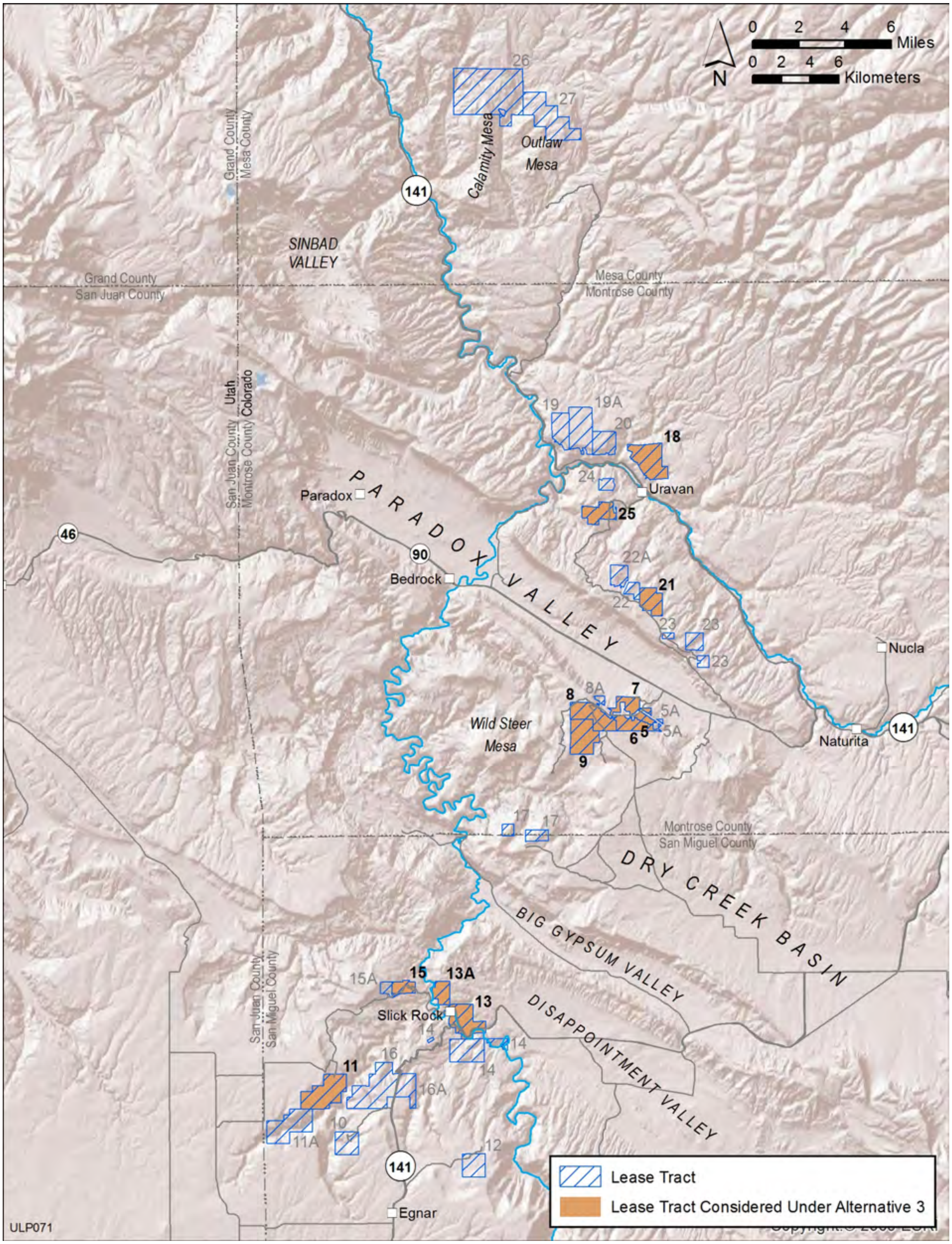


FIGURE 2.2-2 Locations of Lease Tracts Evaluated under Alternative 3

1 **TABLE 2.2-2 Lease Tracts Evaluated under Alternative 3**

Lease Tract	Acreage	Location (County)	Lessee	Current Status
5	151	Montrose	Gold Eagle Mining, Inc.	One existing permitted underground mine
6	530	Montrose	Cotter Corporation	One existing permitted underground mine
7	493	Montrose	Cotter Corporation	Two existing permitted mines: one underground and one very large open pit mine
7A[a]	–	–	–	–
8	955	Montrose	Cotter Corporation	One existing permitted underground mine
9	1,037	Montrose	Cotter Corporation	One existing permitted underground mine
11	1,303	San Miguel	Cotter Corporation	New permit for one underground mine yet to be developed
13	1,077	San Miguel	Gold Eagle Mining, Inc.	Three existing permitted underground mines
13A	420	San Miguel	Cotter Corporation	Exploration of one hole approved; drilling and reclamation of the explored area completed
15	350	San Miguel	Gold Eagle Mining, Inc.	One existing permitted underground mine
18	1,181	Montrose	Cotter Corporation	One existing underground mine
21	651	Montrose	Cotter Corporation	Exploration of two holes approved; drilling and reclamation of the explored area completed
25	639	Montrose	Cotter Corporation	Exploration of one hole approved; drilling and reclamation of the explored area completed

[a] Lease Tract 7A, which existed in 2007, was combined with Lease Tract 7 in February 2011.

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purposes of the analyses for the ULP PEIS, additional assumptions have been developed to form the basis of the impacts analyses for Alternative 3, as discussed in Section 2.2.3.1.

2.2.3.1 Basis for Impacts Analyses for Alternative 3

It is assumed that activities associated with the exploration phase would be minor, given that at all 12 lease tracts involved under Alternative 3 contain existing permitted mines or have been the subject of exploration activities. However, assumptions for the exploration phase for Alternative 3 were developed and are summarized in Appendix C (Section C.1). It is assumed that the total disturbed surface area for the exploration of the two small mines, the four medium mines, and the one large mine would be about 0.11 acre (0.04 ha), 0.44 acre (0.17 ha), and 0.17 acre (0.06 ha), respectively. The one disturbed area for the very large open-pit mine (the JD-7 mine) is about 210 acres (80 ha). It is further assumed that the total number of workers for the exploration phase for Alternative 3 is eight workers.

For the purposes of the impact analyses in the ULP PEIS, a "peak year" of activity representing a reasonable upper-bound level of activity was analyzed in order to provide conservative yet reasonable estimates for Alternative 3, addressing impacts that could result from the largest number of mines that could be operated at the same time. The peak year could occur more than once; that is, there could be multiple years with the same number of mines operating at similar ore production rates. It is also reasonable to expect that there would be a smaller number of mines in operation or that ore production could be less in the years other than the peak year(s). Uranium ore from some of the mines could be exhausted before the 10-year lease period, and operations at these mines could end sooner than the 10-year lease period. The potential impacts for years other than the peak year(s) would fall within the range of impacts discussed in Chapter 4.

For Alternative 3, the potential impacts for the 10-year lease period would be expected to be no more than 10 times those for the peak year, if the assumptions for all 10 years of operations are the same as that for the peak year discussed here.

For the mine development and operations phase for Alternative 3, it is assumed that a total of eight mines (two small, four medium, one large, and one very large) would be in operation at the same time in the peak year of operations. Although the lessee companies would develop and operate multiple mines at the same time, they would most likely start with one mine at a time per company and move to initiate the second mine after 8 months or so from the start of the first mine, and so on, until all of the mines assumed to operate at the same time would be in operation. This approach would allow the lessees to optimize their resources. The assumptions related to the peak year are considered reasonable given the number of lease tracts involved, the number of mines in operation in previous operational periods at the ULP and given that they reflect reasonable expectations regarding potential mining that could be conducted in the near future.

Given that Colorado State permits have already been obtained for most of the lease tracts and given that that these permits remain in effect, the peak year of operations for Alternative 3 could occur as early as year 5 or 6 after the first mine development commenced. The lessees would have to submit a plan to DOE for review and approval prior to the commencement of mining. For existing mines on some of the lease tracts, however, operations could resume sooner and simultaneously; this could result in a peak year that would occur sooner. There could be several peak years, depending on how much ore was available on the lease tracts. It is also expected that some of the mines would be terminated before others, depending on the availability of ore deposits. A 10-year lease period would allow for, on average, about 6 years of operations for each of the mines, and that amount of time might or might not be enough to exhaust the ore that would be available, depending on the lease tracts. However, under Alternative 3, the lease period for a given lease could be extended beyond the 10-year period for another reasonable period, which would then allow additional time for mining operations.

Other assumptions made to estimate potential impacts from this alternative include the tonnage that would be generated by each mine, the size of the surface area that would be disturbed by each mine, the number of workers needed, and the amount of water needed for each mine. (It is assumed that this water would be trucked into the work site and used as potable water, for showers, and for other activities such as dust control.) For Alternative 3, it is assumed that in addition to the two retention pond systems that currently exist at ULP mine sites (located at medium-size mines at Lease Tracts 7 and 9), an additional two new retention pond systems could be utilized for the new mines. Potential future mining operations at Lease Tracts 8 and 13 could encounter water that might need to employ retention pond systems. These ponds are primarily intended to capture surface water and prevent sediment from entering nearby streams and drainages. The pond volumes are between 330,000 gal (about 1 acre-ft) and 470,000 gal (about 1.5 acre-ft) with discharge rates of between 160,000 gal/mo (0.5 acre-ft/mo) and 280,000 gal/mo (0.86 acre-ft/mo). These assumptions are generally based on past uranium mining experiences in the area and are summarized in Table 2.2-3 (see Appendix C for details).

While the existence of ore stockpiles during active mining operations is expected, the duration is not expected to affect human health and the environment. The Colorado State regulations prohibit the stockpiling of ore at the mine sites for more than 180 days.

For the reclamation phase, a workforce of 29 workers would be employed for a 1-year period to perform the reclamation field work for a peak year (see Appendix C for additional details). It is assumed that a team of five workers would be employed for about 3 to 4 months (adjusting for seasonal considerations) to conduct the reclamation needed per lease tract. Hence, three teams of five workers each are assumed for the reclamation of the nine lease tracts, excluding the JD-7 mine. It is assumed that an additional 14 workers would work on the reclamation of the JD-7 mine for 1 year. The peak year of reclamation has been analyzed to address a reasonable upper-bound scenario to provide a conservative estimate of potential impacts; however, it is expected that reclamation would be conducted for a given lease tract when mining operations were considered complete. Similar to Alternatives 1 and 2, it is assumed that field work associated with reclamation would be conducted during daytime work hours.

Reclamation undertaken for Alternative 3 would require the same equipment as that discussed for Alternatives 1 and 2. Details on assumptions related to (1) other materials needed

TABLE 2.2-3 Number of Mines, Ore Production Rate, Disturbed Surface Area, Number of Workers, and Water Usage Assumed for the Peak Year of Operations under Alternative 3

	Values for Parameter per Mine Size				
Parameter Assumed	Small	Medium	Large	Very Large	Total of All Sizes
Number of mines	2	4	1	1[a]	8
Ore production total (tons/d)	100 (50 per mine)	400 (100 per mine)	200	300	1000[b]
Total disturbed acreage	20 (10 per mine)	60 (15 per mine)	20	210[c]	310[d]
Number of workers[e]	14 (7 per mine)	44 (11 per mine)	17	51	126
Water usage (gal/mo)	15,200 (7,600 per mine)	124,000 (31,000 per mine)	46,000	160,000	345,000[f]

[a] This is the large open-pit mine that currently exists on Lease Tract 7, also known as the JD-7 open-pit mine.

[b] This amounts to a total of 20,000 tons per month, assuming 20 days per month of operations; and to a total of 2,400,000 tons, assuming 10 years of operations at the peak year level.

[c] The 210 acres at the JD-7 mine is already disturbed. In addition, about 80 acres have already been disturbed for the topsoil storage area, which is located on private land and not on the lease tract.

[d] After accounting for the 210 acres already disturbed at the JD-7 mine, there would be 100 acres of additional disturbance under Alternative 3, based on the assumptions made for the purposes of the ULP PEIS.

[e] It is assumed that the number of workers at each small mine would work for one shift and that the workers at the medium, large, and very large mines would work for two to three shifts.

[f] For the JD-7 open-pit mine, water usage assumed is for 6 months only (summer) for dust suppression activities. Assuming 10 years of operation at the peak-year level, 120 ac-ft of water would be used. Annual water usage is about 3,200,000 gal (9.8 ac-ft). See Appendix C for details.

for both the mine development and operations phase and the reclamation phase, (2) the cost of equipment and materials needed, and (3) the sanitary and other waste generated are provided in Appendix C. Data on the emissions generated from these phases of mining for Alternative 3 are also provided in Appendix C.

2.2.4 Alternative 4

All 31 lease tracts (see Table 1.2-1 and Figure 1.4-1 in Chapter 1) are assumed to be available for potential exploration and mining of uranium ores under Alternative 4. Leases on the ULP lease tracts would be continued for the next 10 years or for another reasonable period, as appropriate. The current leases include the stipulation for extending the lease period for a given lease, as needed.

As discussed previously in Section 1.7, Lease Tract 8A and Lease Tract 14 (i.e., Lease Tracts 14-1, 14-2, and 14-3) are currently not leased. Lease Tract 8A is a small tract that is isolated and may be located entirely below or outside the uranium-bearing formation, which could indicate a lack of ore. Lease Tract 14 is composed of three parcels (14-1, 14-2, and 14-3).

There was some interest in Lease Tracts 14-1 and 14-2 by potential lessees in the past; however, the third tract (14-3, which lies east of 14-1) is located almost entirely within the Dolores River corridor and was never leased. The leases stipulate that no new mining activity could be conducted within 0.25 mi (0.4 km) of the Dolores River.

As is the case for Alternative 3, no new project-specific plans have been submitted to DOE by the lessees with regard to where and how many mines might be developed and operated in the near future. For the purposes of the analyses for the ULP PEIS, various assumptions have been developed to form the basis of the impact analyses for Alternative 4. These assumptions are discussed in Section 2.2.4.1. Current expectations indicate that most, if not all, of the mines would be underground, with the exception of the JD-7 mine on Lease Tract 7, which is a surface open-pit mine.

2.2.4.1 Basis for Impacts Analyses for Alternative 4

It is assumed that under Alternative 4, there would be a total of 19 mines operating at various production rates at the same time during what would be considered the peak year of operations. Similar to Alternative 3, it is further assumed for Alternative 4 that there would be a smaller number of mines in operation in the years other than the peak year, and that this peak year could occur more than once (that is, there could be multiple years with the same number of mines operating at similar ore production rates). It is expected that the potential impacts for years other than the peak year(s) would fall within the range of impacts discussed in the ULP PEIS in Chapter 4. Similar to Alternative 3, the potential impacts for 10 years of operation would be expected to be no more than 10 times those for the peak year, if the assumptions for all 10 years would be the same as that assumed for the peak year discussed here.

Table 2.2-4 presents the assumed number of mines and associated production rates. The size of the mine (small, medium, large, or very large) was assigned based on the assumed ore production rate. The disturbed surface area, which varies somewhat depending on the size of the mine, is also presented in the table.

These assumptions were developed based on a review of historical information and current expectations regarding potential mining that could be conducted in the near future (see Appendix C for detail). For the exploration phase for Alternative 4, it is assumed that a total of 0.33 acre (0.13 ha), 1.1 acre (0.44 ha), and 0.33 acre (0.13 ha) of surface would be disturbed for the 6 small, 10 medium, and 2 large mines assumed, respectively. For the very large mine, 210 acres (92 ha) has already been disturbed at the JD-7 surface open-pit mine. A total of 20 workers would be required to conduct the exploration phase for the number of mines assumed for Alternative 4 (not including the very large open-pit mine at JD-7, for which exploration is assumed to have been completed).

For Alternative 4, an additional important factor taken into account for the assumed ore production rate in the peak year was the milling capacity at the White Mesa Mill and the proposed Piñon Ridge Mill. The maximum capacities were estimated to be 2,000 tons/d for White Mesa Mill and 1,000 tons/d for Piñon Ridge Mill. However, the proposed Piñon Ridge

TABLE 2.2-4 Number of Mines, Ore Production Rate, and Disturbed Surface Area Assumed for the Peak Year of Operations under Alternative 4

	Value for Parameter per Size of Mine				
Parameter Assumed	Small	Medium	Large	Very Large (JD-7)[a]	Total of All Sizes
Number of mines	6	10	2	1	19
Ore production rate (tons/d)	300 (50 per mine)	1000 (100 per mine)	400 (200 per mine)	300	2000[b]
Total disturbed surface area (acres)	60 (10 per mine)	150 (15 per mine)	40 (20 per mine)	210[a]	460[c]

[a] The one very large mine that is assumed is the JD-7 open-pit mine (on Lease Tract 7), which has been explored and developed but is currently not in operation. The area developed is about 210 acres.

[b] Total tonnage per day that is assumed to be produced exceeds the assumed milling capacity of 1,500 tons/d, but it is further assumed that the excess tonnage produced could be stockpiled for a few days, since the mills process ore on 7 days per week, while production typically occurs only on 5 days per week. Total tonnage of ore generated for 10 years of operation at the peak-year level would be about 4,800,000 tons.

[c] The total additional area that would be disturbed would be 250 acres, since 210 acres from the JD-7 mine is already accounted for from previous disturbance. The total area disturbed for Alternative 4 is 460 acres. This acreage should remain the same through the life of Alternative 4.

Mill is expected to process only up to 500 tons/d in its initial operating period once it is built, and it is expected to reach its maximum capacity of 1,000 tons/d only after several years of operation. Appropriate approvals would also have to be obtained before the proposed Piñon Ridge Mill could increase its milling capacity. Also, the proposed Piñon Ridge Mill is expected to process uranium ore from other mines in addition to the ore generated from the DOE ULP lease tracts, and doing so could take up at least 65% of its milling capacity. The White Mesa Mill also processes ores from other sources. Hence, the assumption of 2,000 tons/d of total ore production on the DOE ULP lease tracts in the peak year could be considered reasonably conservative in that it takes into account the optimal milling capacity that could be available if the mills operated for 7 days per week.

The peak year could occur as early as the seventh year after operations began, for each of the five companies holding the leases. It is assumed that each company would begin mine development and operations at one mine at a time, with the second mine being developed about 8 months after the first one, and so on, until the entire number of mines planned to operate at the same time would be in operation. It is also likely that the resources for some of the mines would be exhausted after several years (e.g., the resources for the mines that were placed into operation first could be exhausted after six years, so the potential impacts for the years before and after the peak year[s] would be less). This assumption allows for 2 to 3 years for obtaining permits and plan approvals.

Other assumptions developed for these alternatives include those associated with the number of workers needed; the number and types of equipment utilized; utilities, water, and other materials (including diesel fuel and explosives) consumed; and overall capital and operational costs (including worker compensation). Waste generated from operations would include a relatively large amount of waste rock, in addition to rubbish from supplies and materials used at the mines and trash generated by the workers (such as lunch room garbage). Details are provided in Appendix C.

As discussed in Section 2.1, some amount of waste-rock material might be "gobbed" back into the mine workings after ore generation was completed for a particular phase of operations as long as groundwater issues do not exist at the given lease tract. The remaining waste rock would be brought to the surface, stockpiled, covered with a layer of soil materials, and ultimately graded to be consistent with the slope of the area, then seeded to conform to its surroundings. Waste-rock material is considered that material containing a uranium concentration of 0.05% or less. Other waste material or trash would be collected and transported to a waste dump or landfill located in nearby Naturita.

The number of workers needed for mine development and operations would depend on the size of the mine and could vary from 7 to 51 workers. It is assumed that 7, 11, 17, and 51 workers would be needed for each small, medium, large, and very large mine, respectively. These workers would consist mostly of mine workers, with part-time support (as appropriate) provided by administrative, environmental specialist, mechanic, geologist, and engineering staff. Larger mine operations, such as those at a very large open-pit mine, might require a full-time mechanic on staff. Appendix C presents additional information on the number and types of workers assumed for the analysis.

Equipment needed for mine development and operations would include both underground and surface equipment. The number and types of equipment assumed are listed in Appendix C. The equipment includes diesel skid-steer loaders, diesel trucks or buggies, development drills, production drills, exploration drills, backhoes, highway haul trucks, scrapers, and power generators. The items of equipment needed for mine development and operations at the one very large mine evaluated (the JD-7 surface open-pit mine on Lease Tract 7) are different than those needed for the underground mines assumed under this alternative; primarily surface equipment would be needed at Lease Tract 7.

Water would also be needed and would be trucked in. The volume of water assumed to be needed for a given size of mine is presented in Table 2.2-5. The annual amount of water needed for the 19 mines assumed for Alternative 4 would be about 6,300,000 gal (19 ac-ft). For the use of retention ponds, similar to the discussion in Section 2.2.3.1 for Alternative 3, as many as four retention pond systems would be used to capture surface water and prevent sediment from entering nearby streams and drainages. Similar pond volumes and discharge rates are discussed in Section 2.2.3.1.

Reclamation of the mine operations for Alternative 4 would involve 39 workers over the course of a peak year. It is also assumed that there would be a waiting period of about 1 or 2 years to account for following up on the revegetation and obtaining the necessary release and

TABLE 2.2-5 Amount of Water To Be Utilized per Mine under Alternative 4

	Value for Parameter per Size of Mine				
Parameter Assumed	Small	Medium	Large	Very Large (JD-7)[a]	Total of All Sizes
Number of mines	6	10	2	1	19
Amount of water utilized per mine (gal/mo)	7,600	31,000	46,000	160,000[b]	–
Total amount of water utilized (gal/mo)	45,600	310,000	92,000	160,000	610,000[c]

[a] The "very large" mine category applies to the JD-7 open-pit mine only.

[b] The 160,000 gal/mo (0.5 ac-ft) used at the JD-7 mine (since showers are not provided for surface workers) is primarily for dust control and only for six months (summer months).

[c] This amounts to 610,000 gal/mo (1.9 ac-ft/mo) for the six summer months; water use per month for the non-summer months would be about 448,000 gal/mo or 1.4 ac-ft/mo (water use for JD-7 is not included for the non-summer months). Assuming 10 years of operation at the peak-year level, 186 ac-ft of water would be used. Annual water usage would be about 6,300,000 gal or 19 ac-ft. See Appendix C for details.

approval from DOE, BLM, and CDRMS. The equipment required would be similar to that discussed for Alternatives 1 through 3; details are presented in Appendix C.

2.2.5 Alternative 5

The primary difference between Alternatives 4 and 5 is that the leases for Alternative 5 would be for the remainder of the 10-year period and the leases would continue exactly as they were executed in 2008. This is the No Action Alternative and reflects the current status for the management of the ULP. The ULP is administering the 29 leases that existed in 2008. So far, the 10-year period for these leases has been extended for a time period equivalent to the time taken to prepare and complete the ULP PEIS. It is currently projected that the leases would be extended by about 3 years, which means that instead of expiring in 2018, as originally stipulated, the leases would now be expiring in 2021. The lease tracts are listed in Table 1.2-1, and the locations are shown on Figure 1.4-1. The basis for the impacts analyses for Alternative 5 is discussed next in Section 2.2.5.1.

2.2.5.1 Basis for Impacts Analyses for Alternative 5

It is assumed that because the lease period for Alternative 5 is shorter than that for Alternative 4, a similar number of mines could be operated in a peak year, but to increase ore production, individual mines would be larger (e.g., there would be more medium mines and no small mines). This would enable the production of as much uranium ore as reasonable within the shorter time frame of Alternative 5. Assuming a starting year of 2014, the peak year could reasonably occur after 2 to 3 years from when mine development and operations began (i.e., in 2017 or 2018). The end of the lease period could be in 2021, accounting for the 3 years that elapsed from 2008 (when the leases were signed) to 2011 (when the U.S. district court stayed the leases) and the additional 7 years after 2014 (when the ULP PEIS is expected to be completed and DOE will move the district court to dissolve its injunction). Assumptions for the number of mines in the peak year, ore production rate, and surface area disturbed per mine of a given size are summarized in Table 2.2-6.

The number of workers assumed for Alternative 5 is similar to that assumed for Alternative 4 for a given mine size. It is also assumed that workers for the medium, large, and very large mines would work for two to three shifts.

Water would also be required and would be trucked in. Use of retention ponds would be similar to that assumed for Alternative 4. The volume of water assumed to be needed for a given size mine is presented in Table 2.2-7.

Reclamation for Alternative 5 is assumed to involve 39 workers over the course of a peak year, similar to the assumption for Alternative 4. It is also assumed that there would be a waiting period of about 1 to 2 years to account for following up on the revegetation and obtaining the

TABLE 2.2-6 Number of Mines, Ore Production Rate, and Disturbed Surface Area Assumed for the Peak Year of Operations under Alternative 5

	Value for Parameter per Size of Mine			
Parameter Assumed	Medium	Large	Very Large (JD-7)[a]	Total of All Sizes
Number of mines	16	2	1	19
Ore production rate (tons/d)	1,600 (100 per mine)	400 (200 per mine)	300	2,300[b]
Total disturbed surface area (acres)	240 (15 per mine)	40 (20 per mine)	210[a]	490[c]

[a] The one very large mine that is assumed is the JD-7 open-pit mine (on Lease Tract 7), which has been explored and developed but is currently not in operation. The area developed is about 210 acres.

[b] The total tonnage per day that is assumed to be produced exceeds the assumed milling capacity of 1,500 tons/d, but it is further assumed that the excess tonnage produced could be stockpiled for a few days, since the mills process ore on 7 days per week, while production typically occurs on only 5 days per week. The total weight of ore generated for 10 years of operations at the peak-year level would be about 5,520,000 tons.

[c] Total additional area that would be disturbed would be 280 acres, since 210 acres from the JD-7 mine is already accounted for from previous disturbance. The total area disturbed for Alternative 5 is 490 acres. This acreage should remain the same through the life of Alternative 5.

TABLE 2.2-7 Assumed Amount of Water To Be Utilized per Mine under Alternative 5

Parameter Assumed	Value for Parameter per Size of Mine: Medium	Large	Very Large (JD-7)[a]	Total of All Sizes
Number of mines	16	2	1	19
Amount of water utilized per mine (gal/mo)	31,000	46,000	160,000[b]	–
Total amount of water utilized (gal/mo)	496,000	92,000	160,000	748,600[c]

[a] The very large mine category applies to the JD-7 open-pit mine (on Lease Tract 7) only.

[b] The 8,000 gal/d used at the JD-7 mine (since showers are not provided for surface workers) is primarily for dust control during the summer (assumed to be for 6 months) .

[c] This amounts to 748,000 gal/mo (2.3 ac-ft/mo) for the six summer months assumed. The monthly water usage for the non-summer months would be about 588,000 gal/mo (1.8 ac-ft/mo). Assuming 10 years of operation at the peak-year level, 250 ac-ft of water would be used. Annual water usage would be about 8,000,000 gal, or 25 ac-ft. See Appendix C for details.

necessary release and approval from DOE, BLM, and CDRMS. The equipment required would be similar to that discussed for Alternatives 1 through 4.

2.3 ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN DETAIL

DOE identified the range of alternatives for detailed analysis based on the purpose and need for agency action described in Section 1.4.

DOE has focused the ULP PEIS on its authority to manage the leasing of land with known uranium resources withdrawn under AEA Public Land Order 459. The extracted ore would later be converted, enriched, and fabricated into nuclear fuel; used in commercial reactors; possibly reprocessed; and ultimately result in the generation of various radioactive wastes requiring specialized disposal. The ULP PEIS does not discuss the impacts of these actions. The quantity of uranium available on the DOE ULP lease tracts (estimated to be 13.5 million lb, or 6.1 million kg) represents approximately only 1.5% of the available domestic uranium reserves (nearly 900 million lb, or 410 million kg). These domestic reserves represent approximately 7% of the world's known uranium reserves. No decisions to be made under the ULP would affect environmental impacts from the use of uranium, including the management of the back end of the nuclear fuel cycle. All components of the nuclear fuel cycle will continue to be addressed by proposal-specific and site-specific environmental analyses by the appropriate governmental entity.

There is no need to evaluate the ISL method for mining uranium in the ULP PEIS because it is not considered to be a viable option due to the location of the ore in "dry" sedimentary strata. The ISL method is not suitable considering the geology of the DOE ULP area and the manner in which the uranium ore is located on the lease tracts. The uranium ore at the DOE ULP lease tracts is expected to be deposited along roll fronts following stream bends. The ISL method would require that the ore be located within areas where groundwater is present in relative abundance, which is not the case at the DOE ULP lease tracts. In addition, past mining operations on the lease tracts have been primarily underground (and current permits have been primarily for underground mining).

2.4 SUMMARY AND COMPARISON OF THE POTENTIAL IMPACTS FROM THE FIVE ALTERNATIVES

The impact analyses discussed in the ULP PEIS use a four-level classification scheme to characterize the impacts from the various mining phases (exploration, mine development and operations, and reclamation) under the five alternatives. Table 2.4-1 provides the intended meaning of the qualitative terms used to describe the levels of potential impact for the various resources evaluated in the ULP PEIS. Sections 2.4.1 through 2.4.14 describe the potential impacts from the five alternatives evaluated for each of the environmental resource areas and human health (see Tables 2.4-4 through 2.4-9, which appear after Section 2.4.14, so as to not interrupt the flow of text). Measures identified to minimize potential impacts summarized in this section are identified in Section 4.6. The measures are categorized as compliance measures, mitigation measures, or best management practices (BMPs). The compliance measures are those that are required by Federal or state regulations. Mitigation measures are ones that are required in the current leases or would be included when the leases are modified. Finally, BMPs are measures considered to be good industry practices that would be considered during implementation.

2.4.1 Air Quality

Potential air quality impacts under the alternatives evaluated are presented in Sections 4.1.1, 4.2.1, 4.3.1, 4.4.1, and 4.5.1. Under Alternatives 1 and 2, the potential impacts on ambient air quality from reclamation activities are anticipated to be minor and temporary. The primary source of emissions could be engine exhaust from heavy equipment used during reclamation and from fugitive dust that would result from earth-moving activities and exposed ground and stockpiles. Criteria pollutants evaluated indicate particulate matter (PM) emissions for the peak years would be at about 0.5% and 0.9% of the three-county (Mesa, Montrose, and San Miguel Counties) total emissions for $PM_{2.5}$ and PM_{10}, respectively. Among the non-PM emissions (carbon monoxide [CO], nitrogen oxides [NO_x], sulfur dioxide [SO_2], volatile organic compounds [VOCs], and greenhouse gases [GHGs such as carbon dioxide or CO_2]), NO_x emissions from diesel combustion of heavy equipment and trucks could be highest at 0.09% of the three-county total emissions. These low emission levels are not anticipated to cause measurable impacts on regional ozone (O_3), and potential impacts to climate change would be negligible.

TABLE 2.4-1 Meaning of Qualitative Terms Used To Describe Potential Impact Levels

	Impact Level			
Resource/System	Negligible	Minor	Moderate	Major
Air quality	No measurable impacts.	Most impacts on affected resource could be avoided with proper mitigation. If impacts occur, the affected resource would recover completely without mitigation once the impacting stressor is eliminated.	Impacts on the affected resource are unavoidable; the viability of the affected resource is not threatened, and would recover completely if proper mitigation is applied or proper remedial action is taken once the impacting stressor is eliminated.	Impacts on the affected resource are unavoidable; the viability of the affected resource may be threatened, and the affected resource would not fully recover even if proper mitigation is applied or remedial action is implemented once the impacting stressor is eliminated.
Acoustic environment	Same as for air quality.	Same as for air quality.	Same as for air quality.	Same as for air quality.
Soil resources	Same as for air quality.	Same as for air quality.	Same as for air quality.	Same as for air quality.
Water resources	Same as for air quality.	Same as for air quality.	Same as for air quality.	Same as for air quality.
Human health	Potential impacts are calculated and results compared to appropriate regulatory limits or guidelines.	Potential impacts are calculated and results compared to appropriate regulatory limits or guidelines.	Potential impacts are calculated and results compared to appropriate regulatory limits or guidelines.	Potential impacts are calculated and results compared to appropriate regulatory limits or guidelines.
Ecological resources[a]	Same as for air quality.	Same as for air quality.	Same as for air quality.	Same as for air quality.
Land use	No measurable impacts.	Adverse impacts on the affected activity, community, or resource could be avoided with proper mitigation. Impacts would not disrupt the normal or routine functions of the affected activity, community, or resource. The	Impacts on the affected activity, community, or resource are unavoidable. Proper mitigation would reduce impacts substantially during the life of the project. A portion of the affected activity, community, or	Impacts on the affected activity, community, or resource are unavoidable. Proper mitigation would reduce impacts substantially during the life of the project. Resources could incur long-term effects or

TABLE 2.4-1 (Cont.)

	Impact Level			
Resource/System	Negligible	Minor	Moderate	Major
Land use (Cont.)		affected activity, community, or resource would return to a condition of no measurable effects once the impacting stressor is eliminated.	resource would have to adjust somewhat to account for disruptions due to impacts of the project. The affected activity, community, or resource would return to a condition of no measurable effects once the impacting stressor is eliminated.	unavoidable disruptions to a degree beyond what is normally acceptable. The affected activity, community, or resource would return to a condition of no measurable effects once the impacting stressor is eliminated.
Socioeconomics	Same as for land use.	Same as for land use.	Same as for land use.	Same as for land use.
Environmental justice	Same as for land use.	Same as for land use.	Same as for land use.	Same as for land use.
Transportation[b]	Radiological impacts are governed by regulations and were found to be negligible. Traffic accident injuries and fatalities are proportional to the distance travelled, with no fatalities expected under any alternative. One potential traffic injury could occur under some alternatives.	Radiological impacts are governed by regulations and were found to be negligible. Traffic accident injuries and fatalities are proportional to the distance travelled, with no fatalities expected under any alternative. One potential traffic injury could occur under some alternatives.	Radiological impacts are governed by regulations and were found to be negligible. Traffic accident injuries and fatalities are proportional to the distance travelled, with no fatalities expected under any alternative. One potential traffic injury could occur under some alternatives.	Radiological impacts are governed by regulations and were found to be negligible. Traffic accident injuries and fatalities are proportional to the distance travelled, with no fatalities expected under any alternative. One potential traffic injury could occur under some alternatives.
Cultural resources	Same as for land use.	Same as for land use.	Same as for land use.	Same as for land use. All of the affected resource would be permanently damaged or destroyed.

TABLE 2.4-1 (Cont.)

	Impact Level			
Resource/System	Negligible	Minor	Moderate	Major
Visual resources[c]	*No contrast:* The contrast is technically visible but unlikely to be seen by the casual observer and unlikely to create discernible contrast.	*Weak contrast:* The contrast is unlikely to be seen by the casual observer but is noticeable to those who look closely at the affected area.	*Moderate contrast:* The contrast is likely to be seen by anyone but does not strongly attract and hold visual attention.	*Strong contrast:* The contrast is strong enough to attract and hold visual attention and may dominate the view.

[a] Ecological resources include vegetation, wildlife, aquatic biota, and threatened, endangered, and rare species. For most biota, these levels are based on population-level impacts rather than impacts on individuals. For species listed under the ESA, the impact levels consider impacts on individuals, when appropriate, as well as on populations. Impacts on species listed under the ESA are discussed using impact levels consistent with determinations made in ESA Section 7 consultation with the USFWS.

[b] Radiological transportation impacts are quantified based on the latest scientific knowledge regarding radiation and human health, to aid in understanding the general level of potential risks, but the assignment of cutoff or significance levels is not appropriate. The same is true for potential injuries and fatalities as a result of potential traffic accidents.

[c] The analysis for visual resources focuses on the potential level of visual contrast (i.e., changes in form, line, color, and texture as compared to the existing or baseline condition) that would occur as a result of mining-related activities on the lease tracts. For this analysis, contrast is characterized as either nonexistent (i.e., no contrast), moderate, weak, or strong—terms that roughly approximate the four-level classification scheme presented in the table.

Under Alternative 3, air quality impacts for the three phases associated with uranium mining (exploration, mine development and operations, and reclamation) were evaluated. For the exploration phase, a relatively short duration of time and little ground disturbance would be involved, and potential impacts on ambient air quality would be minimal and temporary. During the peak year of mine development and operations, it is estimated that total peak-year emission rates would be small compared with the three-county total emissions. PM emissions would be about 1.5% and 0.66% of the three-county total for PM_{10} and $PM_{2.5}$, respectively. NO_x emissions would be the highest of the non-PM emissions, at about 1.0% of the three-county total emissions. Potential impacts on regional ozone would not be of concern. Air emissions from the mine development and operations phase could result in minor impacts on air-quality-related values (AQRVs) at nearby Class 1 areas,[2] but implementation of measures (i.e., compliance measures, mitigation measures, and BMPs discussed in Section 4.6) such as fugitive dust mitigation measures could minimize these potential impacts. Potential impacts on climate change would be negligible. During the reclamation phase, PM_{10}, $PM_{2.5}$, and NO_x emissions would be at 0.98%, 0.55%, and 0.11% of the three-county total emissions, respectively. Potential impacts on ozone and climate change would likewise be negligible during the reclamation phase.

Air quality impacts under Alternatives 4 and 5 were evaluated for the exploration, mine development and operations, and reclamation phases in a manner similar to that done for Alternative 3. As was assumed for Alternative 3, a relatively short duration of time for exploration and little ground disturbance would be involved and potential impacts on ambient air quality would be minimal and temporary. PM_{10} and $PM_{2.5}$ emissions from mine development and operations under Alternative 4 are estimated to be about 3.0% and 1.3% of the three-county total emissions, respectively; NO_x emissions would be highest of the non-PM emissions, contributing about 2.0% of the three-county total emissions. As was discussed for Alternative 3 above, potential impacts to regional ozone would not be of concern. Likewise, air emissions from the mine development and operations phase could result in minor impacts on AQRVs at nearby Class 1 areas, but implementation of measures (i.e., compliance measures, mitigation measures, and BMPs discussed in Section 4.6) could minimize these potential impacts. Potential impacts on climate change would be negligible. During the reclamation phase, PM_{10}, $PM_{2.5}$, and NO_x emissions would be at 1.1%, 0.63%, and 0.17% of the three-county total emissions, respectively. Potential impacts on ozone and climate change would likewise be negligible for the reclamation phase under Alternative 4.

Potential air quality impacts under Alternative 5 would be slightly greater than under Alternative 4. PM_{10} and $PM_{2.5}$ emissions for mine development and operations are estimated to be about 3.2% and 1.4% of the three-county total emissions, respectively; NO_x emissions would be highest of the non-PM emissions, contributing about 2.3% of the three-county total emissions. As was discussed for Alternatives 3 and 4, potential impacts on regional ozone would not be of concern. Likewise, air emissions from the mine development and operations phase could result in minor impacts on AQRVs at nearby Class 1 areas, but implementation of measures (i.e., compliance measures, mitigation measures, and BMPs discussed in Section 4.6) could minimize these potential impacts. Potential impacts on climate change would be negligible. During the reclamation phase, PM_{10}, $PM_{2.5}$, and NO_x emissions would be 1.1%, 0.64%, and 0.18% of the three-county total emissions, respectively, and potential impacts on ozone and climate change would be negligible.

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2 In the context of the prevention of significant deterioration (PSD) program, all state air quality jurisdictions are divided into three classes of air quality protection. Class I areas are special areas of natural wonder and scenic beauty, such as national parks (over 6,000 acres), wilderness areas (over 5,000 acres), national memorial parks (over 5,000 acres), and international parks that were in existence as of August 1977, where air quality should be given special protection. Class I areas are subject to maximum limits on air quality degradation called air quality increments (often referred to as PSD increments). The rest of the country (including the ULP lease tracts) is designated as Class II areas, for which moderate growth is accommodated and to which less stringent increments are applied. If desired by states or Indian tribes, a Class II area may be redesignated to a Class III area, to which the least stringent increments are applied, but none has done so.

2.4.2 Acoustic Environment

Potential noise impacts under the five alternatives are discussed in Sections 4.1.2, 4.2.2, 4.3.2, 4.4.2, and 4.5.2.

Under Alternatives 1 and 2, noise levels would attenuate to about 55 dBA at a distance of 1,650 ft (500 m) from a reclamation site, which is the Colorado daytime maximum permissible limit in a residential zone. Reclamation conducted near the boundary of Lease Tract 13 could exceed the Colorado limit.

For the exploration phase under Alternatives 3 to 5, potential noise impacts on neighboring residences or communities would be minimal and intermittent due to the short duration of the activities conducted.

During the mine development and operations phase under Alternative 3, noise levels at about 55 dBA and 50 dBA (Colorado nighttime limit) would be limited to distances of 1,650 ft (500 m) from the mine sites and 230 ft (70 m) from the haul routes, respectively. Activities conducted near the boundary of Lease Tract 13 could exceed the Colorado limit established for residential areas.

Under Alternatives 4 and 5, activities conducted near the boundaries of Lease Tracts 13, 13A, 16, and 16A could exceed the Colorado limit of 55 dBA. Noise from haul trucks could exceed the Colorado nighttime limit within 350 ft (107 m) under Alternative 4 and 380 ft (120 m) under Alternative 5 from the haul route.

Potential noise impacts from reclamation activities under Alternatives 3 to 5 would be similar to those discussed above for the mine development and operations phase.

2.4.3 Soil Resources

Potential impacts on soil resources under the five alternatives are discussed in Sections 4.1.3, 4.2.3, 4.3.3, 4.4.3, and 4.5.3. Potential impacts on soil resources, both on the lease tracts and on adjacent lands where haul roads and utilities would be used, are anticipated to be minor in the exploration and reclamation phases; mine development and operations would involve more ground disturbance and could result in moderate soil impacts, such as 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. Soils could also be contaminated by the accidental release of chemicals (fuels, solvents, oils). These potential impacts would be reduced by the implementation of BMPs and mitigation measures.

Under Alternatives 1 and 2, reclamation would result in ground-disturbing activities, such as the removal of structures and foundations, backfilling of portals, grading of the disturbed surfaces, and spreading of topsoil over waste-rock piles. Direct impacts from these reclamation activities would be smaller than those from mine development and operations because reclamation activities would occur over a shorter duration. The use of existing access roads would reduce impacts like soil compaction and erosion (e.g., fugitive dust generation).

Under Alternatives 3 through 5, exploration activities would occur over relatively small areas; in addition, potential impacts would be minor, especially with the implementation of good industry practices and mitigation measures.

Mine development and operations under Alternatives 3 to 5 would involve various degrees of potential ground disturbance because the number of lease tracts and number and sizes of mines that would be developed and operated vary among these alternatives. It is expected that potential impacts would be minor under all three alternatives. Hence, potential impacts from Alternative 3 would be less than those from Alternatives 4 and 5. The number of mines assumed to be developed and operated is the same under Alternatives 4 and 5, with mine sizes under Alternative 5 resulting in slightly greater ground disturbance because mines would mostly be medium to large, with no small mines assumed for Alternative 5. The assumed disturbed areas for Alternatives 3, 4, and 5 are about 310 acres (130 ha), 460 acres (190 ha), and 490 acres (200 ha), respectively.

Potential impacts on soil resources during the reclamation phase under Alternatives 3 to 5 would be similar to those under Alternatives 1 and 2.

2.4.4 Water Resources

Potential impacts on water resources under the five alternatives are discussed in Sections 4.1.4, 4.2.4, 4.3.4, 4.4.4, and 4.5.4. Potential impacts on water resources are anticipated to be minor for the exploration and reclamation phases; mine development and operations would involve more ground disturbance and could result in increased soil erosion and surface runoff. Surface water and groundwater could also be potentially contaminated by the accidental release of chemicals (fuels, solvents, oils), mixing of water with varying geochemical characteristics, or cross contamination among aquifers. These potential impacts would be avoided by implementing compliance measures, mitigation measures, and BMPs. The frequently targeted underground source of drinking water in the region (e.g., Navajo Sandstone Aquifer) is not expected to be affected. No public water supply system is present within 5 mi (8 km) from the ULP lease tracts.

Under Alternatives 1 and 2, reclamation activities on Lease Tract 13 would have the greatest potential to affect water resources due to the proximity of the Dolores River and San Miguel River. Soil erosion by water is considered to be minor in general and moderate in some areas. The impacts on groundwater quality by the backfill materials, poor sealing of drill holes and inadequate water reclamation are considered to be minor at Lease Tracts 7, 9, and 13 that have wet underground mines. These potential impacts could be avoided if it is implemented in accordance with reclamation performance standards set forth by the CDWR.

For Alternatives 3 through 5, exploration activities, such as vegetation clearing, drilling, and construction of access roads and drill pads, would occur over small areas. Impacts on water resources associated with runoff generation and erosion would be minor. The exploratory drill holes on Lease Tracts 7, 9, 13, and possibly 8A would have the potential to allow groundwater mixing and leaching because of possible accumulation of small amounts of groundwater found in underground mines. The potential impacts are considered to be minor and could be minimized by implementing compliance measures, mitigation measures, and BMPs.

The mine development and operations phase for Alternatives 3 through 5 has the greatest potential (of the three phases) to affect water resources, primarily because of ground disturbance activities, erosion, mine water runoff, the staging of ores and waste rock, alteration of aquifers, mixing of groundwater with varying geochemical characteristics, cross contamination among aquifers, use of chemicals (oil, grease, lubricant), water use, and wastewater generation. Activities near lease tracts closest to the Dolores and San Miguel Rivers would have the greatest potential to affect surface water quality because of erosion. Potential groundwater contamination impacts or dewatering effects would be minor in Lease Tracts 7, 9, and 13 (possibly 8A), where groundwater seepage occurred in underground mines. However, a limited number of existing domestic water wells, associated with Lease Tracts 7, 9, 13, and 8A, would be potentially affected if local groundwater is contaminated or aquifers are dewatered. Based on the assumptions made for Alternatives 3 through 5. potential impacts from Alternative 3 from mine development and operations would be less than those from Alternatives 4 and 5.

The scale of reclamation activities for Alternatives 3 through 5 is expected to increase. Potential impacts from reclamation under Alternatives 3 through 5 would be greater than those under Alternative 1.

2.4.5 Human Health

Potential human health impacts under the alternatives evaluated are presented in Sections 4.1.5, 4.2.5, 4.3.5, 4.4.5, and 4.5.5. The potential impact during the exploration phase would be minimal and limited to only a few workers. Exploration would excavate only small amounts of soil, which would be placed back to fill the drill holes in a short period of time (less than a few weeks). For the mine development and operations phase, potential impacts are analyzed for the mine workers, the general public living close to the uranium lease tracts, and the general public living within 50 mi (80 km) around the uranium lease tracts. For the reclamation phase, potential impacts are analyzed for the reclamation workers as well as the general public living close to the uranium lease tracts. After the reclamation phase, potential impacts are analyzed for recreationists who are assumed to unknowingly camp in a uranium mine area and individuals entering an inactive underground mine (e.g., state inspectors [operating under state regulations] who check on the status of uranium mines after their closure). The analyses involve the estimates of potential human health risks associated with both radiation and chemical exposures.

Under Alternatives 1 and 2, potential radiation exposures for reclamation workers were estimated to be about 14.3 mrem, resulting primarily from the external radiation incurred while working on a waste-rock pile; the uranium isotopes and their decay products in the waste rocks were the source of the radiation. The corresponding latent cancer fatality (LCF) risk associated with this exposure is estimated to be 1×10^{-5}; i.e., the probability of developing a latent fatal cancer is about 1 in 100,000 (1×10^{5}). These estimates of dose and LCF risk were obtained by assuming a base concentration of 70 pCi/g for Ra-226 in waste rocks (Cotter Corp. 2011, 2012a–g). If a higher or lower concentration was assumed (Cotter Corp. 2011, 2012d), the radiation dose and LCF risk would increase or decrease proportionally. The DOE dose limit for protection of the general public is 100 mrem/yr from all exposure pathways. No adverse health effect would result from the chemical toxicity of the uranium and vanadium minerals contained in the waste rocks. The hazard index associated with the potential chemical risk is estimated to be 0.13, which is well below the threshold value of 1.

The potential radiation exposure of the general public living close to the lease tracts would result from airborne emissions of radioactive particulates and radon from the surfaces of waste-rock piles. The level of exposure would depend on the distance and direction between the residence and the radiation sources. It is estimated that during the reclamation phase, the potential dose to a member of the general public would be less than 9 mrem/yr if the person lived 1,600 ft (500 m) or farther from a waste-rock pile, which is less than the dose limit of 10 mrem/yr promulgated by the EPA for airborne emissions of radionuclides. The LCF risk would be less than 1 in 110,000 (1.1×10^{5}) for 1 year of exposure. The hazard index estimated for the chemical exposure is less than 0.03. Again, the above results were obtained assuming a Ra-226 concentration of 70 pCi/g in waste rocks.

With the base concentrations (70 pCi/g of Ra-226) in waste rocks, it is estimated that after the reclamation phase, a recreationist who unknowingly came close to a waste-rock pile would incur a radiation dose of about 0.88 to 30 mrem through external radiation, inhalation, and soil ingestion, assuming he camped on top of the waste-rock pile for 2 weeks. The corresponding LCF risk was estimated to be about 1×10^{-6} to 2×10^{-5}. No potential chemical risk would be incurred because the surface of the waste-rock pile would be covered by soil materials to facilitate the growth of vegetation, rendering potential exposures through the inhalation of particulates and incidental soil ingestion unlikely. Most encounters of recreationists with the uranium lease tracts would be of a much shorter duration; therefore, the resulting radiation dose and LCF risk would be much smaller than those estimated for a two-week camping.

Based on measurement data collected in inactive underground uranium mines, radon levels could range from 3 to 39 working levels (WLs) at different locations within the mine. Therefore, the potential radiation exposure to an individual receptor who illegally enters an inactive underground uranium mine for an extended period of time after its closure could be high. Based on the measurement data, a radon dose rate of 6.9 to 89 mrem/h was estimated, with a corresponding LCF risk ranging from 9×10^{-6} to 1×10^{-4}/h.

Potential human health impacts for individual receptors during and after the reclamation phase under Alternatives 3, 4, and 5 are expected to be similar to those under Alternatives 1 and 2. This is because for individual receptors, their potential radiation and chemical exposures would be dominated by the contamination sources (i.e., waste-rock piles in this case) that are closest to them. If the radiation sources closest to a receptor are the same, the potential health impact on the receptor would depend only on the distances and directions between the sources and the receptor, regardless of the alternative being evaluated. Therefore, the analytical results obtained for the reclamation phase and post-reclamation phase under Alternatives 1 and 2 are applicable for Alternatives 3, 4, and 5. For this same reason, estimates under Alternative 3 for the nearby individual receptor during the mine development and operations phase would be applicable to the same receptors under Alternatives 4 and 5 as well.

Under Alternative 3, the potential radiation exposures for uranium miners were estimated with historical monitoring data from 1985 to 1989. The average radiation dose for underground uranium miners would be about 433 mrem/yr, the majority of which would result from radon exposures. The corresponding LCF risk was estimated to be 4×10^{-4}/yr, which translates to a probability of about 1 in 2,500 (2.5×10^{3}) of developing a latent fatal cancer from 1 year of exposure. The potential chemical exposure for the uranium miners was estimated to result in a hazard index of 1.06, which is slightly above the threshold value of 1; therefore, potential adverse health effects may be incurred by uranium miners. Radiation and chemical exposures for individual miners under Alternatives 4 and 5 are expected to be similar to those under Alternative 3.

In addition to radiation and chemical exposures, potential physical injuries and fatalities were analyzed for the uranium miners. Based on the statistical data on average injury and fatality rates of mining-related activities, two nonfatal injuries and illnesses could occur during the peak year of operations under Alternative 3, and five and six nonfatal injuries could occur under Alternatives 4 and 5, respectively.

> 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.

During the mine development and operations phase, potential radiation exposure of members of the general public who live close to the uranium lease tracts would result primarily from the emissions of radon associated with mining. The potential radiation dose incurred by an individual would depend on the number and size of the closest uranium mine operation as well as the distance and direction between the residence and each of the uranium mines. Based on the estimates, the maximum radiation dose would be about 5.6 mrem/yr at a distance of 3,300 ft (1,000 m) from a small underground uranium mine; at a distance of 6,600 ft (2,000 m), the dose would decrease to less than 3 mrem/yr. If a medium or a large underground uranium mine was close by, the radiation dose would be two or four times the dose estimated from a small underground uranium mine. Based on the estimates, a nearby resident located downwind from a uranium mine in the most dominant wind direction could receive a radiation dose of more than 10 mrem/yr. The collective dose estimated for the population within 50 mi (80 km) from the uranium lease tracts ranges from 7.5 to 39 person-rem, with a corresponding LCF risk of 0.01 to 0.05 under Alternative 3. Under Alternative 4, the collective dose is estimated to range from 17 to 94 person-rem, with a corresponding LCF risk of 0.02 to 0.1. The collective dose estimated under Alternative 5 is 20 to 110 person-rem, with a corresponding LCF risk of 0.03 to 0.1.

2.4.6 Ecological Resources

Potential impacts on ecological resources for the five alternatives are discussed in Sections 4.1.6, 4.2.6, 4.3.6, 4.4.6, and 4.5.6. Potential impacts on vegetation are anticipated to be minor to moderate and range in duration from short term to long term. Mining activities could result in moderate impacts, such as the degradation and loss of habitats. Potential impacts on wildlife (including threatened, endangered, and sensitive species) are anticipated to be negligible to moderate and would result from the degradation and loss of habitats (including water depletion), wildlife disturbance, and wildlife injury or mortality. These impacts would be localized; the viability of wildlife populations would not be affected. Potential impacts on aquatic biota (including threatened, endangered, and sensitive species) are anticipated to be negligible to moderate and would result from increases in sedimentation and turbidity or an accidental ore spill into a perennial stream or river. These impacts would be localized; the viability of aquatic biota would not be affected.

2.4.6.1 Vegetation

Under Alternatives 1 and 2, potential impacts on vegetation would generally be minor and short term. Areas affected by Alternative 1 and 2 activities would generally consist of previously disturbed areas, and reclamation would generally include relatively small surface areas (approximately 1 to 8 acres [0.4 to 3.2 ha] per mine, other than the JD-7 mine). Reclamation would establish plant communities on disturbed areas, including waste rock; however, resulting plant communities might be considerably different from those of adjacent areas. The successful reestablishment of some plant communities, such as sagebrush shrubland or piñon-juniper woodland, would likely require decades.

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. However, because of the small areas involved and short duration of reclamation activities, these would generally constitute a short-term impact. The establishment of invasive species, including the potential alteration of fire regimes, could result in long-term impacts, although monitoring and vegetation management programs would likely control invasive species. However, potential impacts from Alternatives 4 and 5 would involve a larger disturbed area (i.e., at 460 ac [190 ha] and 490 ac (200 ha) for Alternatives 4 and 5, respectively, versus 310 ac [130 ha] for Alternative 3). In addition, the expected period of disturbance for Alternative 5 would be shorter than that for Alternative 4.

Impacts under Alternatives 3 through 5 would be similar and would range from minor to moderate and short term to long term. Impacts from exploration would include disturbance of vegetation and soils, the removal of trees or shrubs, compaction of soils, destruction of plants, burial of vegetation under waste material, or erosion and sedimentation. Exploration activities are expected to affect relatively small areas, and impacts would generally be short term. The localized destruction of biological soil crusts, where present, would be considered a longer-term impact, particularly where soil erosion has occurred. Impacts would include the destruction of habitats during site clearing and excavation, as well as the loss of habitat in additional use areas. Affected areas might include high-quality mature habitats or previously degraded areas. Wetlands present on project sites could be directly or indirectly affected. Indirect impacts from 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 deposition of fugitive dust and the establishment of invasive species, including the potential alteration of fire regimes, could result in long-term impacts.

2.4.6.2 Wildlife

Under Alternatives 1 and 2, reclamation would occur on 10 lease tracts. Altogether, 267 acres (108 ha) would be reclaimed, with most of the acreage (210 acres, or 85 ha) involving the surface open-pit mine on Lease Tract 7. Habitats 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. 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. Permanent underground mine closure could destroy potential habitat for bats and other wildlife. The use of bat gates in the mine openings would maintain the mines 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.

During reclamation activities, localized obstructions of wildlife movement could occur. There would also be an increase in noise and visual disturbance associated with reclamation activities. 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. Indirect impacts on wildlife could also occur from dust deposition, erosion, sedimentation, and introduction of non-native plant species.

Reclamation would result in long-term, localized improvement of wildlife habitats within the 10 lease tracts. 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, removal of water treatment ponds would also eliminate potential sources of contaminant exposure for wildlife. For a species whose range does not include 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.

Overall, impacts on wildlife would be minor during reclamation activities. Under Alternative 1, negligible impacts on wildlife would occur during DOE's long-term management of the withdrawn lands. Under Alternative 2, 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).

Under Alternative 3, potential impacts on wildlife from exploration would primarily result from short-term disturbance (e.g., due to equipment and vehicle noise and the presence of workers). Some mortality to less mobile wildlife could occur at the exploration sites, and vehicles could hit wildlife. Impacts on wildlife from mine development and operations could occur from habitat disturbance, wildlife disturbance, and wildlife injury or mortality. 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) 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.

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). 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. Habitat reduction could result in a long-term (e.g., decades-long) decrease in wildlife abundance and richness within a mine-site area. 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.

Loss of 310 acres (130 ha) of habitats spread throughout the lease tracts would be considered a minor to moderate impact, since an abundance of similar habitats occurs in the region and since many of the wildlife species that could potentially be affected are habitat generalists. 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. Mining activity might increase the exposure of wildlife to uranium and other radioactive decay products and to other chemical elements. The average concentration of radionuclides in the waste-rock piles and, presumably, in the mine would mostly be less than the biota concentration guidelines (i.e., 23.7 pCi/g or less), although in isolated hot spots, concentrations might be several times higher than recommended guidelines.

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. Impacts on wildlife from reclamation activities would be similar to those described for Alternative 1 and 2. In general, it is expected that impacts would be largely localized and would not affect the viability of wildlife populations. Long-term 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. Overall, localized impacts on wildlife would not affect the viability of wildlife populations.

Impacts on wildlife from exploration, mine development and operations, and reclamation under Alternatives 4 and 5would be similar to those under Alternative 3, except that, under peak years of operation for Alternative 4, a total of 460 acres (190 ha) and, under peak years of operation for Alternative 5, 490 (200 ha) of wildlife habitat at 19 mine sites could be disturbed within any of the 31 lease tracts. Under both alternatives, 210 acres (85 ha) for the very large mine (JD-7) have already been disturbed (as were 80 acres [32 ha] for topsoil storage). The differences in impacts under Alternatives 4 and 5 compared with the impacts under Alternative 3 would be limited. However, the potential impacts on wildlife under Alternative 4 and 5 would occur at 11 additional mine sites and affect an additional 150 acres (61 ha) for Alternative 4 or 180 acres (73 ha) for Alternative 5 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 Alternatives 4 and 5 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. Overall, localized impacts on wildlife from either Alternative 4 or 5 would range from negligible to moderate and would not affect the viability of wildlife populations. 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.

2.4.6.3 Aquatic Biota

Under Alternatives 1 and 2, reclamation activities could cause sediment deposition in ephemeral and intermittent streams, and, during storm events, the sediments could potentially reach perennial streams. The potential for this is most likely at Lease Tract 13 through which the Dolores River flows. However, a total of only 8 acres (3.2 ha) at three mine sites is being reclaimed in Lease Tract 13, and only 4 acres (1.6 ha) are being reclaimed for one mine site in Lease Tract 18. Thus, the potential for sediments (including those that could contain radioactive or chemical contaminants) to enter either the Dolores River or Atkinson Creek due to reclamation activities is unlikely, particularly with the appropriate use of BMPs to control erosion.

Reclaimed areas would become less prone to erosion as vegetation becomes established. 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. Under Alternative 2, impacts on aquatic biota during the 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 would be 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 Tract 13, through which the Dolores River flows).

Under Alternative 3, exploration activities would occur in upland areas and not directly within aquatic habitats (including intermittent and ephemeral drainages). Impacts on aquatic biota from mine development and operation 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. Aquatic biota and habitats most likely to be affected are those associated with small intermittent and ephemeral drainages. 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 River 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.

Overall, impacts on aquatic biota would 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.

Under Alternatives 4 and 5, impacts on aquatic resources would be similar to those under Alternative 3, except that 19 mines could be in operation on any of the 31 lease tracts. Overall, localized impacts on aquatic biota would be negligible during site exploration and negligible to minor during mine development, operations, and reclamation. Moderate impacts would be expected only 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.

2.4.6.4 Threatened, Endangered, and Sensitive Species

Impacts of ULP activities on threatened, endangered, and sensitive species would be fundamentally similar to those impact on vegetation (Section 2.4.6.1), wildlife (Section 2.4.6.2), and aquatic biota (Section 2.4.6.3). 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 Alternatives 1 and 2, reclamation activities would generally cause small, short-term impacts on threatened, endangered, and sensitive species, if present. Although reclamation activities have the potential to create surface disturbances, these disturbances are likely to be short term and are not expected to occur in previously undisturbed areas. The small scale of reclamation activities on previously disturbed areas would generally have a negligible to minor direct impact on sensitive terrestrial species. However, indirect impacts on threatened, endangered, and sensitive species might still be possible (such as those resulting from water withdrawal, erosion, sedimentation, and fugitive dust). Erosion and sedimentation might have a small, short-term impact on sensitive aquatic species. Reclamation activities under Alternatives 1 and 2 are not likely to require large amounts of water from the Upper Colorado River Basin. Therefore, the impact of water withdrawals on aquatic species (particularly the Colorado River endangered fish species) is expected to be minor. Reclamation activities under Alternatives 1 and 2 may affect, but are not likely to adversely affect, the Colorado River endangered fish species or their critical habitat. Impact levels for species listed under the ESA were made consistent with impact determinations made in ESA Section 7 consultation. ULP activities under Alternatives 1 and 2 would have no effect on terrestrial species listed under the ESA. ULP activities under Alternatives 1 and 2 may affect, but not likely to adversely affect, the Colorado River endangered fish species or their critical habitat.

Under Alternative 3, potential impacts on terrestrial 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 water depletions, fugitive dust, erosion, and sedimentation. Most impacts of Alternative 3 ULP activities on terrestrial threatened, endangered, and sensitive species may be minimized or avoided with the implementation measures identified in Table 4.6-1. However, 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). Under Alternative 3, approximately 3,200,000 gal (12,000,000 L) of water would be required to support mining activities during the peak year of operations. This volume of water would equate to approximately 9.7 ac-ft of water during the peak year of operations. 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. As discussed in Sections 2.2.3.1 and 4.3.6.4.1, it is estimated that as much as 9.7 ac-ft of water would be needed to support ULP activities during the peak year of operations. It is assumed that the source of this water would be the Upper Colorado River Basin. DOE has completed ESA Section 7 consultation requirements with the USFWS regarding anticipated impacts on the Colorado River endangered fish and other species listed under the ESA. 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 (see Section 4.3.6.4.1 and Appendix E).

Under Alternatives 4 and 5, potential impacts would be similar to those under Alternative 3. However, there would be more lease tracts available for mining under these alternatives, thereby increasing the area that could be disturbed or developed and the potential for impacts on threatened, endangered, and sensitive species. The total disturbed area for Alternative 5 is slightly greater than that for Alternative 4.

2.4.7 Land Use

Potential impacts on land use from the five alternatives are discussed in Sections 4.1.7, 4.2.7, 4.3.7, 4.4.7, and 4.5.7. Potential land use impacts are anticipated to be minor for Alternatives 1 through 5. Withdrawn lands would continue to be closed to mineral entry but would remain open for ROW authorizations and oil and gas leasing. Mining activities would likely preclude some land uses, such as recreation or grazing, but surrounding lands would offer opportunities for these activities.

2.4.8 Socioeconomics

Potential impacts on socioeconomics from the five alternatives are discussed in Sections 4.1.8, 4.2.8, 4.3.8, 4.4.8, and 4.5.8. The impact analyses for socioeconomics indicate that potential socioeconomic effects would generally be minor and positive, in that a few jobs would be created and the completion of reclamation activities could have a small, positive impact on recreation and tourism. It is also likely that there would be less in-migration of people to work in the mining jobs created from the alternatives, since there would likely be unemployed workers in the local community to fill these newly created jobs.

Under Alternatives 1 and 2, reclamation activities would require 29 direct jobs and generate 16 indirect jobs. Reclamation would produce $1.7 million in income. There would likely be a minor positive impact on recreation and tourism because of the reclamation that would be completed.

Under Alternative 3, the potential impact is expected to be minor. Mine development and operations would create 123 direct jobs, 93 indirect jobs, $4.7 million in direct income, and $4.0 million in indirect income. In-migration could include up to 87 people moving into the ROI. However, as was discussed above, there is an adequate workforce currently available in the ROI that could supply the labor needed, so there could be less in-migration than estimated in the ULP PEIS as a result. Reclamation activities would require 29 direct jobs and generate 17 indirect jobs. Reclamation would produce $1.8 million in income.

Potential impacts under Alternatives 4 and 5 would be almost the same and are expected to be minor. Under Alternative 4, mine development and operations would create 229 direct jobs, 152 indirect jobs, and $14.8 million in income. In-migration could include up to 115 people moving into the ROI. Reclamation activities would require 39 direct jobs and generate 21 indirect jobs. Reclamation would produce $2.4 million in income. Under Alternative 5, mine development and operations would create 253 direct jobs, 152 indirect jobs, and $15.6 million in income. In-migration could include up to 122 people moving into the ROI. Reclamation activities would require 39 direct jobs and generate 25 indirect jobs. Reclamation would produce $2.5 million in income.

2.4.9 Environmental Justice

Potential impacts on minority and low-income populations from the five alternatives are discussed in Sections 4.1.9, 4.2.9, 4.3.9, 4.4.9, and 4.5.9. Potential impacts on the general population could result from the uranium mining activities, but 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 certain cultural and religious activities would be minor. For the majority of resources, any adverse impacts from ULP activities would not disproportionately affect minority or low-income populations.

2.4.10 Transportation

Potential impacts on transportation from the five alternatives are discussed in Sections 4.1.10, 4.2.10, 4.3.10, 4.4.10, and 4.5.10.

Under Alternatives 1 and 2, no transportation of uranium ore would occur. There would be no radiological transportation impacts. No changes in current traffic trends near the DOE ULP lease tracts are anticipated because no significant supporting 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.

Under Alternative 3, there would be an average of approximately 40 round-trip uranium ore truck shipments per weekday. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 1.10 million mi (1.77 million km), primarily on State Highways CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.33 and 0.029, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes was estimated to be approximately 0.14 person-rem, a dose that could potentially result in an LCF risk of 8×10^{-5}. The potential annual collective dose estimated for the truck drivers is 0.71 person-rem, with an associated risk of 0.0004 LCF. Dependent on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 0.47 million to 2.22 million mi (751,000 to 3.58 million km), with impacts roughly proportional to the distance travelled.

Under Alternative 4, there would be an average of approximately 80 round-trip uranium ore truck shipments per weekday. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 2.22 million mi (3.57 million km), primarily on CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.63 and 0.057, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes was estimated to be approximately 0.28 person-rem, resulting in an LCF risk of 0.0002 in the population. The potential annual collective dose estimated for the truck drivers is 1.4 person-rem, with an associated LCF risk of 0.0009. Dependent on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 1.14 million to 4.26 million mi (1.84 million to 6.86 million km), with impacts roughly proportional to the distance travelled.

Under Alternative 5, there would be an average of approximately 92 round-trip uranium ore truck shipments per weekday. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 2.72 million mi (4.38 million km), primarily on CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.81 and 0.073, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes is estimated to be approximately 0.34 person-rem, a dose that could potentially result in an LCF risk of 0.0002 in the population. The potential annual collective dose estimated for the truck drivers was 1.8 person-rem, with an associated LCF risk of 0.001. Depending on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 1.45 million to 4.90 million mi (2.34 million to 7.88 million km), with impacts roughly proportional to the distance travelled.

2.4.11 Cultural Resources

Cultural resources include archaeological sites, historic buildings and structures (including mining features), and historic landscapes and traditional cultural properties, which include natural features and landscapes that hold cultural significance to specific tribal groups. Cultural resources eligible for listing on the *National Register of Historic Places* (NRHP) are called "historic properties." Federal agencies must take into account the effects of their undertakings on historic properties. All unevaluated historic properties must be treated as if eligible for listing until shown to be ineligible (see Section 3.11). Activities that would physically alter the land surface or that would modify the built environment, such as the alteration or demolition of a building, would have the greatest potential for directly adversely affecting cultural resources. However, an undertaking might have indirect effects as well. Resources in areas surrounding the location of the undertaking itself can be affected by increased human presence. Artifacts on the surface might be subject to displacement or damage by trampling or loss by unauthorized, illegal, and unrecorded collecting. The noise generated by the presence and operation of a facility might compromise the solitude that is an important part of the integrity of a traditional cultural property, or it might represent a visual intrusion into a cultural landscape. Road improvements have the potential to disturb cultural resource sites. Access roads already exist for the permitted mines. Disturbance would occur only if existing roads were widened or altered.

Impacts on a cultural resource are evaluated based on the likely effect each alternative would have on its integrity. Effects resulting from the exploration, mine development and operations, and reclamation phases of uranium mining are analyzed for each of the alternatives when applicable. Table 2.4-2 summarizes known cultural resource sites by lease tract cluster. For the purposes of this analysis, lease tracts have been grouped into four clusters. Since the visual context of a site is an important component of its integrity, the groupings used in Section 3.12 (Visual Resources) are followed here. Site densities were calculated for the surveyed areas of each lease tract. Since it is not known where specific development would take place, it is assumed that any site within a lease tract might be subject to indirect impacts during the exploration, mine development and operations, and reclamation phases. Table 2.4-3 summarizes the number of cultural resource sites likely to be subject to direct and indirect impacts under each alternative. Indirect impacts could occur to all known sites and any newly discovered sites in each lease tract. Direct impacts would occur only when the size or required location of a new facility precluded the avoidance of identified cultural resources or compromised the visual context of a site where visual context is an important part of its integrity.

TABLE 2.4-2 Summary of Known Cultural Resource Sites by Lease Tract Cluster

Lease Tract Cluster	Total Cluster Acreage	Acres Surveyed	Percent Surveyed	No. of Known Sites	Sites per Surveyed Acre
North	5,754	661	11	43	0.0650
North Central	6,398	694	11	56	0.0807
South Central	3,744	325	9	19	0.0584
South	10,013	977	10	103	0.1053
Total	25,909	2,657	10	221	0.0832

TABLE 2.4-3 Summary of Potential Impacts on Known Cultural Resource Sites

	Estimated No. of Sites That Could Be Affected	
Alternative	Indirect Impacts[a]	Direct Impacts
1	111	0
2	111	0
3	128	8
4	221	21
5	221	23

[a] Indirect impacts could occur to all known sites and any newly discovered sites in each lease tract.

Section 106 of the National Historic Preservation Act (NHPA) requires that areas developed as a result of Federal undertakings be surveyed for the presence of cultural resources prior to project implementation. Through these surveys, cultural resources that are eligible for nomination to the NRHP are identified, and plans would be modified to avoid or mitigate negative impacts on cultural resources. Potential impacts on cultural resources are discussed in Section 4.1.11, 4.2.11, 4.3.11, 4.4.11, and 4.5.11.

Under Alternatives 1 and 2, direct impacts are not expected to occur. However, indirect impacts, such as an increased potential for vandalism related to road or footpath expansion or damage to cultural resources from fugitive dust, could occur on all 111 estimated resources within the 10 lease tracts. Positive impacts could also result, since the termination of uranium mining might result in reduced fugitive dust and ground vibration from heavy equipment and traffic.

Under Alternative 3, indirect impacts on all of the 128 cultural resources located within the 12 lease tracts could occur. Direct impacts are estimated to be possible on 8 of these 128 resources. Potential direct impacts would include the disturbance of buried cultural resources or surface deposits as a result of excavation, vibration from equipment, and fugitive dust. Indirect impacts would include visual disturbance to resources; the introduction of noise to traditional cultural areas; potential damage to traditional plant and animal species; and an increased potential for vandalism, erosion, trampling, and unauthorized collecting related to road or footpath expansion.

Under Alternatives 4 and 5, indirect impacts could occur on the 221 cultural resources located within the 31 lease tracts. Direct impacts could occur on 21 and 23 of these resources, respectively. Types of potential direct and indirect impacts would be the same as those under Alternative 3.

2.4.12 Visual Resources

Visual impacts are expressed as contrasts between an existing landscape and a proposed project or activity in terms of form, line, color, and texture. Visual impacts depend on the type and degree of visual contrasts introduced into an existing landscape. Potential impacts on visual resources are analyzed in 4.1.12, 4.2.12, 4.3.12, 4.4.12, and 4.5.12.

Under Alternatives 1 and 2, one or more of the 10 lease tracts would be visible from portions of the Sewemup Wilderness Study Area (WSA), Palisade Outstanding Natural Area (ONA) Area of Critical Environmental Concern (ACEC), Palisade WSA, Unaweep/Tabeguache Scenic and Historic Byway, Tabeguache Area, Dolores River Canyon WSA, Dolores River Special Recreation Management Area (SRMA), San Miguel River SRMA, McKenna Peak WSA, San Miguel ACEC, and Trail of the Ancient Byways, which are located within 0 to 25 mi (0 to 40 km) of the lease tracts. Visual contrast of visible activities occurring within the lease tracts would range from none to strong, depending on the viewer's location within the special visual resource area (SVRA). Potential visual impacts that could occur under Alternatives 1 and 2 would include vegetation clearing, landform alteration, removal of structures and materials, changes to existing roadways, vehicular and worker activity, and light pollution in the form of skyglow, light trespass, or glare.

Under Alternative 3, 1 or more of the 12 lease tracts would be visible from portions of the Sewemup WSA, Unaweep/Tabeguache Scenic and Historic Byway, Tabeguache Area, Dolores River Canyon WSA, Dolores River SRMA, San Miguel River SRMA, McKenna Peak WSA, San Miguel ACEC, and Trail of the Ancient Byways, which are located within 0 to 25 mi (0 to 40 km) of the lease tracts. Visual contrast of visible activities occurring within the lease tracts would range from none to strong, depending on the viewer's location within the SVRA. Potential visual impacts that could occur under Alternative 3 include vegetation clearing, exploratory drilling, road construction, support facility construction, worker and equipment presence, and lighting in the form of skyglow, light trespass, or glare. Visual impacts resulting from activities associated with mine development and operations would vary in frequency and duration, given that mining activity could last 10 years or more.

Under Alternatives 4 and 5, 1 or more of the 31 lease tracts would be visible from portions of the Sewemup, Palisade, Squaw/Papoose Canyon, McKenna Peak, Dolores River Canyon, and Cahone Canyon WSAs; the Palisade ONA and San Miguel ACECs; the Unaweep/Tabeguache Scenic and Historic Byway; the Tabeguache Area; the Dolores River SRMA; the San Miguel River SRMA; the Canyon of the Ancients National Monument; and the Trail of the Ancient Byways, which are located within 0 to 25 mi (0 to 40 km) of the lease tracts. Visual contrast of visible activities occurring within the 31 lease tracts would range from none to strong, depending on the viewer's location within the SVRA. Potential visual impacts under Alternatives 4 and 5 would be the same as those under Alternative 3.

2.4.13 Waste Management

In addition to waste rock, other waste materials would also be generated from the exploration, mine development and operations, and reclamation phases of uranium mining. The waste could include solid residue from the treatment of mine water, chemical waste from used oil, antifreeze, and solvents from maintenance activities. Other solid waste materials generated could include concrete from ore pads and foundations, drill steel, mill timbers, and vent bags. Bulk radiological materials would be taken to a mill for uranium recovery, or transported for disposal to a licensed low-level radioactive waste disposal facility. Inert materials, such as the foundation and concrete, would be broken up and buried on the site. Wastes could also be taken to a recycling or a permitted landfill located near Nucla or Naturita, Colorado.

Potential impacts on the waste management or disposal practices just discussed would be minor, since capacity is available at the permitted landfills or licensed facilities. Waste that would remain at the mine site would be placed in a manner that is protective to human health and the environment, in compliance with Federal, state, and local requirements.

2.4.14 Cumulative Impacts

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 generally assumed to be 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 potential environmental justice impacts and potential impacts on the human health of the population generally addressed a 50-mi (80-km) radius, which is why the ROI for cumulative effects was extended to this larger radius (see Appendix D for information on how the radius was identified as the ROI for each resource area).

The major ongoing projects 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 permitted projects, 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. These include the Piñon Ridge Mill[3] and Whirlwind Mine near Gateway.

Several uranium-mining-related projects are also planned and include the planned Piñon Ridge Mill and the Whirlwind Mine near Gateway. Other planned or proposed projects include the Book Cliff Coal Mine near Fruita in Mesa County, a ROW maintenance project for the Western Area Power Administration (WAPA), the reduction of tamarisk and other invasive non-native plant species, and the 2012 restoration of a section of the Hanging Flume located northwest of Nucla.

The environmental impacts discussion in Chapter 4 indicates that potential impacts on the resource areas evaluated for the five alternatives would be minor and could be further minimized by implementing measures (i.e., compliance measures, mitigation measures, or BMPs described in Section 4.6) determined in 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.

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

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[3] Energy Fuels Resources Corporation has planned to construct the Piñon Ridge Mill (a conventional uranium mill) in Paradox Valley, between Naturita and Bedrock in Montrose County, Colorado. In early 2011, the CDPHE issued a final radioactive materials license to Energy Fuels Resources Corporation (which is an asset of Ontario's Energy Fuels, Inc., located in Lakewood, Colorado), following CDPHE's preparations of a decision analysis and environmental impact analysis (CDPHE 2011). A group of plaintiffs then challenged that license by filing a lawsuit against CDPHE in Colorado's District Court for the City and County of Denver. On June 13, 2012, the court issued a decision in which it held that the CDPHE had unlawfully issued the license without conducting the necessary administrative procedures. The 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 Piñon 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.

to the types of potential environmental impacts that could occur, and most of these are located closer to (within 25 mi or 40 km of) the lease tracts. However, information for most of the projects is either not available or qualitative in nature.

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 uranium-mining-related projects and other non-uranium-mining-related projects when added to the ULP alternatives would result in overall impacts that would be negligible to moderate.

TABLE 2.4-4 Comparison of the Potential Impacts on Air Quality, the Acoustic Environment, and Soil Resources from Alternatives 1 through 5

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Air Quality	Potential impacts on ambient air quality anticipated to be minor and temporary in nature. It is estimated that PM_{10} emissions would be about 0.92% of emission totals for the three counties and NO_x emissions would be about 0.09% of the three-county totals.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Potential impacts from the exploration phase would be minimal and temporary in nature. Peak-year emission rate estimates would be small during mine development and operations compared with the emission totals for the three counties. PM_{10} and $PM_{2.5}$ emissions could contribute about 1.5% and 0.66% of the three county total, respectively. NO_x emissions could be highest during operations, contributing about 1% of the three-county total emissions. During reclamation, PM_{10} emissions could be highest, at about 0.98% of the three-county total emissions.	Similar to Alternative 3 in that potential impacts from the exploration phase would be minimal and temporary in nature. Peak-year emission rates would be small during mine development and operations compared with the emission totals for the three counties. PM_{10} and $PM_{2.5}$ emissions could contribute about 3.0% and 1.3% of the three-county total, respectively. Estimates indicate NO_x emissions would contribute about 2% of the three-county total emissions. During reclamation, PM_{10} emission estimates could be highest at about 1.1% of the three-county total emissions.	Peak-year mine development and operations emission rates are estimated to be higher than those under Alternative 4. PM_{10} and $PM_{2.5}$ emissions could contribute about 3.2% and 1.4% of the three-county total, respectively. NO_x emissions would contribute about 2.3% of the three-county total. During reclamation, PM_{10} emission estimates could be highest at about 1.1% of the three-county total emissions.

TABLE 2.4-4 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acoustic Environment	Noise levels would attenuate to about 55 dBA (the Colorado daytime maximum permissible limit) at a distance of 1,650 ft (500 m) from the reclamation sites. Most area residences are located beyond this distance. However, if reclamation activities were conducted near the boundary of Lease Tract 13, noise levels at nearby residences could exceed the Colorado limit.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Noise impacts during the exploration phase on neighboring residences or communities would be minimal and intermittent in nature. During mine development and operations, noise levels at about 55 dBA and 50 dBA (Colorado nighttime limit) would be limited to distances of 1,650 ft (500 m) from the mine sites and 230 ft (70 m) from the haul routes, respectively. Most area residences are located beyond these distances. If activities were conducted near the boundary of Lease Tract 13, noise levels at nearby residences could exceed the Colorado limit. For reclamation, some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities could occur.	Noise impacts for the three phases would be similar to those from Alternative 3. Activities conducted near Lease Tracts 13, 13A, 16, and 16A could exceed the Colorado daytime limit of 55 dBA. In addition, noise from haul trucks could exceed the Colorado nighttime limit of 50 dBA within 350 ft (107 m) from the haul route, and possibly any residences within this distance could be affected.	Similar to Alternative 4, except Colorado nighttime limit exceedance from haul trucks within 380 ft (120 m) from the haul route.

TABLE 2.4-4 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Soil Resources	Ground disturbances from reclamation activities could result in minor impacts due to soil compaction, soil horizon mixing, soil contamination (from oil and fuel releases related to use of trucks and other equipment), and soil erosion.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Ground disturbances from mining-related activities could result in minor impacts due to soil compaction, soil horizon mixing, soil contamination (from oil and fuel releases related to use of trucks and other equipment), and soil erosion. Potential impacts from Alternative 3 would likely be greater than those from Alternative 1 since there would be impacts from mine development and operations, which would also be conducted.	Potential impact could be greater than that from Alternative 3 since more mines would be developed and operated.	Similar to Alternative 4.

TABLE 2.4-5 Comparison of the Potential Impacts on Water Resources, Land Use, and Waste Management from Alternatives 1 through 5

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Water Resources	Of the 10 lease tracts evaluated for Alternative 1, reclamation activities on Lease Tract 13 have the greatest potential to affect surface water resources due to the proximity to the Dolores River. The potential impacts due to the backfill materials and poor sealing of drill holes would be minor in Lease Tracts 7, 9, and 13 and avoided by implementation of reclamation performance standards set by the CDWR.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Potential impacts (i.e., runoff generation and erosion) associated with exploration would be minor due to the small spatial extent involved. Potential impacts of groundwater mixing and leaching via exploratory drill holes are expected to be minor in a few lease tracts (i.e., Lease Tracts 7, 9, and 13). For mine development and operations, activities on lease tracts closest to the Dolores River and San Miguel River (i.e., Lease Tracts 13 and 18) pose the greatest potential to affect water quality because of erosion. Potential groundwater contamination impacts and dewatering effects would be minor in a few lease tracts (i.e., Lease Tracts 7, 9, and 13). However, a limited number of existing domestic water wells, associated with Lease Tracts 7, 9, and 13, would be potentially affected if local groundwater is contaminated or aquifers are dewatered. Impacts from reclamation activities would be greater than those for Alternative 1.	Similar to the type of potential impacts under Alternative 3, potential impacts associated with exploration (i.e., runoff generation and erosion) would be minor due to the small spatial extent involved. Potential impacts of groundwater mixing and leaching via exploratory drill holes are expected to be minor in a few lease tracts (i.e., Lease Tracts 7, 9, and 13). Also, mine development and operations on the lease tracts closest to the Dolores River and San Miguel River (i.e., Lease Tracts 13 and 18) would have the greatest potential to affect water quality because of erosion. Potential groundwater contamination impacts and dewatering effects would be minor in a few lease tracts (i.e., Lease Tracts 7, 9, 13, and possibly 8A). The number of domestic wells that might be affected is similar to Alternative 3, and they are associated more with Lease Tracts 5, 6, 8, 13, 16, and 18. Impacts from reclamation activities would be greater than those under Alternative 1.	Similar to Alternative 4.

TABLE 2.4-5 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Land Use	Potential impacts due to land use conflicts are expected to be small under Alternative 1; the lands would continue to be closed to mineral entry, and all other activities, like recreation within the lease tracts, would continue.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Potential impacts due to land use conflicts are expected to be minor under Alternative 3; the lands would be closed to mineral entry, and all other activities, like recreation within the lease tracts, would continue.	Potential impacts due to land use conflicts are expected to be small under Alternative 4; the lands would continue to be closed to mineral entry, and all other activities, like recreation within the lease tracts, would continue.	Similar to Alternative 4.
Waste Management	Amounts of waste or trash generated would be small and would be taken to a mill for recovery, or taken to a permitted landfill near Nucla or Naturita.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Amounts of waste that would be generated during exploration, mine development and operations, and reclamation would be small and managed in a manner similar to that described for Alternative 1. Any waste-rock piles that would remain at the mine surface would be graded to be consistent with the surrounding area, provided with a top cover of soil or other material from the mine site, and seeded.	Amounts of waste or trash generated during the three phases would be small but more than those generated under Alternative 3. They would be managed in a manner similar to that described for Alternatives 1 and 3.	Similar to Alternative 4.

TABLE 2.4-6 Comparison of the Potential Impacts on Human Health from Alternatives 1 through 5

Phase of Activities	Receptor	Assessment Endpoint[a]	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mine development and operations	Uranium miner	Individual rad dose (mrem/yr)	NA[b]	NA	433[c]	Same as Alt. 3	Same as Alt. 3
		Individual LCF risk (1/yr)	NA	NA	4×10^{-4} [c]	Same as Alt. 3	Same as Alt. 3
		Chemical risk (hazard index or HI)	NA	NA	1.1[d]	Same as Alt. 3	Same as Alt. 3
	General public – resident	Individual rad dose (mrem/yr)	NA	NA	16–1.9[e] (WL: 0.0013 to 0.00016)	Same as Alt. 3	Same as Alt. 3
		Individual LCF risk (1/yr)	NA	NA	2×10^{-5} to 3×10^{-6} [e]	Same as Alt. 3	Same as Alt. 3
		Collective rad dose (person-rem/yr)	NA	NA	7.5 to 39[f]	17–94[f]	20–110[f]
		Collective LCF (1/yr)	NA	NA	0.01 to 0.05[f]	0.02–0.1[f]	0.03–0.1[f]
		Chemical risk (HI)	NA	NA	<< 1.0[e]	Same as Alt. 3	Same as Alt. 3
Reclamation	Reclamation worker	Individual rad dose (mrem/yr)	14.3 (WL: $<2 \times 10^{-4}$)	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Individual LCF risk (1/yr)	1×10^{-5}	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Chemical risk (HI)	0.13	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
	General public – resident	Individual rad dose (mrem/yr)	8.9–0.08[g] (WL: $<5 \times 10^{-4}$)	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Individual LCF risk (1/yr)	9×10^{-6} to 8×10^{-8} [g]	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Chemical risk (HI)	< 0.03	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1

TABLE 2.4-6 (Cont.)

Phase of Activities	Receptor	Assessment Endpoint[a]	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Post-reclamation	General public – recreationist	Individual rad dose (mrem/yr)	0.88 to 30[h] (WL: $<2 \times 10^{-4}$)	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Individual LCF risk (1/yr)	1×10^{-6} to 2×10^{-5}	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Chemical risk (HI)	< 0.39	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
	General public – individual entering an inactive underground mine	Individual rad dose (mrem/h)	6.9 to 89[i] (WL: 3 to 39)	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Individual LCF risk (1/h)	9×10^{-6} to 1×10^{-4}[i]	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
		Chemical risk (HI)	0	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1

[a] Radiation dose and chemical risk (HI) estimates are rounded to two significant figures; LCF risk is rounded to one significant figure. For some radiation doses, the corresponding radon levels in terms of working level (WL) are also listed in parentheses. The estimates listed are based on a Ra-226 concentration of 70 pCi/g in waste-rock piles.

[b] NA = not applicable; continued uranium mining would not occur under Alternatives 1 and 2.

[c] The listed values are based on historical data on the average exposures of underground uranium miners.

[d] The impact associated with exposure to particulates containing uranium and vanadium compounds during this phase was estimated based on the radiation dose associated with inhalation of particulates containing uranium isotopes and their decay products.

[e] Potential individual radiation dose and LCF risk for the general public – resident scenario would depend on the location of the residence. The dose and risk are functions of the distance and direction from the residence to the radon emission source. The listed range is associated with a residence located in the dominant wind direction that gives the highest exposures at a distance of 1,600 to 16,000 ft (500 to 5,000 m) to the emission source, which is a medium-underground mine. Potential dose and LCF risk associated with a small underground mine would be about half of the listed values; those associated with a large underground mine would be about twice the listed values. Potential dose and LCF risk associated with a very large open-pit mine would be greater than those associated with a small underground mine but less than those associated with a medium-sized underground mine for a distance of 3,300 ft (1,000 m) or greater. Potential hazard index associated with the exposures of residents is expected to be much smaller than that associated with the exposures of uranium miners (i.e., much smaller than the threshold value of 1). Detailed calculation results are provided in Sections 4.1.5, 4.2.5, 4.3.5, 4.4.5, and 4.5.5 for the five alternatives.

Footnotes continued on next page.

TABLE 2.4-6 (Cont.)

[f] The collective dose and LCF risk were estimated for the entire population living at a distance of 3.1 to 50 mi (5 to 80 km) from the center of each lease tract group. The collective dose and LCF risk correspond to the peak year of operations. In any other year, the collective dose/LCF risk is expected to be lower than the listed value.

[g] Potential individual radiation dose and LCF risk for the general public – resident scenario would depend on the location of the residence. The dose and risk are functions of the distance and direction from the residence to the source of radon and particulate emissions. The listed range is associated with a residence located in the most dominant wind direction at a distance of 1,600 to 16,000 ft (500 to 5,000 m) to the emission source, which is a waste-rock pile at a scale ranging from small to very large. The waste-rock pile is assumed to be generated by the development and operations of an underground mine for 10 years. Detailed calculation results are provided in Sections 4.1.5, 4.2.5, 4.3.5, 4.4.5, and 4.5.5 for the five alternatives.

[h] The recreationist dose and LCF risk results were obtained based on the assumption that the emission source (i.e., a waste-rock pile) would be covered by 0–1 ft (0–0.3 m) of soil materials.

[i] Potential individual radiation dose and LCF risk for the general public – individual entering an inactive underground mine were calculated on the basis of radon levels that were measured in three abandoned mines in the United Kingdom (Denman et al. 2003).

1 **TABLE 2.4-7 Comparison of the Potential Impacts on Ecological Resources from Alternatives 1 through 5**

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Vegetation	It is expected that impacts under Alternative 1 would generally be minor and short term. Areas affected by Alternative 1 activities would generally consist of previously disturbed areas, and reclamation would generally include relatively small surface areas (approximately 1 to 8 acres [0.4 to 3.2 ha] per mine, other than the JD-7 mine). Reclamation would establish plant communities on disturbed areas, including waste rock; however, resulting plant communities might be considerably different from those of adjacent areas. The successful reestablishment of some plant communities, such as sagebrush shrubland or piñon-juniper woodland, would likely require decades. 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. However, because of the small areas involved and short duration of reclamation activities, these would generally constitute a short-term impact. The establishment of invasive species, including the potential alteration of fire regimes, could result in long-term impacts, although monitoring and vegetation management programs would likely control invasive species.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Impacts under Alternative 3 would range from minor to moderate and short term to long term. Impacts from exploration would result from disturbance of vegetation and soils, the removal of trees or shrubs, compaction of soils, destruction of plants, burial of vegetation under waste material, or erosion and sedimentation. Exploration activities are expected to affect relatively small areas, and impacts would generally be short term. The localized destruction of biological soil crusts, where present, would be considered a longer-term impact, particularly where soil erosion has occurred. Ground disturbance from mine development and operations would range from 10 to 20 acres (4 to 8 ha) per mine, except for the 210-acre (85-ha) JD-7 open-pit mine. Impacts would include the destruction of habitats during site clearing and excavation, as well as the loss of habitat in additional use areas. Affected areas might include high-quality mature habitats or previously degraded areas. Wetlands present on project sites could be directly or indirectly affected. Indirect impacts from 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 deposition of fugitive dust and the establishment of invasive species, including the potential alteration of fire regimes, could result in long-term impacts.	Impacts would be similar to those for Alternative 3, except a larger area (460 acres, or 190 ha) would be disturbed.	Similar to Alternative 4 with respect to the amount of area disturbed, but disturbance would be for a shorter period of time (i.e., 10 years versus potentially more than 10 years for Alternative 4).

TABLE 2.4-7 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Wildlife	Reclamation activities would cause a short-term, localized disturbance of wildlife in the area of the 13 mine sites on 10 lease tracts. Reclamation of 267 acres (108 ha) would result in long-term, localized improvement of wildlife habitats within the 10 lease tracts. Negligible impacts on wildlife would occur during DOE's long-term management of the withdrawn lands.	Similar to Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	There could be impacts on a total of 310 acres (125 ha) of wildlife habitat at 8 mine sites within 1 or more of the 12 formerly active lease tracts during the peak year of operations. Additional habitats could be affected by any access roads or utility lines required for the mines. Impacts on wildlife could occur from habitat disturbance, wildlife disturbance, and wildlife injury or mortality and habitat loss. Overall, localized impacts on wildlife would range from negligible to moderate during mine development and operations, while wildlife impacts would be long term (last for decades), would be scattered temporarily and, especially, spatially, and would not affect the viability of wildlife populations.	Impacts would be similar to those from Alternative 3, except that a total of 460 acres (190 ha) of wildlife habitat at 19 mine sites could be disturbed within any of the 31 lease tracts during the peak year of operations. Overall, localized impacts on wildlife would range from negligible to moderate and would not affect the viability of wildlife populations.	Impacts on a total of 490 acres (198 ha) of wildlife habitat at 19 mine sites within any of the 31 lease tracts during the peak year of operations. Impacts on wildlife would be similar to, but for a shorter time period than, those for Alternative 4. Overall, localized impacts on wildlife would range from negligible to moderate and would not affect the viability of wildlife populations.
Aquatic Biota	Reclamation activities could cause sediment deposition in intermittent and ephemeral streams and possibly the Dolores River. The potential for sediments to enter the perennial streams is negligible to minor due to the limited amount of land undergoing reclamation in any given area. Reclaimed areas would be less prone to erosion as vegetation becomes established.	Similar to Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	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.	Impacts on aquatic resources would be similar to those under Alternative 3, except that 19 mines could be in operation on any of the 31 lease tracts during the peak year of operations. Overall, localized impacts on aquatic biota would range from negligible to moderate and would not affect the viability of any aquatic species	Impacts on aquatic resources would be similar to those under Alternative 4, except that the mines would be in operation for a shorter length of time. Overall, localized impacts on aquatic biota would range from negligible to moderate and would not affect the viability of any aquatic species.

TABLE 2.4-7 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Threatened, Endangered, and Sensitive Species	Reclamation activities would generally cause minor, short-term impacts on threatened, endangered, and sensitive species. The small scale of reclamation activities on previously disturbed areas would generally have minor direct impacts on sensitive terrestrial species. Indirect impacts associated with water withdrawal, erosion, and sedimentation might have minor, short-term impacts on sensitive aquatic species (including Colorado River endangered fish species).	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	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. 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).	Similar to Alternative 3. However, there would be more lease tracts available for mining under this alternative, thereby increasing the area that could be disturbed or developed and the potential for impacts on threatened, endangered, and sensitive species.	Similar to Alternative 4, but the total disturbed surface area is somewhat larger than that under Alternative 4.

TABLE 2.4-8 Comparison of the Potential Impacts on Socioeconomics, Environmental Justice, and Transportation from Alternatives 1 through 5

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Socioeconomics	Potential impact is expected to be minor. Reclamation activities would require 29 direct jobs and generate 16 indirect jobs. Reclamation would produce $1.7 million in income. There would likely be a small positive impact on recreation and tourism because of the reclamation that would be completed.	Same as Alternative 1. However, under BLM’s multiple use policies, there could be additional potential impacts.	Potential impact is expected to be minor. Mine development and operations would create 123 direct jobs, 98 indirect jobs, $4.7 million in direct income, and $4.0 million in indirect income. In-migration could include up to 63 people moving into the ROI. Reclamation activities would require 29 direct jobs and generate 17 indirect jobs. Reclamation would produce $1.8 million in income.	Potential impact is expected to be minor. Mine development and operations would create 229 direct jobs, 152 indirect jobs, and $14.8 million in income. In-migration could include up to 115 people moving into the ROI. Reclamation activities would require 39 direct jobs and generate 21 indirect jobs. Reclamation would produce $2.4 million in income.	Potential impact is expected to be minor. Mine development and operations would create 253 direct jobs, 152 indirect jobs, and $15.6 million in income. In-migration could include up to 122 people moving into the ROI. Reclamation activities would require 39 direct jobs and generate 25 indirect jobs. Reclamation would produce $2.5 million in income.
Environmental Justice	Potential impacts on the general population could result from uranium mining activities. For the majority of resources evaluated, impacts would be likely to be minor and would be unlikely to disproportionately affect low-income and minority populations.	Same as Alternative 1. However, under BLM’s multiple use policies, there could be additional potential impacts.	Potential impacts are likely to be minor and unlikely to disproportionately affect low-income and minority populations. 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; however, no disproportionately high and adverse impacts on low-income or minority populations would occur. Impacts on low-income and minority populations 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. The types of impacts related to mine development and operations under Alternative 5 would be similar to those under Alternative 4. Under Alternative 5, for the majority of resources evaluated, the impacts would likely be minor and would be unlikely to have disproportionate impacts on low-income or minority populations.

TABLE 2.4-8 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Transportation	No transportation of uranium ore would occur. There would be no radiological transportation impacts. No changes in current traffic trends near the DOE ULP lease tracts would be 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.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	There would be an average of approximately 40 round-trip uranium ore truck shipments per weekday under Alternative 3. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 1.10 million mi (1.77 million km), primarily on CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.33 and 0.029, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes was estimated to be approximately 0.14 person-rem, a dose that could potentially result in an LCF risk of 8×10^{-5}. The potential annual collective dose estimated for the truck drivers is 0.71 person-rem, with an associated LCF risk of 0.0004. Dependent on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 0.47 million to 2.22 million mi (751,000 to 3.58 million km), with impacts roughly proportional to the distance travelled.	There would be an average of approximately 80 round-trip uranium ore truck shipments per weekday under Alternative 4. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 2.22 million mi (3.57 million km), primarily on CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.66 and 0.057, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes was estimated to be approximately 0.28 person-rem, a dose that could potentially result in an LCF risk of 0.0002 in the population. The potential annual collective dose estimated for the truck drivers is 1.4 person-rem, with an associated LCF risk of 0.0009. Dependent on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 1.14 million to 4.26 million mi (1.84 million to 6.86 million km), with impacts roughly proportional to the distance travelled.	There would be an average of approximately 92 round-trip uranium ore truck shipments per weekday under Alternative 5. For the sample case considered, the total annual distance travelled in the peak year by the haul trucks would be about 2.72 million mi (4.38 million km), primarily on CO 90 and CO 141 and on US 491 and US 191. The estimated attendant traffic accident injuries and fatalities would be about 0.81 and 0.073, respectively. The resultant collective radiological population dose to those individuals living and working near the haul routes is estimated to be approximately 0.34 person-rem, a dose that could potentially result in an LCF risk of 0.0002 in the population. The potential annual collective dose estimated for the truck drivers was 1.8 person-rem, with an associated LCF risk of 0.001. Depending on which lease tracts have mining operations and which mill was used in each case, the total annual distance in the peak year could range from about 1.45 million to 4.90 million mi (2.34 million to 7.88 million km), with impacts roughly proportional to the distance travelled.

1 **TABLE 2.4-9 Comparison of the Potential Impacts on Cultural Resources and Visual Resources from Alternatives 1 through 5**

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Cultural Resources	Under Alternative 1, indirect impacts could occur on all known cultural resources located within the 10 lease tracts. It is estimated that there are 111 resources within the 10 lease tracts (see Table 4.1-12). Direct impacts are not expected because areas to be reclaimed have already been disturbed, and no new land disturbance is expected. Indirect impacts under Alternative 1 would include the increased potential for vandalism related to road or footpath expansion and for the disturbance of a cultural resource from fugitive dust. Significant cultural properties that could be adversely affected by the proposed action would be identified before any ground-disturbing activities occurred, and plans would be modified to avoid or mitigate impacts on cultural resources. There is potential for buried cultural deposits to be uncovered even if sites were not identified on the surface prior to ground disturbance activities.	Same as Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Under Alternative 3, indirect impacts could occur on all known cultural resource sites located within the 12 lease tracts. It is estimated that there are 128 resources within the 12 lease tracts. Direct impacts could occur on eight of these resources (see Table 4.1-12). Potential direct impacts would include the disturbance of buried cultural resources or surface deposits as a result of excavation, vibration from equipment, and fugitive dust. Indirect impacts would include visual disturbance to resources; the introduction of noise to traditional sacred areas; and an increased potential for vandalism, erosion, trampling, and nonauthorized collecting related to road or footpath expansion. Significant cultural properties that would be adversely affected by the proposed actions would be identified before any ground-disturbing activities occurred, and plans would be modified to avoid or mitigate impacts on cultural resources.	Under Alternative 4, indirect impacts on all known cultural resources located within the 31 lease tracts could occur. Direct impacts could occur on 21 of these resources (see Table 2.4-3). Types of potential impacts would be the same as those discussed for Alternative 3. Significant cultural properties that would be adversely affected by the proposed action would be identified before ground-disturbing activities occurred, and plans could be modified to avoid or mitigate impacts on cultural resources.	Similar to Alternative 4, except that direct impacts could occur on 23 of the known cultural resources on the 31 lease tracts (see Table 2.4-3).

TABLE 2.4-9 (Cont.)

Resource/ System	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Visual Resources[a]	Potential visual impacts that could occur under Alternative 1 would include vegetation clearing, landform alteration, removal of structures and materials, changes to existing roadways, vehicular and worker activity, and light pollution. Under Alternative 1, one or more of the 10 lease tracts would be visible from portions of the Sewemup WSA, Palisade ONA ACEC, Palisade WSA, Unaweep/ Tabeguache Scenic and Historic Byway, Tabeguache Area, Dolores River Canyon WSA, Dolores River SRMA, McKenna Peak WSA, San Miguel ACEC, San Miguel SMRA, and Trail of the Ancient Byways, which are located within 0–25 mi (0–40 km) of the lease tracts. Visual contrast of visible activities occurring within the lease tracts would range from none to strong, depending on the viewer's location with respect to the SVRA.	Similar to Alternative 1. However, under BLM's multiple use policies, there could be additional potential impacts.	Potential visual impacts that could occur under Alternative 3 include vegetation clearing, exploratory drilling, road construction, support facility construction, worker and equipment presence, and lighting in the form of skyglow, light trespass, or glare. Under Alternative 3, one or more of the 12 lease tracts would be visible from portions of the Sewemup WSA, Unaweep/Tabeguache Scenic and Historic Byway, Tabeguache Area, Dolores River Canyon WSA, Dolores River SRMA, McKenna Peak WSA, San Miguel ACEC, San Miguel SMRA, and Trail of the Ancient Byways, which are located within 0–25 mi (0–40 km) of the lease tracts. Visual contrast of visible activities occurring within the lease tracts would range from none to strong, depending on the viewer's location with respect to the SVRA**.**	Potential visual impacts under Alternative 4 would be the same as those under Alternative 3. Under Alternative 4, 1 or more of the 31 lease tracts would be visible from portions of the Sewemup, Palisade, Squaw/Papoose Canyon, McKenna Peak, Dolores River Canyon, and Cahone Canyon WSAs; the Palisade ONA, San Miguel SMRA, and San Miguel ACECs; the Unaweep/ Tabeguache Scenic and Historic Byway; the Tabeguache Area; the Dolores River SRMA; Canyon of the Ancients National Monument; and Trail of the Ancient Byways, which are located within 0–25 mi (0–40 km) of the lease tracts. Visual contrast of visible activities occurring within the 31 lease tracts would range from none to strong, depending on the viewer's location with respect to the SVRA.	Similar to Alternative 4.

[a] ONA = Outstanding Natural Area, SRMA = Special Recreation Management Area, SVRA = special visual resource area, WA = Wilderness Area, WSA = Wilderness Study Area.

2.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Uranium mining activities associated with the five alternatives evaluated in the ULP PEIS would result in an irreversible and irretrievable commitment of resources. Table 2.5-1 summarizes the estimated amounts of the resources assumed to be utilized with the implementation of any of the five alternatives. These resources would be irreversible and irretrievable in that once utilized, the resources are essentially spent and not replaceable.

The maximum amounts are associated with Alternative 4 based on the assumption of the operational period being 10 years. The period of operations for Alternative 5 is assumed to be five years based on the stipulated lease period for the alternative (i.e., remainder of the 10-year lease period that started in 2008 and no extensions of the leases). For Alternative 4, the preferred alternative, approximately 480,000 tons/yr of uranium ore would be removed from the DOE ULP lease tracts for processing at the mills and ultimately used for various energy purposes. In addition, about 6.3 million gal (19 ac-ft) of water could be utilized during the peak year of mine operations. Other materials that would be expended during operations for Alternative 4 would include about 1.2 million kWh of electricity, about 9,900 tons of steel, and 590,000 gal (2.3 million L) of fuel and lubricants.

2.6 PREFERRED ALTERNATIVE IDENTIFIED

DOE's preferred alternative for the management of the ULP is Alternative 4. DOE would continue to allow, after appropriate NEPA analysis, the exploration, mine development and operations, and reclamation of uranium mines on the 31 lease tracts that are being managed

TABLE 2.5-1 Estimated Amount of Resources Assumed To Be Irreversible and Irretrievable as a Result of the Implementation of the ULP Alternatives

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Uranium ore[a] (tons)	None	None	2,400,000	4,800,000	2,760,000
Water (gal)[b]	160,000	160,000	32,000,000	63,000,000	40,000,000
Fuel and lubricants (gal)[b]	110,000	110,000	300,000	590,000	330,000
Steel (tons)[b]	NA[c]	NA	4,400	9,900	5,300
Electricity (kWh)[b]	NA	NA	580,000	1,200,000	700,00

[a] For Alternatives 3 and 4, assumed 10 years of operations; for Alternative 5, assumed 5 years of operations.

[b] For Alternatives 1 and 2, resource utilized for the reclamation phase only (which would be completed in 1 year of field work); for Alternatives 3 to 5, estimates include 10 years of operations in addition to the 1 year of exploration and reclamation.

[c] NA denotes none assumed.

Source: Appendix C of the ULP PEIS

under the DOE ULP. As stated in previous sections, the difference between Alternative 4 (the preferred alternative) and Alternative 5 (the No Action Alternative for the ULP PEIS) is the lease period associated with these alternatives. Under Alternative 4, the lease period would be for the next 10 years or for another reasonable period; under Alternative 5, the lease period would be for the remainder of the 10-year period stipulated in the leases executed in 2008. Hence, the number of years available for ore generation would be shorter under Alternative 5 and might not give the lessees enough flexibility to time their mining activities to coincide with periods when the economic market for uranium ore was favorable. The shorter period of time associated with Alternative 5 could also mean that the ore in some of the mines might not be exhausted by the time the lease(s) expired, resulting in the premature shutdown of activities, termination, and reclamation.

The comparison and summary of potential impacts in Section 2.4 indicates that in general, the potential impacts from Alternative 4 would be similar to those from Alternative 5. The exception is that it is assumed that a slightly greater quantity of ore would be generated each year under Alternative 5. This assumption was made to simulate conditions in which the lessees would expedite the ore production by operating medium-sized to large mines (and not any small mines, which are considered under Alternative 4). The slightly higher amount of ore generated under Alternative 5 would result in slightly greater potential impacts than those under Alternative 4.

Potential impacts from reclamation activities would be similar under all the alternatives, 1 through 5. Potential impacts under Alternatives 1 and 2 would result only from reclamation. Potential impacts from mine operations would be slightly less under Alternative 3 than under Alternative 4 because it is assumed that fewer mines (with fewer leases—13 versus 31) would be operated under Alternative 3. The assumptions developed for Alternative 4 are considered more realistic based on historical experience and based on the outlook for future uranium mining in the area.

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3 AFFECTED ENVIRONMENT

The ROIs affected by the proposed action presented in the ULP PEIS are described for each resource area evaluated (see Appendix D for additional discussion on the determination of the ROIs). This site-specific information will be used as the basis for evaluating the potential impacts from the alternatives discussed in Chapter 4.

Regions of Influence (ROIs) for the Various Resource Areas Evaluated in the ULP PEIS

Air Quality**:** Mostly within 31 mi (50 km) from the source(s) but up to several hundred miles, a minimal but cumulative contribution to air quality-related values (such as visibility and acid deposition)

Noise: Within 2–3 mi (3–5 km), from noise source(s) at best

Paleontological Resources: Lease tracts and any other areas on adjacent lands that could be affected by mining activities

Soil Resources: The lease tracts and any other areas on adjacent lands (e.g., unpaved access roads) that could be affected by mining activities

Water Resources: Montrose, Mesa, and San Miguel Counties, primarily on the lease tracts; also the Dolores River, San Miguel River, and their tributaries

Human Health: 50-mi (80-km) radius of the lease tracts

Land Use: The lease tracts and land within a 25-mi (40-km) radius of each lease tract, with an emphasis on specially designated public land areas

Ecological Resources: Montrose, Mesa, and San Miguel Counties, primarily on the lease tracts; the Dolores River, San Miguel River, and Colorado River (for threatened and endangered species evaluation only)

Socioeconomics: Montrose, Mesa, and San Miguel Counties

Environmental Justice: 50-mi (80-km) radius of the lease tracts

Transportation: 25-mi (40-km) radius from the boundary of the lease tracts

Cultural Resources: Lease tracts and any other areas on adjacent lands that could be affected by mining activities

Visual Resources: 25 mi (40 km) from the lease tracts

Waste Management: Surface mine plants on the lease tracts

3.1 AIR QUALITY

3.1.1 Climate

3.1.1.1 General Climate

Wide variations in elevation and topographic features within the area surrounding the ULP lease tracts have an impact on wind patterns, temperatures, and storm tracks in all seasons (NCDC 2011a). The area has a semi-arid, mid-continental climate characterized by abundant sunshine, low humidity, low precipitation, and cold, snowy winters. Strong, outgoing terrestrial radiation provides cool nights. In midwinter, air temperatures are often low, but strong solar radiation and dry air combine to provide generally pleasant conditions.

The local climate is strongly influenced by microclimatic features such as slope, aspect, and elevation. The prevailing wind direction aloft over the region is from the west or the southwest (the westerlies), as it is in most of the United States; however, complex terrains in western Colorado are responsible for deflecting these winds. Accordingly, wind patterns are sometimes dissimilar even over short distances.

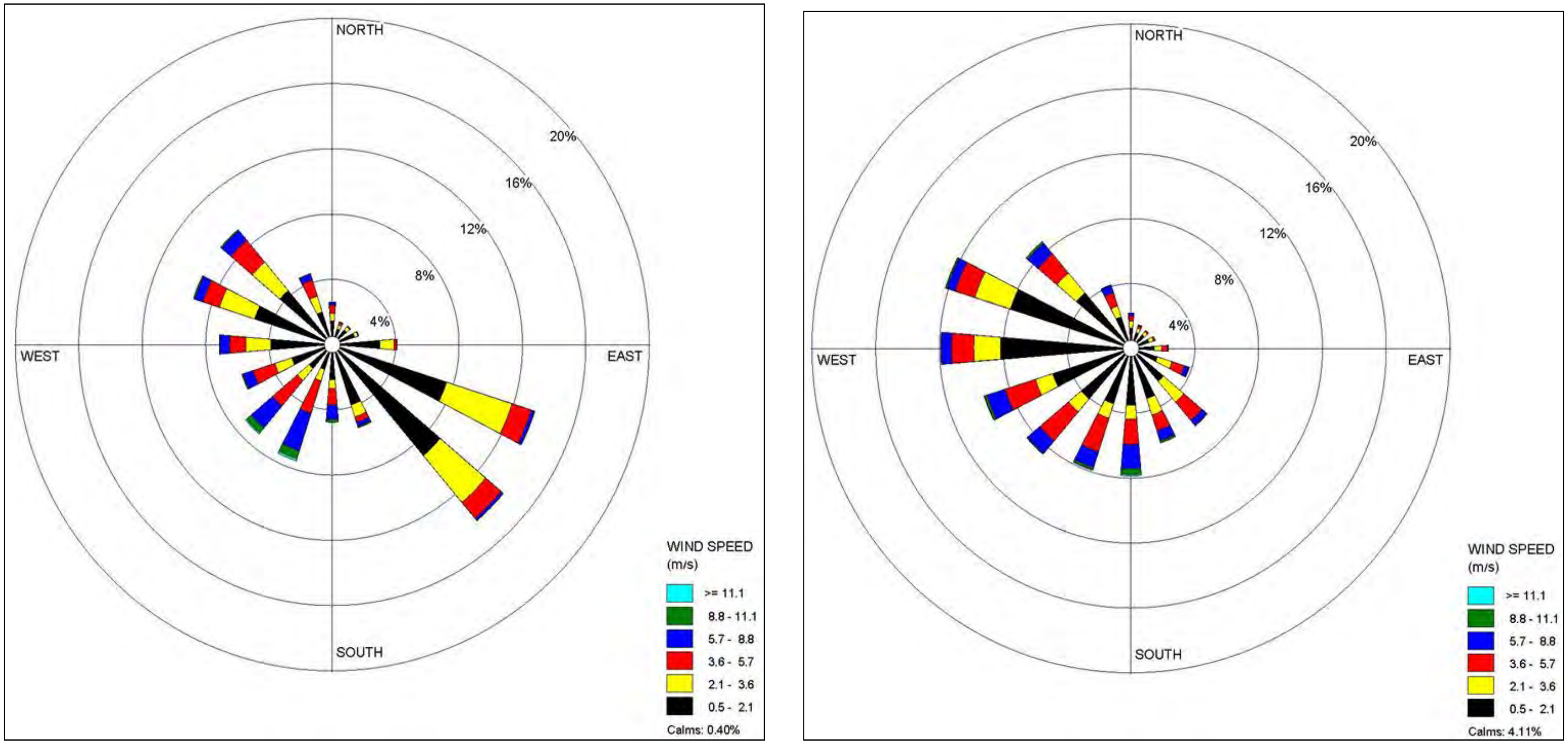
The ULP lease tracts are located in southwestern Mesa County and in western Montrose and San Miguel Counties in southwestern Colorado. The elevations of lease tracts range from 5,100 ft (1,500 m) to 8,000 ft (2,439 m) with an average elevation of about 6,401 ft (1,951 m). The area surrounding the ULP lease tracts is characterized by complex topography with valleys, canyons, and plateaus, so the climate varies considerably from place to place.

3.1.1.2 Wind

Wind roses (which graphically display the distribution of wind speed and direction) are presented here based on data available from weather stations in place for the proposed Piñon Ridge Mill, because they are located in the center of the ULP lease tracts scattered over a wide area. These stations are referred to as Site 1 (33-ft [10-m] level) and Site 2 (98-ft [30-m] level). Data for a 3-year period (April 2008–March 2011) are shown in Figure 3.1-1 (Rogers 2011). The proposed Piñon Ridge Mill site is located in the eastern Paradox Valley in western Montrose County, which is roughly at the center of ULP lease tracts. The Paradox Valley is aligned in a northwest–southeast direction. Winds are controlled in large part by the valley and ridge topography. At Site 1 (33-ft [10-m] level), winds blow more frequently from the northwest and southeast, reflecting the channeling of winds parallel to the valley axis. The annual average wind speed is about 6.3 mph (2.8 m/s). Average wind speeds are highest in spring at 7.9 mph (3.5 m/s) and lowest in winter at 4.6 mph (2.1 m/s). Prevailing wind directions are from the southeast (about 14% of the time) and the east–southeast (about 14% of the time). Secondary prevalent wind directions are from the northwest and west-northwest about 18% of the time combined. Thus, about half of the time, upslope and downslope winds along the valley axis prevail. However, effects of prevailing westerlies aloft are relatively minor at the surface. Northwesterly upslope winds blow more frequently during daytime, while southeasterly downslope winds (also called drainage winds) prevail at night.

Wind rose at Site 2 (98-ft [30-m] level) of the proposed Piñon Ridge Mill site, which is located about 1.3 mi (2.1 km) south–southeast of Site 1 on the same valley floor but closer to the valley wall, is provided in Figure 3.1-1(b). Wind patterns are somewhat different from those at Site 1 (33-ft [10-m]) level. Daytime upslope winds observed are like those at Site 1, while nighttime downslope winds are relatively weak. Typically, downslope winds are shallower than upslope winds, with little or no turbulence because of the stable temperature structure of the air. Throughout the year, westerly or southwesterly winds prevail at Site 2, especially during nighttime hours, suggesting it is more affected by regional winds than by local flows. Average wind speed at Site 2 is about 5.9 mph (2.6 m/s). As it is at Site 1, wind speed at Site 2 is highest in spring and lowest in winter. Prevailing wind direction at Site 2 is from the west–northwest (about 12% of the time) and secondarily is from the west (about 12% of the time). Winds that range from the southeast clockwise to northwest sectors, which is the lower-left half of the valley axis, account for more than three-fourths of the time.

Typically, wind speeds at higher elevations are faster than those at lower elevations because of surface friction. However, the reverse is observed at the proposed Piñon Ridge Mill. The upslope-downwind speed at Site 2 is lower than that at Site 1, which is located on the central



(a) (b)

FIGURE 3.1-1 Wind Roses at the Proposed Piñon Ridge Mill, Montrose County, Colorado, April 2008–March 2011: (a) Site 1, 33-ft (10-m) Level; and (b) Site 2, 98-ft (30-m) Level (Source: Rogers 2011)

valley floor, due to friction with the nearby valley wall at Site 2 and because local flows seem somewhat stronger than regional westerly winds.

Aside from the weather stations at the proposed Piñon Ridge Mill, there is also a BLM Remote Automated Weather Station at Nucla near the ULP lease tracts. Nucla station is located outside the southeastern edge of Paradox Valley, about 2 mi (3 km) south of Nucla and about 11 mi (18 km) east of the proposed Piñon Ridge Mill site. However, wind patterns are quite different from those at Piñon Ridge Mill. As shown in Figure 3.1-2, prevailing wind directions are from the east throughout the year due to predominant nighttime drainage winds from the San Miguel River valley to the east (DRI 2011). During daytime hours, effects of the San Miguel River valley, which runs in a northwest–southeast direction, parallel those of the Paradox Valley, and regional westerly winds are more prominent.

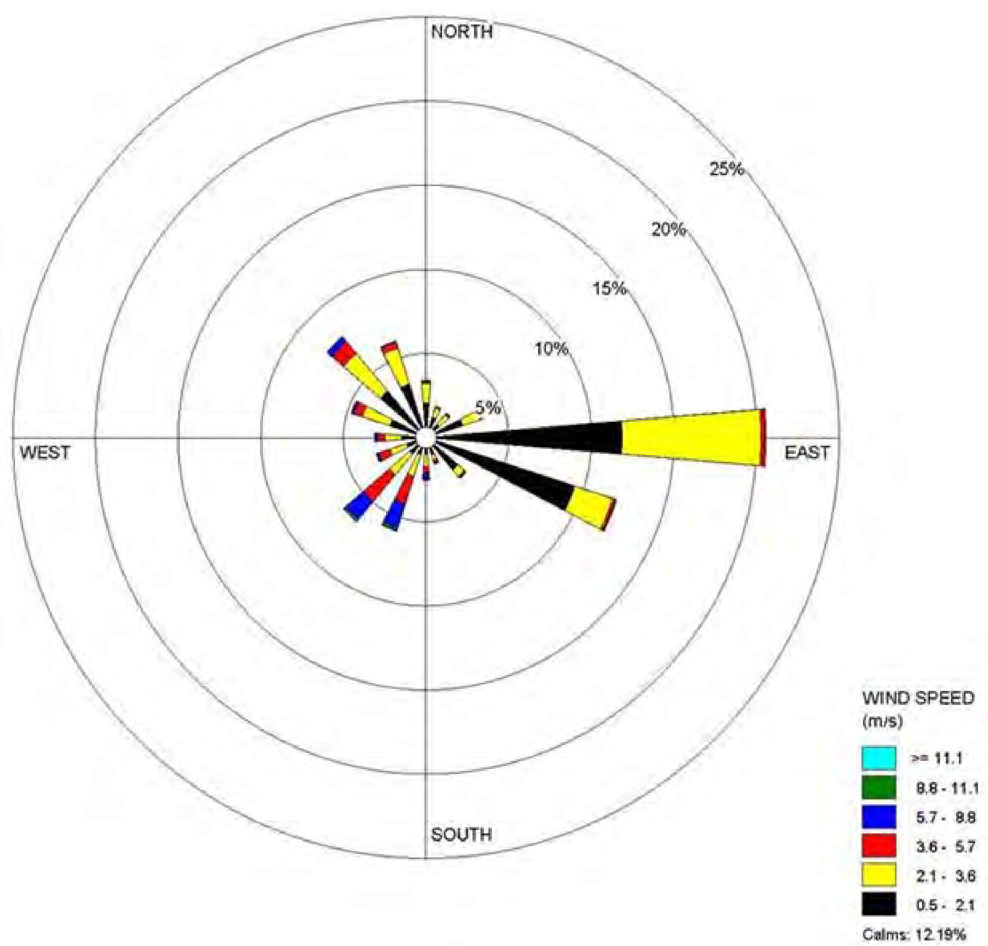


FIGURE 3.1-2 Wind Rose at 20-ft (6.1-m) Level at Nucla, Montrose County, Colorado, 2006–2010 (Source: DRI 2011)

3.1.1.3 Temperature

Temperatures in the region vary widely with elevation, latitude, season, and time of day. In western Colorado, topography plays a large role in determining the temperature of any specific location (NCDC 2011a). The ULP lease tracts sit at a higher elevation; thus, temperatures there are lower than at lower elevations of comparable latitude. Historical annual average temperatures measured at selected meteorological stations around the ULP lease tracts range from 45.3°F (7.4°C) in Northdale (about 10 mi [16 km] south of the southernmost ULP lease tract at an elevation of 6,680 ft [2,040 m]) to 53.9°F (12.2°C) in Gateway 1 SE (about 6 mi [10 km] northwest of the northernmost ULP lease tract at an elevation of 4,550 ft [1,390 m]), as presented in Table 3.1-1 (WRCC 2011a; DRI 2011). Typically, January is the coldest month, with nighttime lows ranging from 9.0 to 18.0°F (–12.8 to –7.8°C), and July is the warmest month, with daytime highs ranging from 86.5°F to 98.6°F (30.3 to 37.0°C). During the reporting period, the highest temperature of 110°F (43.3°C) was reached in June 1950 at Paradox 1 E and in July 1989 at Uravan, and the lowest of –42°F (–41.1°C) was reached in February 1933 at Northdale. Each year, about 17–76 days had a maximum temperature of ≥90°F (32.2°C), while about 132–205 days had minimum temperatures at or below freezing with subzero temperatures of about 3–18 days.

3.1.1.4 Precipitation

In Colorado, precipitation patterns are largely controlled by mountain ranges and elevation (NCDC 2011a). The interior, continental location, ringed by mountains on all sides, results in low precipitation year-round. Air masses crossing the region, which gather moisture over the Pacific Ocean and traverse several hundred miles of mountainous terrain, have precipitated a large percentage of inherent moisture, and thus the Colorado region receives little precipitation. For the reporting period, annual precipitation ranged from about 9.6 in. (24.3 cm) at Nucla to 16.0 in. (40.7 cm) at Paradox 1 W (WRCC 2011a). Precipitation is relatively evenly distributed throughout the year; however, isolated thunderstorms occur during the summer months. In general, precipitation is somewhat higher in fall months (about 30% of the annual total), and lower in winter months (about 22% of the annual total) around the ULP lease tracts. Snowfall varies by location (ranging on average from about 11 in. [28 cm] in Uravan to about 41 in. [104 cm] in Northdale), with the snowiest months being December through February. In general, snowfall tends to increase with increasing elevation, while precipitation has no clear relationship with respect to latitude and elevation in the area.

3.1.1.5 Severe Weather

Because mountain ranges surrounding ULP lease tracts block air masses from penetrating into the area, severe weather events, such as tornadoes, are a rarity, but floods, hail, high winds, winter storms, and wildfires do occur frequently (NCDC 2011b).

TABLE 3.1-1 Temperature and Precipitation Data Summaries at Selected Meteorological Stations around the ULP Lease Tracts, in Order of Meteorological Station Starting from North to South

		Temperature (°F)							Precipitation (in.)			
Station[c]	County	Average Monthly Minimum[a]	Average Monthly Maximum[a]	Annual Mean	Extreme Low	Extreme High	No. of Days with Max. Temp. ≥90°F	No. of Days with Min. Temp. ≤32°F (≤0°F)	Total Water Equiv.	Snowfall	Period of Record	Elev. (ft)
Gateway 1 SE	Mesa	18.0	93.2	53.9	–28	106	61.9	132.3 (3.1)	11.40	15.9	1947–2010	4,550
Paradox 1 W[b]	Montrose	17.4	90.1	50.9	–14	106	43.8	153.6 (3.1)	16.02	27.5	1977–1995	5,530
Paradox 1 E[b]	Montrose	12.0	92.5	49.7	–21	110	57.6	181.4 (9.9)	11.73	23.4	1948–1977	5,280
Uravan[c]	Montrose	15.5	95.6	53.2	–23	110	75.9	149.1 (3.8)	12.61	11.1	1960–2010	5,010
Nucla	Montrose	12.6	98.6	52.1	–10	104	NA[c]	NA	9.55	NA	1998–2011	5,860
Northdale	Dolores	9.0	86.5	45.3	–42	103	17.3	205.0 (17.8)	12.49	40.9	1930–2002	6,680

[a] "Average Monthly Minimum" denotes the monthly average of daily minimum values during the period of record, which normally occurs in January. "Average Monthly Maximum" denotes the monthly average of daily maximum values during the period of record, which normally occurs in July.

[b] Paradox 1 W and 1 E and Uravan are located at almost the same latitude.

[c] NA denotes not available.

Sources: DRI (2011); WRCC (2011a)

In the western valleys, localized flood-producing storms are more frequent. Occasionally, remnants of a decayed Pacific hurricane may dump heavy, widespread rains in Colorado (NCDC 2011a). Flash flooding from localized intense thunderstorms is more severe than flooding caused by snowmelt. Since 1994, 88 floods (with 61 flash floods) were reported in Mesa, Montrose, and San Miguel Counties combined (NCDC 2011b). Most floods were reported in towns along the river valleys, including Grand Junction, Gateway, and Mesa in Mesa County; Montrose, Naturita, Nucla, Uravan, and Bedrock in Montrose County; and Telluride and Placerville in eastern San Miguel County. These floods occurred mostly during summer months and caused some property and crop damage.

In these three counties, a total of 58 hail events were reported since 1962; some of these caused property and crop damage (NCDC 2011b). Hail events occurred mostly from May through September. Hail measuring 1.8 in. (4.4 cm) in diameter was reported in nine incidents.

Since 1962, 130 high wind events occurred in the three counties. Most were reported in Mesa County (NCDC 2011b). These high wind events occurred more frequently from May through September, with peak occurrence in June. A high wind with a maximum wind speed of 122 mph (54.5 m/s), which created blizzard conditions, was reported in January 1999 in Mesa County.

Winter snows are fairly frequent but are mostly light and quick to melt, except for the land around the southernmost DOE lease tracts near Edgar/The Spud Patch, which have substantial amounts of snow in some years that remain for much of the winter. Heavy snows in the high mountains are much more common. Since 1993, 410 snow and ice events were reported in Mesa County alone (NCDC 2011b). These caused some property damage and several deaths and injuries resulting from avalanches and traffic accidents.

Since 1999, 24 wildland and forest fires have been reported in the three counties, mostly during summer months, and they caused some property damage (NCDC 2011b). These fires were triggered by lightning in the area. Associated with ongoing global warming, large-wildfire frequency, fire duration, and fire season length have increased substantially in the western United States in recent decades and are projected to increase, especially in the Southwest (USGCRP 2009). This is due primarily to earlier spring snowmelt and higher spring and summer temperatures that reduce the moisture availability and dry out the vegetation that provides the fuel for fires.

Complex terrain typically disrupts the mesocyclones associated with tornado-producing thunderstorms; thus, tornadoes are less frequent and destructive in this region than they are in tornado alley (in the central United States) or Colorado’s eastern plains. Tornado frequencies per area in counties within the ULP lease tracts are less than one-tenth of those in the rest of the state. In the period April 1950 to August 2011, a total of 12 tornadoes (0.2 per year) were reported in the three counties (NCDC 2011b): 9 tornadoes in Mesa County; 3 tornadoes in Montrose County; and no tornados in San Miguel County. However, most tornadoes occurring in the area were relatively weak (eight F0 and four F1 on the Fujita tornado scale[1]), but one caused injury, and some minor property damage was reported. Most of these tornadoes occurred either in northern Mesa County around the I-70 area or in northeastern Montrose County. However, in October 2005, one F1 tornado hit Bedrock, which is located several miles from ULP lease tracts.

3.1.2 Existing Air Emissions

Mesa, Montrose, and San Miguel Counties have many small-scale industrial emission sources and two coal-fired power plants—Cameo station[2] in Palisade, Mesa County, and Nucla station in Nucla, Montrose County. The absolute amount of emissions, except for emissions from the two coal-fired power plants, is relatively low. The population is sparse, and the population centers and many of the industrial facilities are located along the handful of major roads such as I-70, US 50, and US 550. Several state highways exist around the ULP lease tracts, such as CO 90 and CO 141. Onroad mobile and industrial source emissions are concentrated along these routes.

Data on annual emissions of criteria pollutants and VOCs in Mesa, Montrose, and San Miguel Counties are presented in Table 3.1-2 for 2008 (CDPHE 2011a). Among the three counties, emissions are the highest in Mesa County and the lowest in San Miguel County. Emission data are categorized by type of source: point; area; onroad mobile; nonroad mobile; road dust; construction; biogenic; fires (forest/agricultural fires and structural fires); and so on. In 2008, onroad vehicle sources were primary contributors to total carbon monoxide (CO) emissions in three counties (about 38%), followed by forest/agricultural fires (about 21%). Onroad vehicle sources and point sources were primary and secondary contributors to total emissions of nitrogen oxides (NO_x) in three counties (about 31% and 22%, respectively). Point sources accounted for most of sulfur dioxide (SO_2) emissions in the three counties (over 94%), because of the two coal-fired power plants. Road dust was the primary contributor to PM_{10} emissions[3] (about 29%), with construction being a secondary contributor (about 27%). Biogenic sources (i.e., vegetation—including trees, plants, and crops—and soils) that release naturally

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1 The Fujita tornado scale is classified with the fastest 0.40-km (0.25-mi) wind speeds: F0 (gale); F1 (moderate); and F2 (significant) through F5 (incredible) tornadoes are classified with wind speeds of 40 to 72 mph (19 to 32 m/s), 73 to 112 mph (33 to 50 m/s), and 113 to 157 mph up to 261 to 318 mph (51 to 70 m/s up to 117 to 142 m/s). The new Enhanced Fujita (EF) scale based on 3-second wind gusts was implemented on February 1, 2007. Similar to the original Fujita scale, the ratings are from EF0 to EF5. However, historical tornadoes are still categorized with the original Fujita scale, as are those in the NCDC's *Storm Events* database.

2 The station has shut down at the end of 2010 and thus is no longer in service (see Section 4.7.2.10).

3 Particulate matter, or PM, is dust, smoke, and other solid particles and liquid droplets in the air. The size of the particulate is important and is measured in micrometers (μm), which is 1 millionth of a meter (0.00004 inch). $PM_{2.5}$ is PM with an aerodynamic diameter that is less than or equal to 2.5 μm, and PM_{10} is PM with an aerodynamic diameter that is less than or equal to 10 μm. "Respirable" $PM_{2.5}$ is released into atmosphere through combustion-related sources, such as motor vehicles, power plants, and forest fires, and it can penetrate deep into the lungs. In contrast, sources of "inhalable" PM_{10} include crushing and grinding operations and fugitive dust from vehicles travelling on roads, and this pollutant can enter the respiratory system. These particles can cause or aggravate respiratory, heart, and lung diseases.

TABLE 3.1-2 Annual Emissions of Criteria Pollutants and Volatile Organic Compounds in Mesa, Montrose, and San Miguel Counties, Colorado, Encompassing the ULP Lease Tracts, 2008

	Annual Emissions (tons/yr)			
Pollutant[a]	Mesa County	Montrose County	San Miguel County	Three-County Total
CO	40,688	19,533	5,548	65,769
NO_x	9,048	3,665	1,093	13,806
VOCs	39,828	21,220	13,065	74,113
$PM_{2.5}$[b]	2,838	2,316	370	5,524
PM_{10}	8,050	5,823	1,504	15,377
SO_2	2,879	1,358	9	4,246

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

[b] $PM_{2.5}$ emissions were not included in the CDPHE's 2008 air pollutant emissions inventory database, so they were estimated by using available $PM_{2.5}/PM_{10}$ ratios (ARB 2011; Countess Environmental 2006).

Source: CDPHE (2011a)

occurring emissions accounted for a significant portion of the VOC emissions (about 83%). Forest/agricultural fires were the primary contributor (about 31%) to total $PM_{2.5}$ emissions of three counties, followed by point sources (about 21%).

Most of the Paradox Valley is utilized for open ranching, but some agricultural sources exist near Bedrock, Paradox, and Nucla, Montrose County. There are several minor sources throughout the valley, including aggregate processing operations, concrete batch plants, and uranium/vanadium ore mining (Edge Environmental, Inc. 2009). These operations are primarily sources of PM but can also utilize processes and/or equipment that emit NO_X, SO_2, CO, and some hazardous air pollutants (HAPs). Tri-State Generation and Transmission Association, Inc., operates a 100-MW coal-fired power plant in Nucla, which receives its coal supply exclusively from a coal strip mine, New Horizon Mine, by tractor-trailer truck (Tri-State 2011). The mine is located about 5 mi (8 km) northwest of the plant. The mining activities and coal transportation are sources of PM, while the power plant is a primary source of SO_2, NO_X, PM, CO, and some HAPs.

In 2010, Colorado produced about 130 million metric tons of *gross*[4] carbon dioxide equivalent (CO_2e)[5] emissions (Strait et al. 2007). Gross GHG emissions in Colorado increased by about 50% from 1990 to 2010, an increase more rapid than that in the nation as a whole, which was attributable to Colorado's population growth. In 2010, consumption-based electricity use (37%), followed by transportation (24%), was the primary contributor to gross GHG emissions in Colorado. Electricity use from coal-fired power plants is the single largest contributor to GHG emissions in Colorado (about 31%). Fossil fuel use (in the residential, commercial, and industrial sectors) and fossil fuel industry accounted for about 18% and 9%, respectively, of total state emissions. Non-energy-related emissions from agriculture, industrial processes, and waste management accounted for the rest of the GHG emissions in Colorado. These gross emissions in Colorado equate to about 2% of total GHG emissions of 6,600 million metric tons of CO_2e in the United States during 2009 (EPA 2011a). Colorado's *net* emissions were about 100 million metric tons of CO_2e, considering carbon sinks from forestry land use and agricultural soils throughout the state.

Climate changes are primarily associated with human-induced emissions of heat-trapping gases, so-called GHGs. These emissions come mostly from the burning of fossil fuels (e.g., coal, oil, and natural gas), with considerable contributions from land use changes, such as deforestation or agricultural practices. GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorine-containing halogenated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These gases are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, and are thus capable of preventing long-wave thermal radiant energy emitted at the earth's surface from leaving earth's atmosphere. The net effect over time is a trapping of absorbed radiation and a tendency to warm the planet's surface and the boundary layer of the earth's atmosphere, and this constitutes the "greenhouse effect." Some GHGs (CO_2, CH_4, and N_2O) are both naturally occurring and the product of industrial activities, while fluorine-containing halogenated substances are man-made and are present in the atmosphere exclusively due to human activities. In 2009, CO_2 emissions account for about 83.0% of total U.S. GHG emissions on the CO_2e equivalent basis, followed by CH_4 (about 10.3%) and N_2O (about 4.5%), with fluorine-containing halogenated substances accounting for the rest (EPA 2011a).

[4] Excluding GHG emissions removed by agricultural soils and as a result of forestry and land use.

[5] This is a measure used to compare the emissions from various GHGs on the basis of their global warming potential, defined as the cumulative radiative forcing effect of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas, CO_2. For example, global warming potentials used for GHG emission calculations and reporting are 1 for CO_2, 21 for methane (CH_4), and 310 for nitrous oxide (N_2O) over a 100-year time horizon. For other GHGs, including sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), global warming potentials are typically much higher. The CO_2e for a gas is derived by multiplying the mass of the gas by the associated global warming potential.

3.1.3 Existing Air Quality

Under the Clean Air Act (CAA) which was last amended in 1990, the EPA has set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment (EPA 2011b). NAAQS have been established for six criteria pollutants—CO, lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), PM (both $PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2), as shown in Table 3.1-3. The CAA established two types of NAAQS: primary standards to protect public health including sensitive populations (e.g., asthmatics, children, and the elderly) and secondary standards to protect public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings. Any individual state can have its own State Ambient Air Quality Standards (SAAQS), but SAAQS must be at least as stringent as the NAAQS. If a state has no standard that corresponds to one of the NAAQS or if the SAAQS are not as stringent as the NAAQS, then the NAAQS apply. Colorado has a more stringent standard than the NAAQS for 3-hour SO_2 (CDPHE 2011b), as shown in Table 3.1-3.

An area where a criteria pollutant concentration exceeds NAAQS levels is called a nonattainment area. Previous nonattainment areas where air quality has improved to meet the NAAQS are redesignated as maintenance areas and are subject to an air quality maintenance plan. States must have State Implementation Plans (SIPs) that demonstrate how nonattainment areas will meet the NAAQS and how the NAAQS will be maintained in maintenance areas.

Mesa, Montrose, and San Miguel Counties, which encompass the ULP lease tracts, are located administratively within the Grand Mesa Intrastate Air Quality Control Region (AQCR) (see 40 CFR 81.173), along with other west-central counties in Colorado. Mesa County is within Colorado State AQCR 11, while Montrose and San Miguel Counties are within Colorado State AQCR 10. Currently, Colorado State AQCRs 10 and 11 are designated as being in unclassifiable/attainment for all criteria pollutants (EPA 2011c). However, Telluride in San Miguel County, which is located about 58 mi (93 km) east of the southernmost ULP lease tract, has been designated as a moderate maintenance area for PM_{10} since 2001.

The western counties generally have smaller towns, usually located in fairly broad river valleys. Because of the relatively low population density, low level of industrial activities, and relatively low traffic volume in the area, the quantity of anthropogenic emissions is small, and ambient air quality is thus relatively good.

Except for PM_{10} data at the proposed Piñon Ridge Mill, there are no recent measurement data for criteria air pollutants around the ULP lease tracts. Currently, CO, O_3, $PM_{2.5}$, and PM_{10} data are collected around the Grand Junction area in Mesa County (CDPHE 2011c). In addition, PM_{10} data are collected in Telluride in San Miguel County, which is designated as a PM_{10} maintenance area. No monitoring stations are operating in Montrose County.

In addition to the standards, Table 3.1-3 presents background levels for criteria pollutants. The highest background concentration levels that are related to the NAAQS for CO, Pb, NO_2, annual $PM_{2.5}$, and SO_2 representative of the ULP lease tracts in the statewide

1 **TABLE 3.1-3 National Ambient Air Quality Standards (NAAQS), Colorado State Ambient Air**
2 **Quality Standards (SAAQS), and Background Concentration Levels Representative of the ULP**
3 **Lease Tracts in Mesa, Montrose, and San Miguel Counties, Colorado[a]**

		NAAQS[b]			Background Concentration Levels	
Pollutant	Averaging Time	Standard Value	Standard Type[c]	Colorado SAAQS	Value[d,e]	Location[f] (Year)
CO	1-hour	35 ppm	P	–[g]	7 ppm (20%)	Grand Junction, Mesa County (2008–2010)
	8-hour	9 ppm	P	–	2 ppm (22%)	Grand Junction, Mesa County (2008–2010)
Pb	Rolling 3-month	0.15 μg/m^3	P, S	–	0.037 μg/m^3 (25%)	Denver (2008–2010)
NO_2	1-hour	100 ppb	P	–	38 ppb (38%)	Durango, La Plata County (2008–2010)
	Annual	53 ppb	P, S	–	3 ppb (6%)	Durango, La Plata County (2006–2008)
O_3	8-hour	0.075 ppm	P, S	–	0.067 ppm (90%)	Palisade, Mesa County (2008–2010)
$PM_{2.5}$	24-hour	35 μg/m^3	P, S	–	34.3 μg/m^3 (98%)	Grand Junction, Mesa County (2008–2010)
	Annual	15 μg/m^3	P, S	–	9.2 μg/m^3 (62%)	Grand Junction, Mesa County (2008–2010)
PM_{10}	24-hour	150 μg/m^3	P, S	–	131 μg/m^3 (87%)	Grand Junction, Mesa County (2008–2010)
					89 μg/m^3 (59%)	Piñon Ridge Mill, Montrose County (April 2008–March 2010)
SO_2	1-hour	75 ppb	P	–	38 ppb (50%)	Denver (2008–2010)
	3-hour	0.5 ppm	S	700 μg/m^3 (0.267 ppm)	0.01 ppm (4%)	Denver (2006–2008)

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of ≤ 2.5 μm; PM_{10} = particulate matter with an aerodynamic diameter of ≤ 10 μm; SO_2 = sulfur dioxide; ppm = part(s) per million; ppb = part(s) per billion.

Footnotes continued on next page.

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TABLE 3.1-3 (Cont.)

[b] Refer to 40 CFR Part 50 and EPA (2011b) for detailed information on attainment determination and the reference method for monitoring.

[c] P = primary standards, which set limits to protect public health, including the health of "sensitive" populations, such asthmatics, children, and the elderly. S = secondary standards, which set limits to protect welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

[d] Monitored concentrations are second-highest for 1-hour and 8-hour CO and 3-hour SO_2; the highest for 24-hour Pb (no rolling 3-month averages available at the time of this writing); 3-year average of 98th percentile of 1-hour NO_2 and 24-hour $PM_{2.5}$; highest annual mean over 3 years for annual NO_2; 3-year average of annual fourth-highest daily maximum 8-hour average for O_3; 3-year average of annual means for annual $PM_{2.5}$; fourth-highest over 3 years for PM_{10} for Grand Junction data but highest over 2 years for Piñon Ridge Mill data; and 3-year average of 99th percentile of 1-hour daily maximum for 1-hour SO_2.

[e] Values in parentheses are background concentration levels as a percentage of NAAQS or SAAQS (for 3-hour SO_2 only).

[f] For each pollutant, the location shown is the closest monitoring station from the ULP lease tracts. For Pb and SO_2, values for Denver are presented to show that even the highest monitored values in Colorado are still well below the standard and thus not a concern.

[g] A hyphen indicates that no standard exists.

Sources: CDPHE (2011b); EPA (2011b,d)

monitoring network were less than or equal to 62% of their respective standards, as shown in Table 3.1-3 (EPA 2011d). However, 8-hour O_3 and 24-hour $PM_{2.5}$ and PM_{10} concentrations were approaching or close to the applicable standard (maximum at about 98% for 24-hour $PM_{2.5}$).

In addition, the Energy Fuels Resources Corp. air monitoring program collected PM_{10} data for 24 hours every 6 days at Sites 1 and 2, which are collocated with 10-m (33-ft) and 30-m (98-ft) meteorological towers of the proposed Piñon Ridge Mill, respectively. The 24-hour average PM_{10} data collected at Sites 1 and 2 are presented as a function of time for the period of April 2008 through March 2010 in Figure 3.1-3 (Rogers 2011) and are also presented in Table 3.1-3. The monitored highest 24-hour PM_{10} concentration of 89 $\mu g/m^3$ at the proposed Piñon Ridge Mill was well below the NAAQS of 150 $\mu g/m^3$.

Climate changes are under way in the United States and globally, and they are projected to continue to grow substantially over next several decades unless intense, concerted measures are taken to reverse this trend (USGCRP 2009). Climate-related changes include rising temperature and sea level, increased frequency and intensity of extreme weathers (e.g., heavy downpours, floods, and droughts), earlier snowmelts and associated frequent wildfires, and reduced snow cover, glaciers, permafrost, and sea ice.

The Western States have heated up more than the world as a whole (Saunders et al. 2008). For the 2003–2007 period, the global climate has averaged 1°F (0.6°C) warmer than the

20th century average. For the same period, the 11 Western States averaged 1.7°F (0.9°C) and Colorado averaged 1.9°F (1.1°C) warmer than the 20th century average. In the arid/semi-arid West, global warming is already having serious consequences on the region's scarce water supplies, particularly the snow that makes up most of the region's precipitation and, when melted, provides 70% of its water. To date, decreases in snowpack, less snowfall, earlier snowmelt, more winter rain events, increased peak winter flows, and reduced summer flows have been documented.

As the effects of global climate change continue, it is very likely that, associated with northward migration of storm tracks (USGCRP 2009), desertification will intensify in the Southwestern States; thus, it will be more likely that more dust will be produced as vegetative cover decreases and as soils dry (Morman 2010). It is widely understood that impurities in snow, such as dust or soot, decrease snow albedo and enhance solar radiation absorption and melt rates. Dust may shorten snow cover duration by as much as a month (Painter et al. 2007). Earlier spring snowmelt along with higher spring/summer temperatures have broad implications with regard to water resources in Southwestern States that are already strapped for water, especially during the summer when peak demand is higher, and it leads to an increased the number of forest fires (USGCRP 2009). The problem of disturbed desert dust causing regional climate change and early snowmelt is discussed in numerous recent scientific articles. Neff et al. (2008) documented how the phenomenon of dust causing snowmelt was largely coincidental with increased settlement of the American West. The deposition of this disturbed desert dust on snow leads to early snow melt (Painter et al. 2007). In the Colorado River Basin, these effects are significant. Painter et al. (2010) estimated that the landing of disturbed desert soils traceable to settlement of the American West on mountain snowpack in the Upper Colorado River Basin has resulted in a net loss of approximately 5% of the annual flow of the Colorado River as measured at Lees Ferry, Arizona. It is likely that most dust on snowpack at high mountains around the ULP region is coming from nearby lands where soil-disturbing activity has made them susceptible to wind erosion and from the deserts of the Colorado Plateau along with prevailing westerlies; it is also coming from other Southwestern deserts to some extent. Activities such as exploration and development of energy resources, off-road vehicle use, agriculture, and grazing serve to destabilize soils, making them more susceptible to wind erosion (Belnap et al. 2009).

3.1.4 Regulatory Environment

3.1.4.1 Prevention of Significant Deterioration (PSD)

The Prevention of Significant Deterioration (PSD) regulations (see 40 CFR 52.21), which are designed to limit the growth of air pollution in clean areas, apply to a new major source or a modified existing major source within an attainment or unclassified area. PSD regulations limit increases in ambient concentrations above legally established baseline levels for selected criteria pollutants, as shown in Table 3.1-4. Incremental increases in PSD Class I areas, such as National Parks (NPs) or Wilderness Areas (WAs), are strictly limited, while those in

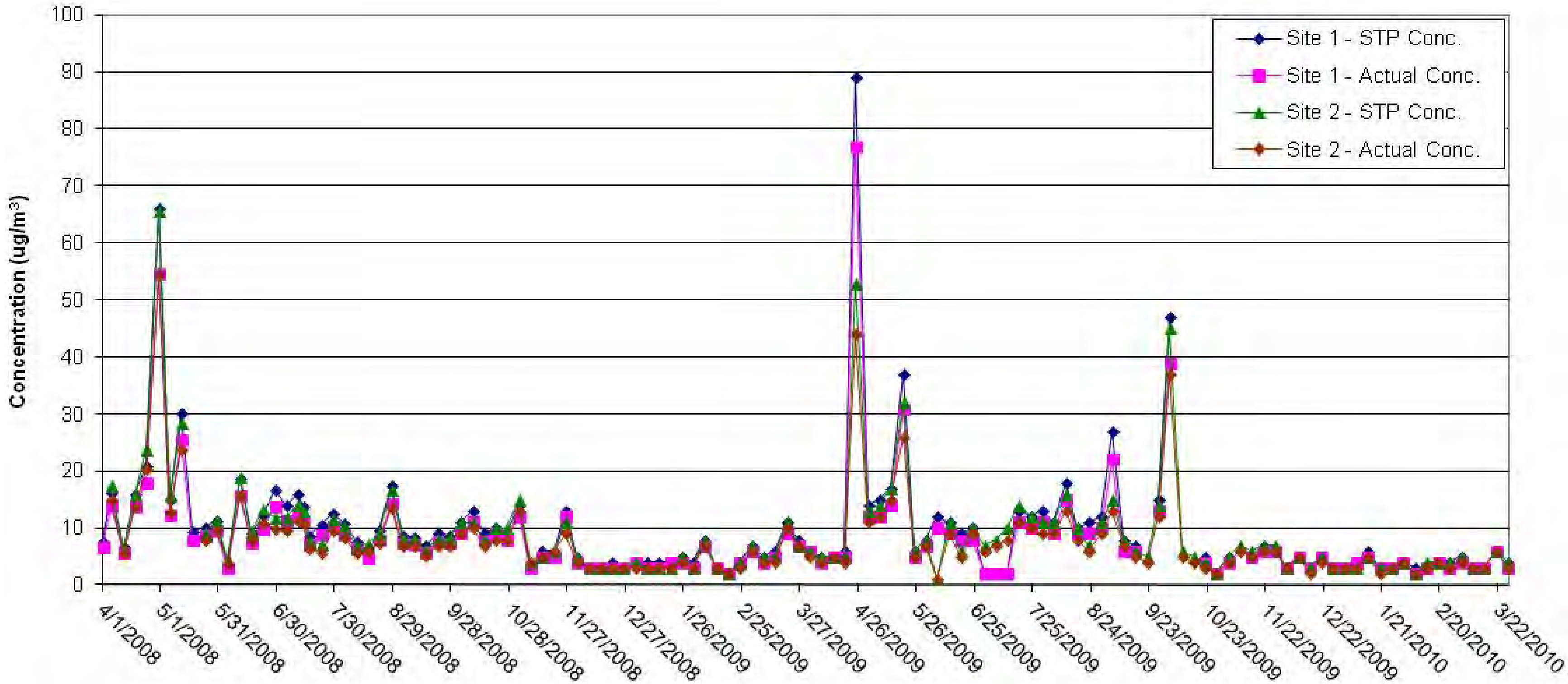


FIGURE 3.1-3 Monitored PM_{10} Concentrations at Sites 1 and 2 of the Proposed Piñon Ridge Mill, April 2008–March 2010 (Rogers 2011)

TABLE 3.1-4 Maximum Allowable PSD Increments for PSD Class I and Class II Areas

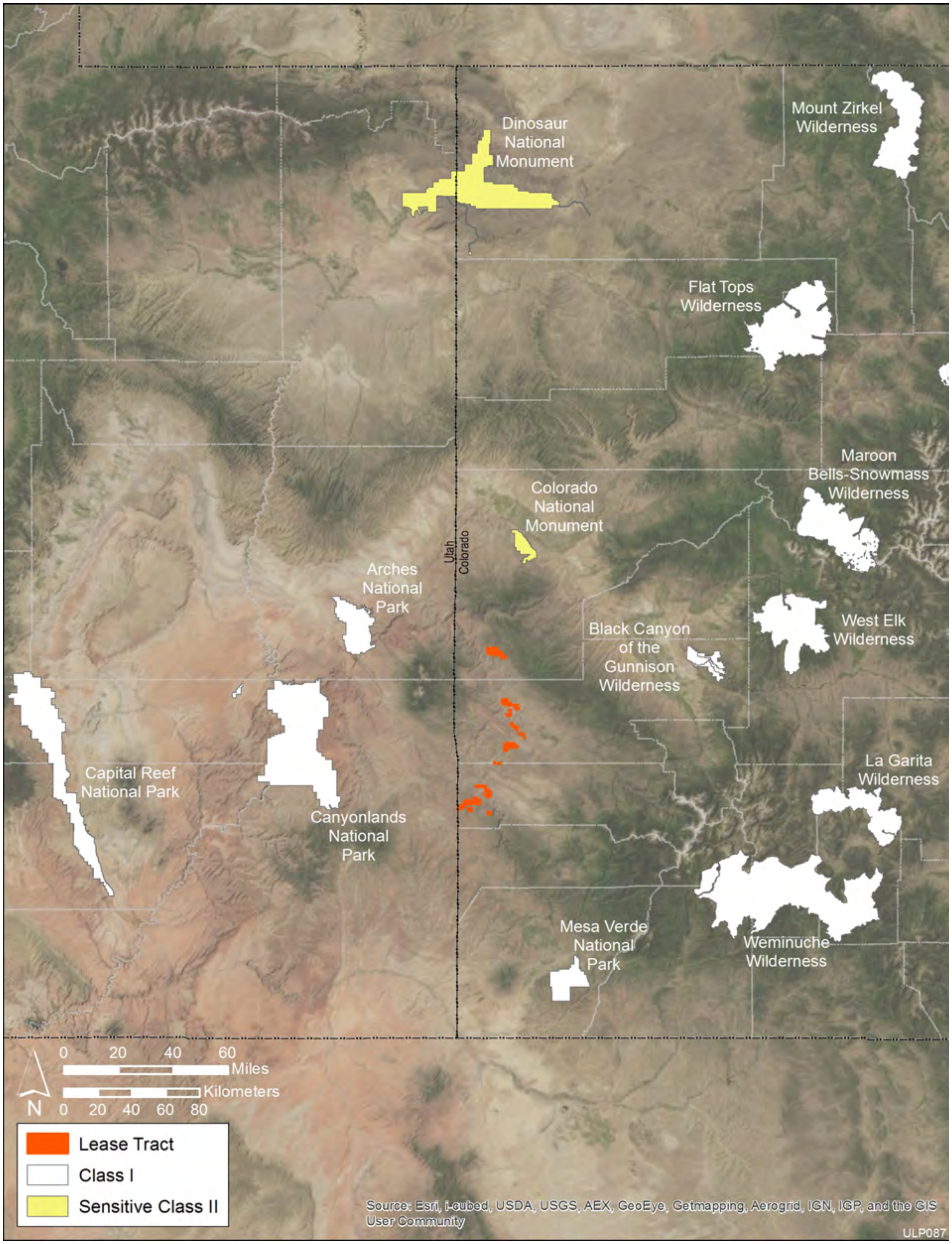
		PSD Increment ($\mu g/m^3$)	
Pollutant	Averaging Time	Class I	Class II
NO_2	Annual	2.5	25
$PM_{2.5}$	24-hour	2	9
	Annual	1	4
PM_{10}	24-hour	8	30
	Annual	4	17
SO_2	3-hour	25	512
	24-hour	5	91
	Annual	2	20

Source: 40 CFR 52.21; 75 FR 64864

Class II areas (the rest of the country) allow for moderate growth in emission levels. Most of the area surrounding the ULP lease tracts is classified as PSD Class II. Major (large) new and modified stationary sources must meet the requirements for the area in which they are located and the areas they affect.

As a matter of policy, the EPA recommends that the permitting authority notify the Federal Land Managers (FLMs)[6] when a proposed PSD source would locate within 62 mi (100 km) of a Class I area for a determination of the potential impact on AQRVs, which are discussed in Section 3.1.4.4. There are several Class I areas around the ULP lease tracts, five of which are situated within 62 mi (100 km), as shown in Figure 3.1-4. The permit may still be issued even if the FLM determines that there may be an adverse impact on AQRVs. The nearest Class I area is the Arches NP in Utah (40 CFR 81.430), about 32 mi (51 km) west of the northernmost lease tract. The other four Class I areas within this range include Canyonlands NP in Utah, which is about 34 mi (55 km) west of the southernmost lease tract, and Mesa Verde NP, Black Canyon of the Gunnison WA, and Weminuche WA in Colorado (40 CFR 81.406); these WAs are located about 47 mi (76 km) south–southeast of the southernmost lease tract, 50 mi (81 km) east–northeast of the central lease tract, and 62 mi (100 km) east–southeast of the

[6] FLM is the Secretary of the department with authority over the Federal Class I areas (or the Secretary’s designee). For DOI, the Secretary has designated the Assistant Secretary for Fish and Wildlife and Parks as the FLM, whereas the Secretary of Agriculture has delegated the FLM responsibilities to the Regional Forester and, in some cases, the Forest Supervisor.

1 

2 **FIGURE 3.1-4 PSD Class I Areas and Colorado Sensitive Class II Areas around the**
3 **ULP Lease Tracts**

southernmost lease tract, respectively. There are two sensitive Class II areas that are regulated by CDPHE as Class I for SO_2: Colorado National Monument and Dinosaur National Monument, which are located about 25 mi (40 km) north–northeast and 111 mi (179 km) north of the northernmost ULP lease tracts, respectively. The ULP lease tracts are designated as a PSD Class II area by EPA and the State of Colorado.

3.1.4.2 Visibility Protection

Visibility was singled out for particular emphasis in the CAA Amendments of 1977. Visibility in a Class I area is protected under two sections of the Act. Section 165 provides for the PSD program (described above) for new sources. Section 169(A), for older sources, describes requirements for both reasonably attributable single sources and regional haze that address multiple sources. FLMs have a particular responsibility to protect visibility in Class I areas. Even sources located outside a Class I area may need to obtain a permit that ensures they have no adverse impact on visibility within the Class I area, and existing sources may need to retrofit controls. The EPA's 1999 Regional Haze Rule set goals of preventing future impairments and remedying existing impairments to visibility in Class I areas. States had to revise their SIPs to establish emission reduction strategies to meet a goal of natural conditions by 2064.

3.1.4.3 General Conformity

Federal departments and agencies are prohibited from taking actions in nonattainment and maintenance areas unless they first demonstrate that the actions would conform to the SIP as it applies to criteria pollutants. Transportation-related projects are subject to requirements for transportation conformity. General conformity requirements (40 CFR Parts 51 and 93, 75 FR 17254, dated April 5, 2010) apply to stationary sources. Conformity addresses only those criteria pollutants for which the area is in nonattainment or maintenance (e.g., VOCs and NO_x for O_3). If annual source emissions are below specified threshold levels, no conformity determination is required. If the emissions exceed the threshold, a conformity determination must be done to demonstrate how the action will conform to the SIP. The demonstration process involves public notification and response and may require extensive analysis.

3.1.4.4 Air Quality-Related Values

AQRVs are defined as valued resources that may be adversely affected by a change in air quality from air pollutant emissions, including visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area. Although the permit applicant should identify the potential impacts of the source on all applicable AQRVs of that area, an FLM may ask an applicant to address any or all of the areas of concern. The primary areas of concern to the FLMs are visibility impairment and effects of pollutant deposition on soils and surface waters (USFS et al. 2010).

Visibility is a measure of aesthetic value and the ability to enjoy scenic vistas, but it also can be an indicator of general air quality. Visibility degradation is caused by cumulative emissions of air pollutants from a myriad of sources scattered over a wide geographical area, such as combustion-related sources and fugitive sources. The primary cause of visibility degradation is the scattering and absorption of light by fine particles (such as sulfates, nitrates, organic carbon, light-absorbing soot, soil dust, and sea salt) with a secondary contribution provided by gases (such as nitrogen dioxide). In general, visibility conditions in the western United States are substantially better than those in the eastern United States, which has higher pollutant loads and humidity levels. Dust sources vary greatly spatially and temporally but play a more important role in visibility degradation in the arid parts of the western United States. Fugitive dust from wind erosion and anthropogenic activities, including agriculture, construction, grazing, mining, and vehicle traffic on paved and unpaved roads, would be a major concern in the arid desert environment. The typical visual range (defined as the farthest distance at which a large black object can be seen and recognized against the background sky) in most of the West is about 60 to 90 mi (97 to 145 km), while that in most of the eastern United States is about 15 to 30 mi (24 to 48 km) (EPA 2006).

Annual mean reconstructed light extinction coefficients (b_{ext}) and deciview (dv)[7] averaged over 2005–2008 are similar for Class I areas around the ULP lease tracts (Hand et al. 2011): b_{ext} of 20.18 Mm^{-1} and 6.66 dv for Canyonlands NP; b_{ext} of 21.34 Mm^{-1} and 7.07 dv for Mesa Verde NP; and b_{ext} of 20.34 Mm^{-1} and 6.66 dv for Weminuche WA. These values correspond to about 120–125 mi (193–201 km) in visual range.

Much progress has been made to control SO_2 and NO_2 emissions primarily from fossil fuel–fired power plants and onroad/offroad engine exhaust, but dry and wet depositions of sulfur and nitrogen compounds continue to be a problem in the United States. Acid deposition causes acidification of lakes and streams, which has direct impacts on aquatic habitats, and contributes to the damage of trees at high elevation and many sensitive forest soils. In particular, certain sensitive freshwater lakes and streams continue to lose acid-neutralizing capacity (ANC), defined as a measure of the ability for water or soil to neutralize added acids, and sensitive soils continue to be acidified (USFS et al. 2010). In particular, many alpine lakes in the western United States are low in ANC because of thin soils and slowly weathering bedrock. Thus, these alpine lakes are vulnerable to changes in water chemistry caused by acid deposition.

Average total (dry + wet) depositions of sulfur and nitrogen combined at Clean Air Status and Trends Network (CASTNET) stations around the ULP lease tracts are about 2.88 kg/ha/yr for Canyonlands NP; 3.11 kg/ha/yr for Gothic in Gunnison County, Colorado; and 3.82 kg/ha/yr for Mesa Verde NP (EPA 2012b). These deposition fluxes are much lower than those in the

[7] The extinction coefficient (b_{ext}) represents the ability of the atmosphere to scatter and absorb light primarily by particles and, to some extent, by gases, and has unit of inverse length (inverse megameters, Mm^{-1}). The b_{ext} is related to visual range and deciview (a haziness index designed to be linear with respect to human perception of visibility, analogous to the decibel scale in acoustics). A higher b_{ext} corresponds to a lower visual range and higher deciview values.

eastern United States. In general, nitrogen depositions are primary contributors to total depositions; in the eastern United States, sulfur depositions are more important.

3.2 ACOUSTIC ENVIRONMENT

3.2.1 Sound Fundamentals

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibel (dB) scale.[8] To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 Hz),[9] A-weighting (denoted by dBA) (Acoustical Society of America 1983, 1985) is widely used. This scale has a good correlation to a human's subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

To account for variations of sound with time, several sound descriptors are used. L_{90} is the sound level exceeded 90% of the time. It is called the residual sound level (or background level), and it is a fairly steady, lower sound level on which discrete single events are superimposed. The equivalent-continuous sound level (L_{eq}) is the level that, if it were continuous during a specific time period, would contain the same total energy as the actual time-varying sound. In addition, human responses to noise differ depending on the time of the day. People are more annoyed by noise during nighttime hours when there are lower background noise levels. The day-night average sound level (L_{dn}, or DNL) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several Government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development, and Nuclear Regulatory Commission). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC 2002).

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[8] Scales for measuring most familiar quantities such as length, distance, and temperature are linear. Logarithmic scales, such as dB, compress the values of the measurements and are useful for measuring quantities like sound levels that can vary over a large range. For example, two linear measurements of 10 units and 1,000,000,000 units might correspond to values of 1 and 9, respectively, on a logarithmic scale. Logarithmic units also add differently than do linear units. For example, if one object is 6 ft long and a second is twice as long, the second object is 12 ft long. For sounds, however, if one sound level is 50 dB and a second is twice as loud, the second sound level will be 60 dB, not 100 (50 + 50) dB.

[9] The frequency is defined as the number of cycles per second, which is denoted by the unit of hertz (Hz). The normal hearing for a healthy young person ranges in frequency from about 20 to 20,000 Hz. The higher the frequency of the waveform, the higher the pitch of the sound heard.

3.2.2 Background Noise Levels

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in Wilderness Areas, typical noise levels are on the order of 20 dBA (Harris 1991).

State highways CO 90 and CO 141 run through or near the ULP lease tracts, and many county roads are scattered all over the ULP lease tracts. The nearest railroad runs as close as about 27 mi (43 km) from the northernmost ULP lease tracts. The nearest airport is Hopkins Field Airport in Nucla, about 7 mi (11 km) east of central ULP lease tracts. Other nearby public airports within a 50-mi (80-km) range include Grand Junction Regional Airport and Mack Mesa Airport in Mesa County, Montrose Regional Airport in Montrose County, Telluride Regional Airport in San Miguel County, and Monticello Airport in San Juan County, Utah . In addition, many private airports and heliports are scattered over the counties encompassing the ULP lease tracts. Most of Paradox Valley, which is located in the center of the ULP lease tracts, is utilized for open ranching, but some agricultural activities occur near Bedrock, Paradox, and Nucla in Montrose County. There are several minor noise sources throughout the valley, including aggregate processing operations, concrete batch plants, and uranium and vanadium ore mining (Edge Environmental, Inc. 2009). There is a 100-MW coal-fired power plant in Nucla, which receives coal from a nearby strip mine (New Horizon Mine) by tractor-trailer truck (Tri-State 2011). In addition, agricultural activities occur near Egnar in San Miguel County, south of the southernmost ULP lease tracts. Accordingly, in addition to natural sound sources (e.g., wind, rain, wildlife), noise sources around the ULP lease tracts include road traffic, aircraft flyovers, animal noise, agricultural activities, industrial activities, and nearby community activities and events. Other potential noise sources are recreational all-terrain vehicles being driven across the ULP lease tracts and ventilation shaft noise from underground mines. In summary, the area around the ULP lease tracts is remote, sparsely populated, and undeveloped; the overall character is considered mostly rural or undisturbed wilderness.

No sensitive receptors (e.g., hospitals, schools, or nursing homes) exist within a range of 3 mi (5 km) from the ULP lease tracts. Only 17 residences exist within 1 mi (1.6 km) of the 31 lease tracts; 7 of the 17 residences are adjacent to the 13 lease tracts. To date, no environmental noise survey has been conducted around the ULP lease tracts. It is likely that noise levels along the state highways and near agricultural/industrial activities would be relatively higher (about 50–60 dBA), while levels in areas far removed from manmade noise sources would be similar to wilderness background noise levels (below 30 dBA). On the basis of county population density data, L_{dn} noise level estimates around the ULP lease tracts would be about 38 dBA for Mesa County, 35 dBA for Montrose County, and 30 dBA for San Miguel County (Miller 2002). For comparison, rural and undeveloped areas typically have L_{dn} levels in a range of 33–47 dBA (Eldred 1982).

3.2.3 Noise Regulations

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet Communities Act of 1978, 42 USC 4901–4918) delegate the authority to regulate noise to the states and direct Government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA 1974). For protection against hearing loss in the general population from nonimpulsive noise, the EPA recommends L_{eq} of 70 dBA or less over a 40-year period.

ULP activities would have to follow applicable Federal, state, or local guidelines and regulations on noise. Colorado has a noise statute with quantitative noise limits by zone and time of day, as shown in Table 3.2-1 (Colorado Revised Statutes, Title 25, “Health,” Article 12, “Noise Abatement,” Section 103, “Maximum Permissible Noise Levels”). However, Mesa, Montrose, and San Miguel Counties, which encompass the ULP lease tracts, do not have quantitative noise guidelines and regulations applicable to the ULP activities.

TABLE 3.2-1 Colorado Limits on Maximum Permissible Noise Levels

	Maximum Permissible Noise Levels (dBA)[a]	
Zone	7 a.m. to next 7 p.m.[b]	7 p.m. to next 7 a.m.
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80	75

[a] At a distance of 25 ft or more from the property line. Periodic, impulsive, or shrill noises are considered a public nuisance at a level of 5 dBA less than the levels tabulated. Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for (1) the period within which construction is to be completed pursuant to any applicable construction permit issued by the proper authority or (2) if no time limitation is imposed, for a reasonable period of time for completion of the project.

[b] The tabulated noise levels may be exceeded by 10 dBA for a period not to exceed 15 minutes in any 1-hour period.

Source: Colorado Revised Statutes, Title 25, “Health,” Article 12, “Noise Abatement,” Section 103, “Maximum Permissible Noise Levels”

3.3 GEOLOGICAL SETTING AND SOIL RESOURCES

3.3.1 Geological Setting

3.3.1.1 Physiography

The lease tracts are located within the eastern part of the Canyon Lands section of the Colorado Plateau physiographic province in southwestern Colorado (Figure 3.3-1). The plateau is an extensive region generally characterized by nearly horizontal sedimentary formations covering an area of about 130,000 mi^2 (340,000 km^2) in the four corners region of Utah, Colorado, Arizona, and New Mexico. It is characterized by high elevation (the general plateau surface has an average elevation of about 5,200 ft [1,600 m], with plateaus and peaks nearly as high as 13,000 ft [4,000 m]) and a deeply incised drainage system, forming steep-walled canyons

FIGURE 3.3-1 Physiographic Map of the Colorado Plateau (modified from Foos 1999)

that expose geologic formations of late Paleozoic and early Mesozoic age. Most of the Colorado Plateau is drained by the Colorado River and its main tributaries, the Green, San Juan, and Little Colorado Rivers (Hunt 1974; Chronic and Williams 2002; Foos 1999).

The Canyon Lands section has been broadly uplifted, and structural features that have been superposed on it have strongly affected its topography (Thornbury 1965). In the eastern part of the Canyon Lands section in the area of the ULP lease tracts, topographic features are mainly related to a series of northwest-striking anticlines and synclines. These structures are caused by flowage or solution of masses of salt and gypsum that were deposited during Pennsylvanian time in the Paradox Basin (Thornbury 1965). The section is also known for its incised canyons that have formed in its drainage system. The example in the lease tracts area is the Dolores River and its canyons and incised meanders.

3.3.1.2 Structural Geology

The Colorado Plateau is an uplifted crustal block that is tectonically distinct from the extensional block-faulted regime of the Basin and Range province (to the west and south) and the Rio Grande rift (to the east). The predominant structural features are northwest trending basement uplifts (such as the Uncompahgre Plateau) that form steeply dipping monoclines with associated structural basins. Most of the tectonic deformation on the plateau occurred during the Laramide orogeny from 70 to 40 million years ago. Uplift of the plateau likely began about 29 million years ago as a result of compression created by extensional zones flanking the region to the west and east. Heat flow measurements throughout the Colorado Plateau indicate low heat flow in the relatively stable interior and high heat flow along the margins (Wong and Humphrey 1989).

The lease tracts are located in the eastern part of the Paradox Basin, an elliptically shaped structural basin that covers about 14,000 mi^2 (36,000 km^2) of the Colorado Plateau in southwestern Colorado and southeastern Utah (Figure 3.3-2). The basin has little surface expression, but is defined as the area on the plateau that is underlain by thick accumulations of evaporites (mainly halite) of the Pennsylvanian age Paradox Formation. The area of northwest-striking anticlines and synclines in the northeast part of the Paradox Basin is known as the Paradox fold and fault belt (Figure 3.3-2). In this belt, the anticlinal structures are known as valleys because their central salt cores have been breached by erosion and the subsequent collapse has formed anticlinal valleys (Thornbury 1965). Strata along the valley sides indicate that diapirism of the salt core occurred as recently as the late Jurassic (about 145 million years ago), especially in the northeastern part of the belt (Hite and Lohman 1973; Chenoweth 1987; Whitfield et al. 1983; Grout and Verbeek 1997; Condon 1997). Synclinal areas between the anticlines have created flat-topped mesas or broad valleys that contrast highly with the fault-bounded anticlinal valleys (Thornbury 1965). The ULP lease tracts are in the eastern part of the Paradox fold and fault belt, in Colorado. Examples of the anticlinal valleys in the lease tracts area are the Paradox and Big Gypsum Valleys; synclinal examples are Dry Creek Basin and Disappointment Valley. Figure 3.3-3 is a shaded relief map showing the locations of the ULP lease tracts.

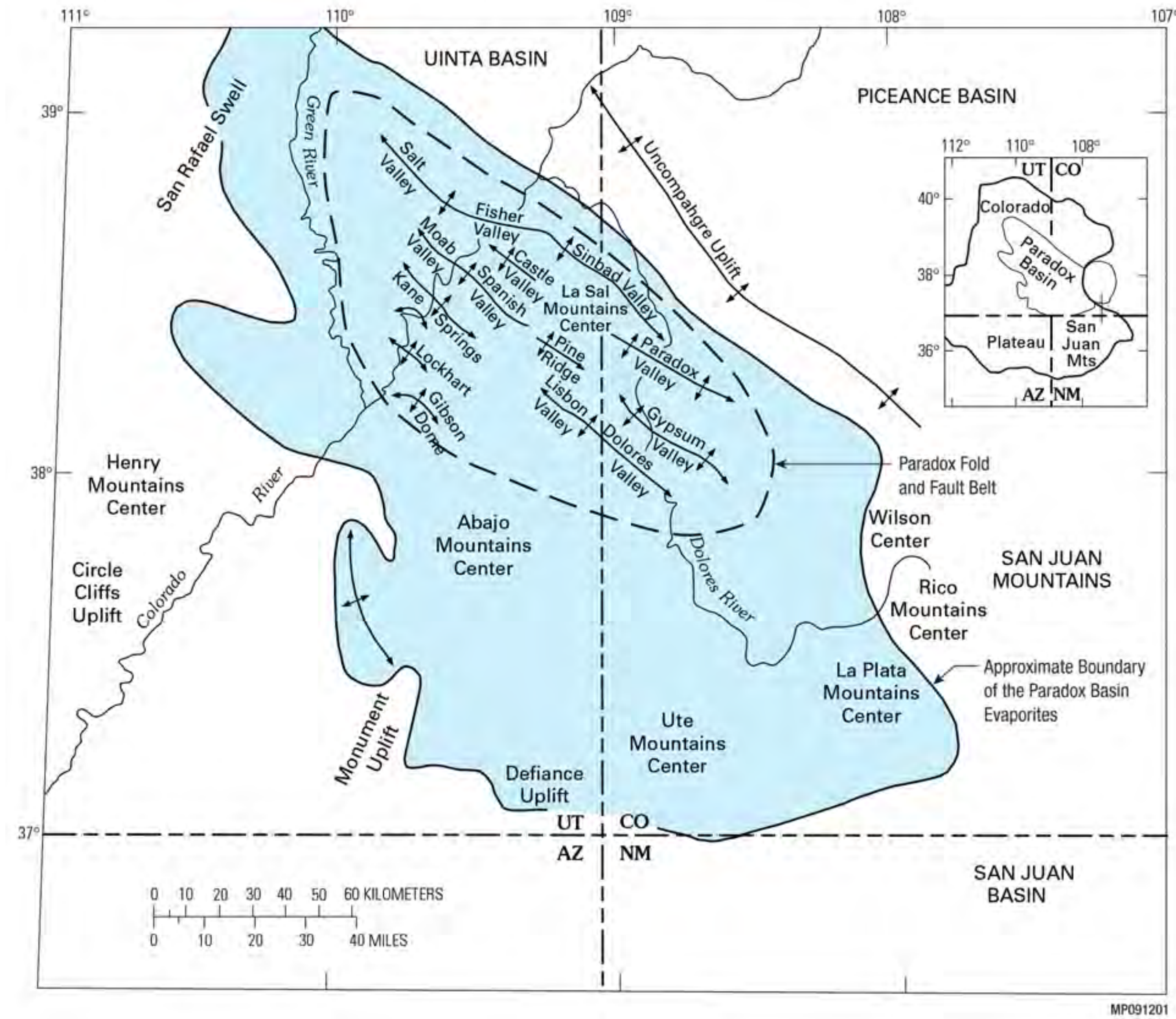
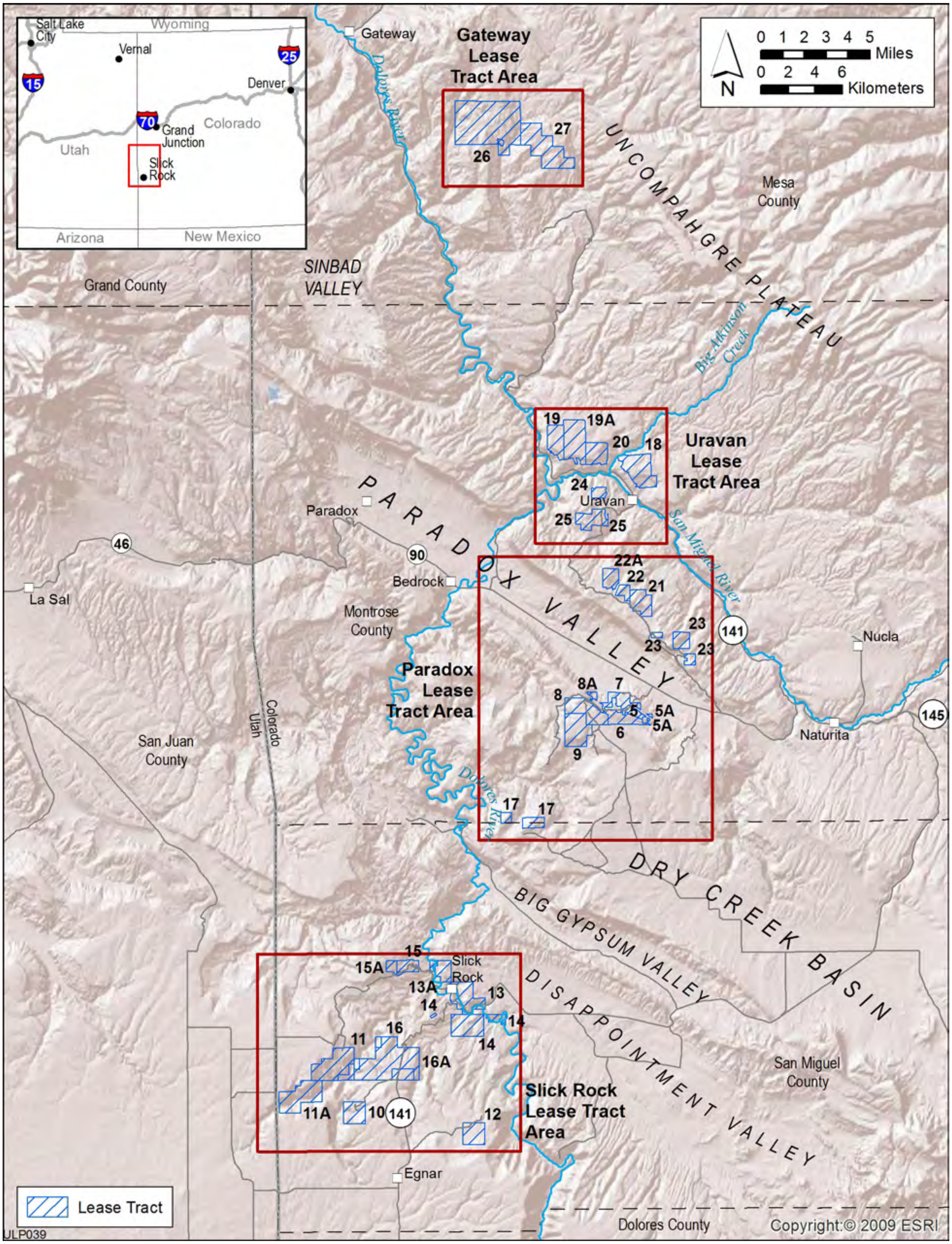


FIGURE 3.3-2 Extent of the Paradox Basin and the Paradox Fold and Fault Belt in Southwestern Colorado and Southeastern Utah (modified from Grout and Verbeek 1997)

To the north of the Paradox Basin is the Uncompahgre Uplift (or Plateau), a northwest-trending, Precambrian basement-cored fold that overlies a basinward-oriented overthrust fault (Figure 3.3-2). Vertical offset along this fault is about 3.7 mi (6 km); horizontal offset, which is mainly left lateral, is about 6.2 mi (10 km) (Grout and Verbeek 1997; Condon 1997).

Relatively young laccolithic intrusions (Oligocene to Miocene age) form several mountain ranges within the basin, including the Abajo and La Sal Mountains in southeastern Utah and the Ute and La Plata Mountains in southwestern Colorado (Figure 3.3-2). These intrusive centers are thought to have been emplaced during a period of crustal extension on the Colorado Plateau (Grout and Verbeek 1997).

1 

2 **FIGURE 3.3-3 Shaded Relief Map Showing Location of ULP Lease Tracts**

Crossing the anticlines and synclines of the Paradox fold and fault belt is the Uravan Mineral Belt, which generally contains the most productive uranium-vanadium deposits (Figure 3.3-4). This north-to-south arcuate band of the mineral belt encompasses all of the ULP lease tracts (Figure 3.3-3). The uranium-vanadium deposits in the mineral belt and the geology of the individual lease tracts are described in Sections 3.3.1.3.2 and 3.3.1.5, respectively.

3.3.1.3 Bedrock Geology

The geology of the area covering the ULP lease tracts and vicinity is shown in Figure 3.3-5. Exposed geologic units are predominantly sedimentary rocks of Cretaceous (Mancos Shale, Dakota Sandstone, and Burro Canyon Formation) and Jurassic (Morrison Formation) age.

3.3.1.3.1 Stratigraphy. The general stratigraphy of the Paradox Basin is shown in Figure 3.3-6. Selected bedrock formations cropping out in the lease tracts—from the Chinle Formation (Upper Triassic) to the Dakota Sandstone (Lower Cretaceous)—are described here in ascending order (oldest to youngest). Quaternary surficial deposits (alluvium, colluvium, and talus) occur throughout the basin and are found in abundance in river valleys and canyon bottoms.

Chinle Formation (Upper Triassic). The Chinle Formation is composed predominantly of siltstone, shale, conglomerate, and sandstone. Sediments of the formation were deposited on the southwestern edge of a nonmarine back-arc basin centered on the four corners region about 250 million years ago (Hazel 2000). Outcrops of the formation occur along the bottom of Summit Canyon and Dolores River Canyon. Its lowest unit, the Moss Back Member, is a fine-grained sandstone with thin layers of mudstone, siltstone, shale, and conglomerate. The unit is about 60 ft (18 m) thick and unconformably overlies the Moenkopi and Cutler Formations (Lower Triassic to Permian). In the Slick Rock area, the Moss Back Member is thought to comprise a system of coalescing channel-fill deposits with a northwestward trend. It is the only unit in the Chinle Formation that is known to be a host rock for uranium deposits (Shawe et al. 1968; Shawe 2011).

Entrada Sandstone (Middle Jurassic). The Entrada Sandstone is a fine-grained unit that is moderately well sorted, with thick to very thin crossbedded units and wavy-parallel laminated units. It is normally a reddish-brown color but is bleached to a yellowish brown in areas where it is overlain by the Pony Express Limestone Member of the Wanakah Formation. In the lease tracts, it has a whitish appearance in outcrop that makes it a good marker bed for discerning the approximate base of the Salt Wash Member of the Morrison Formation. Near Uravan, the formation sits unconformably atop the Kayenta Formation (Lower Jurassic) or a thin remnant of the Navajo Sandstone (Lower Jurassic). This unconformity, known as the J-2, is traceable throughout the U.S. western interior. Vanadium-uranium-chromium mineralization has been well

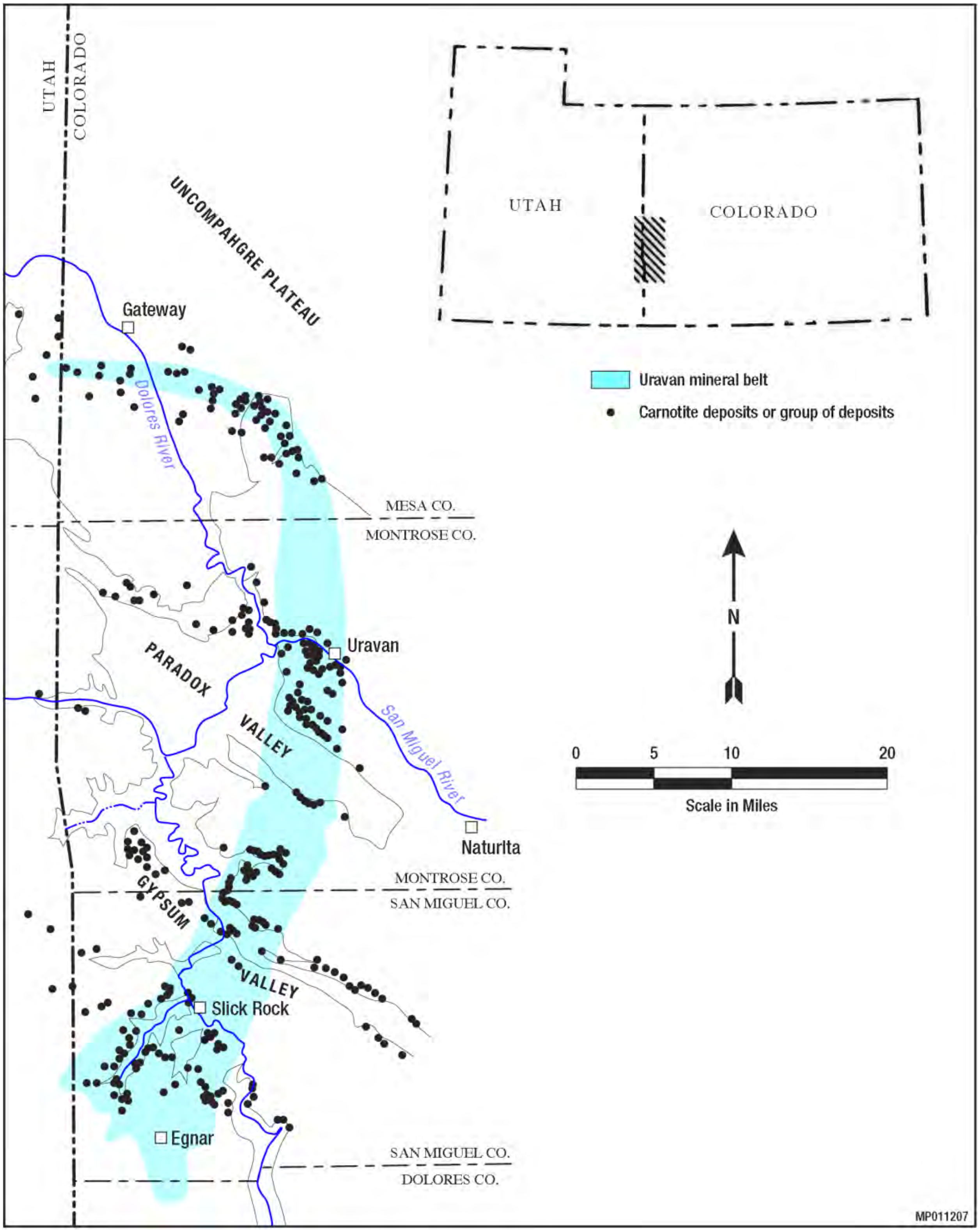
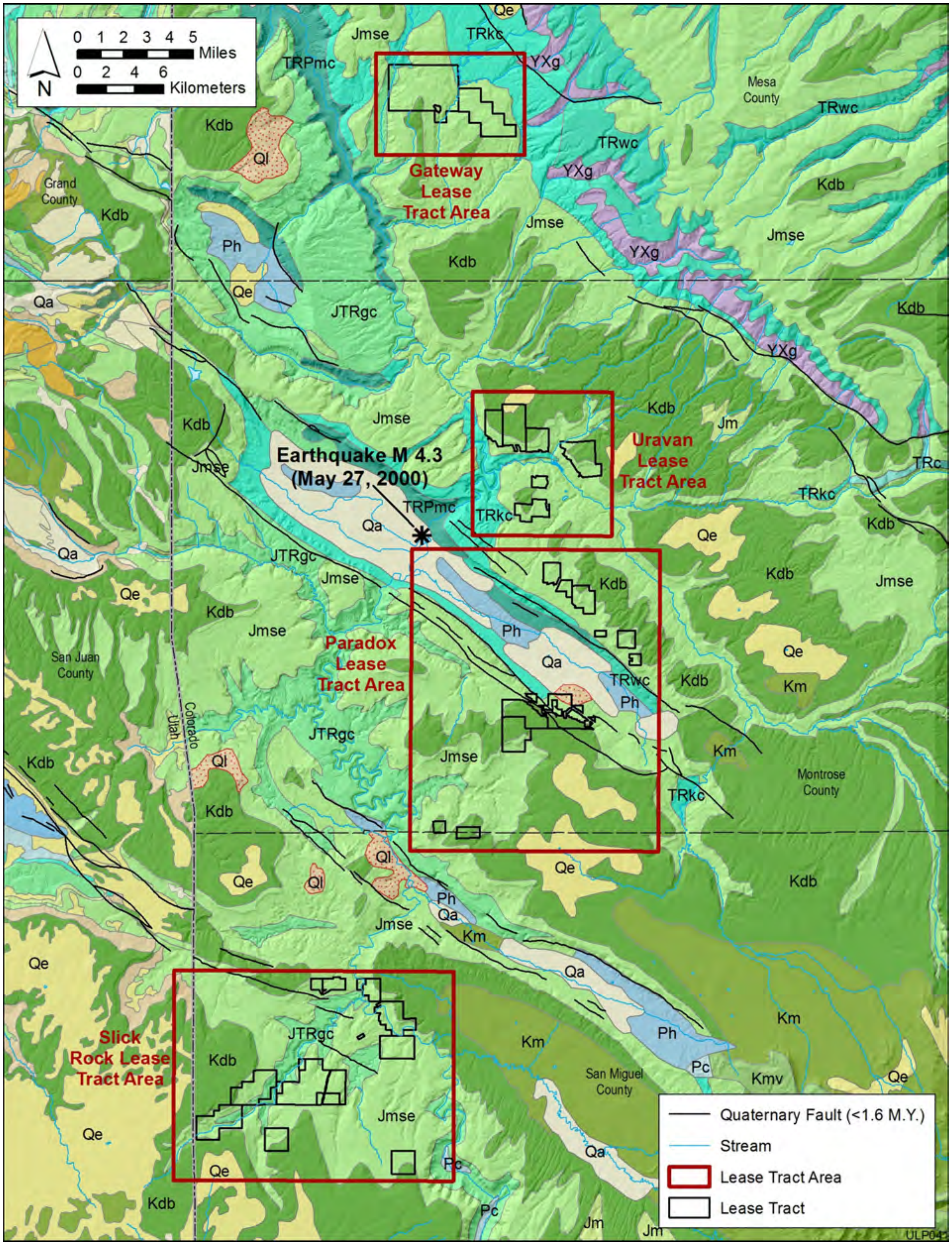


FIGURE 3.3-4 Extent of the Uravan Mineral Belt in Relation to Known Uranium-Vanadium Deposits (modified from Fischer and Hilpert 1952)

1 

2 **FIGURE 3.3-5 Geologic Map Covering the ULP Lease Tracts (Stoeser et al. 2007; Tweto 1979;**
3 **source of mapped faults and earthquake is USGS 2012)**

Cenozoic (Quaternary, Tertiary)

- Qa — Alluvial deposits
- Qe — Eolian deposits
- Ql — Landslide deposits
- Tmi — Middle Tertiary intrusive rocks (20 - 40 M.Y.); intermediate to felsic composition

Mesozoic (Cretaceous, Jurassic, Triassic)

- Kmv — Mesaverde Group
- Km — Mancos Shale
- Kdb — Dakota Sandstone and Burro Canyon Formation
- Jm — Morrison Formation
- Jmse — Morrison Formation, Summerville Formation, and Entrada Sandstone
- JTRgc — Glen Canyon Group and Chinle Formation
- TRkc — Kayenta Formation, Wingate Sandstone, and Chinle Formation
- TRwc — Wingate Sandstone and Chinle Formation
- TRc — Chinle Formation
- TRPmc — Moenkopi Formation (lower Triassic) and Cutler Formation (Permian)

Paleozoic (Permian, Pennsylvanian)

- Pc — Cutler Formation
- Ph — Hermosa Group

Precambrian

- YXg — Granitic rocks (1,400 - 1,700 M.Y.)

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FIGURE 3.3-5 (Cont.)

Era	Period	Million Years before Present	Stratigraphic Unit	Unit Thickness (feet)	Physical Characteristics
Cenozoic	Quaternary	0 – 2.6	Alluvium	0–100	Alluvium sands and gravels, loess, colluvium, windblown sands
Mesozoic	Upper Cretaceous	65.5 – 99.6	Mesaverde Group	100–1,000	Sandstone, siltstone, and shale; major coal beds in lower part
Mesozoic	Upper Cretaceous		Mancos Shale	1,000–5,000	Shales interbedded with minor sandstone
Mesozoic	Upper Cretaceous		Dakota Sandstone	0–200	Fine-to coarse-grained cross-bedded sandstone; coal present.
Mesozoic	Lower Cretaceous	99.6 – 145.5	Burro Canyon Fm	0–250	Conglomerate, sandstone and shale
Mesozoic	Upper Jurassic	145.5 – 161	Morrison Formation: Brushy Basin Member	400–500	Shales interbedded with minor sandstone
Mesozoic	Upper Jurassic		Morrison Formation: Salt Wash Member	300	Medium-grained sandstone interbedded with red shale
Mesozoic	Lower and Middle Jurassic	161 – 201.6	Wanakah Fm (Summerville Fm)	0–120	Shales interbedded with minor sandstone
Mesozoic	Lower and Middle Jurassic		Entrada Sandstone	15–170	Buff to grayish-white cross-bedded sandstones
Mesozoic	Lower and Middle Jurassic		Carmel Formation	0–40	Siltstone and mudstone interbedded with fine-grained sandstone
Mesozoic	Lower and Middle Jurassic		Navajo Sandstone	0–125	Fine-grained, cross-bedded quartz sandstone
Mesozoic	Lower and Middle Jurassic		Kayenta Formation	0–200	Sandstone interbedded with siltstone and thin-bedded shale
Mesozoic	Upper Triassic	201.6 – 235	Wingate Sandstone	0–400	Medium-grained, poorly cemented, cross-bedded sandstone
Mesozoic	Upper Triassic		Dolores Formation	150–230	Pink to red mudstone and fine-grained sandstone. Present in southeast part of basin.
Mesozoic	Upper Triassic		Chinle Formation	0–500	Shale, siltstones, interbedded with minor fine-grained sandstone
Mesozoic	Lower Triassic	235 – 251	Moenkopi Formation	0–480	Mudstone interbedded with minor sandstone
Paleozoic	Permian	251 – 299	Cutler Formation	0–3,500	Fine-grained sandstone interbedded with minor conglomerate and mudstone
Paleozoic	Pennsylvanian	299 – 318	Hermosa Group	0–3,900	Shales, limestones, salt and gypsum; includes the Paradox Formation
Paleozoic	Mississippian	318 – 359	Leadville Limestone	20–100	Massive to thinly laminated, gray buff and yellow limestone
Paleozoic	Devonian to Cambrian	359 – 542	Ouray, Elbert, and Ignacio Formations	0–150	Limestone, shale, dolomite; Ignacio is a quartzite

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FIGURE 3.3-6 Generalized Stratigraphy of the Paradox Basin (based on Topper et al. 2003, Walker and Geissman 2009, and Molenaar 1987)

documented in the upper part of the Entrada Sandstone (e.g., to the southeast of Uravan near Placerville) (Steele 1985).

Wanakah (also known as the Summerville) Formation (Middle Jurassic). The Wanakah Formation unconformably overlies the Entrada Sandstone and is of marine and marginal marine origin. It is composed of three members—the upper Marl Member, the middle Bilk Creek Sandstone Member, and the lower Pony Express Limestone Member—but is undifferentiated in places. The upper unit (Marl) consists of alternating thin lenticular beds of fine-grained sandstone, siltstone, mudstone, and claystone; the middle unit (Bilk Creek) consists of a moderately well sorted, fine-grained sandstone and an upper unit of well-indurated carnelian sandstone. These units are underlain by a limestone unit (Pony Express) with scattered silt-sized quartz and feldspar grains (Steele 1985).

Morrison Formation (Upper Jurassic). The Morrison Formation occurs throughout the U.S. western interior and its greatest known thickness is in the Slick Rock area, where a cored section near Disappointment Valley is more than 1,100 ft (340 m) thick. In the lease tracts area, the formation consists of two members: the lower Salt Wash Member and the upper Brushy Basin Member. Sediments of the Salt Wash Member are composed of interbedded, fluvial sandstones and mudstones deposited in stream channels and floodplains. These sediments were laid down in an area of downwarping that resulted in a fan-shaped apron of thick sediment within the main alluvial plain of deposition. This sediment apron, with its continuous sandstone beds and abundant carbonized plant material, comprises the Salt Wash Member and is the host rock for most of the uranium-vanadium deposits in the Paradox Basin. In the Slick Rock area, the Salt Wash Member is about 300 ft (90 m) thick. The Brushy Basin Member conformably overlies the Salt Wash Member. It consists predominantly of bentonitic mudstones, suggesting deposition in a low-energy lacustrine environment. The sediments of the Brushy Basin Member have a high devitrified volcanic glass content (from ashfalls). Some investigators have suggested that the volcanic glass was originally uranium-rich and that uranium was released during the devitrification process. This would make the Brushy Basin Member a possible source of uranium in the underlying Salt Wash Member ore deposits (Shawe 2011; Breit and Fisher 1988; Mullins and Freeman 1954).

Burro Canyon Formation (Lower Cretaceous). The Burro Canyon Formation overlies the Brushy Basin Member of the Morrison Formation. Its type locality is near Slick Rock in San Miguel County. The formation is composed of alternating beds of conglomeratic sandstone and mudstone, with minor chert and limestone. Sandstone units are most abundant in the lower part of the formation, forming ledges and vertical cliffs in outcrop; mudstones predominate in the upper units and tend to form gentle to steep slopes. Together these units are thought to reflect a sequence of high-energy deposition in a fluvial environment during a period of tectonic uplift (lower sandstone) followed by a period of tectonic quiescence and low-energy deposition (upper mudstones). The thickness of the formation is variable across short distances, but in the lease tracts, it is consistently 130 ft (40 m) or more thick (with a maximum thickness of about 300 ft (90 m) measured in a drill hole in Disappointment Valley) (Craig 1982).

Dakota Sandstone (Upper Cretaceous). The Dakota Sandstone unconformably overlies the Burro Canyon Formation and consists mainly of fine- to medium-grained sandstone with a basal unit of conglomerate and a middle unit of carbonaceous shale and mudstone (fossil plants, pyrite, and coal are also present) (Shawe et al. 1968; Simmons 1957). Along with the Burro Canyon Formation, this unit forms the caprock of several mesas in the lease tracts.

3.3.1.3.2 Uranium Deposits. The uranium deposits of the Salt Wash Member are known as “sandstone-type” deposits. These are epigenetic concentrations of uranium minerals that occur in fluvial, lacustrine, and deltaic sandstone formations in either continental or marginal marine environments. The dominant host rocks are fine- to medium-grained sandstones of various composition; uranium minerals are typically very fine-grained and occupy the intergranular spaces of the host rock or locally replace fossil wood and bones. Other ore-grade minerals, such as vanadium, copper, and trace metals (molybdenum, selenium, chromium, and radium), are found in association with uranium deposits in the Salt Wash Member (Finch and Davis 1985).

The Uravan Mineral Belt was defined in the early 1950s to delineate the area of the most concentrated and most productive uranium-vanadium deposits in sandstones of the Salt Wash Member of the Morrison Formation that had been found up to that time (Fischer and Hilpert 1952). Boundaries of the belt are approximate; at that time, some of the deposits were outside of the belt. Since that time, additional deposits have been found by deeper exploratory drilling and other improved exploration methods both within and outside the boundaries of the mineral belt (Figure 3.3-4).

Most of the mineralized zones in the Salt Wash Member are tabular (lenticular) and concordant with bedding planes; however, some deposits cut across bedding in smooth curves to form rolls or roll fronts, especially near the edge of the ore body. Tabular deposits are thought to have precipitated at chemical interfaces between connate pore waters and infiltrating groundwater solutions; in contrast, roll-front deposits likely precipitated at a redox interface of oxidizing recharge waters enriched with uranium passing through a reducing pyrite-bearing sandstone. Sedimentary features have an important influence on the shape and distribution of deposits in the Salt Wash Member. Most of the Salt Wash deposits are elliptical in plain view and tend to cluster along the margins of major channels. More locally, individual deposits concentrate along features that produce permeability changes, such as shale horizons. Faults also play a role in mineral deposition by providing conduits for mineralizing solutions to access the host rock (Chenoweth 1981; Finch and Davis 1985; Shawe 2011).

3.3.1.4 Seismicity

Seismicity on the Colorado Plateau is characterized as small to moderate in magnitude with a low to moderate rate of earthquake occurrence. Most seismic activity is concentrated in the Wasatch Plateau-Book Cliffs region (north of Paradox Basin), where numerous small-magnitude earthquakes are generated by coal mining. Earthquakes on the plateau generally occur in the upper crust, ranging in depth from the near-surface to 9 to 12 mi (15 to 20 km) (Wong and Humphrey 1989).

The lease tracts are located in the southeastern region of the Paradox Basin known as the Paradox fold and fault belt in the eastern part of the Paradox Basin (Figure 3.3-2). In this belt, normal faulting is associated with salt anticlines that have collapsed along their crests to form graben-like structural features. An example of such a fault is U.S. Geological Survey (USGS) No. 2286, a high-angle normal fault that trends northwestward along the Paradox Valley graben following the general trend of the valley (Figure 3.3-2). Faults along the edges of the graben are well-defined, and Quaternary movement has been inferred by several investigators. However, no evidence has been found to suggest Holocene age movement has occurred (Widmann 1997; Kirkham and Rogers 1981).

Seismic activity in the Paradox Basin is generally low, and earthquakes are of small magnitude and diffusely distributed (Wong and Humphrey 1989). From January 2000 through August 2012, only 13 earthquakes (of any magnitude) have been recorded within a 62-mi (100-km) radius of Paradox Valley; the most recent earthquake occurred on March 6, 2012 and registered a surface wave magnitude (MLg)[10] of 2.7. The largest earthquake occurred on May 27, 2000. It was located along the Dolores River in the central part of the valley and registered 4.3 MLg (Figure 3.3-5). Since 1980, only 10 of the 28 recorded earthquakes (36%) within a 62-mi (100-km) radius of Paradox Valley had surface wave magnitudes that were equal to or greater than 3.0 (USGS 2012a).

Ake et al. (2005) has noted the occurrence of more than 4,000 human-induced seismic events in Paradox Valley caused by high-pressure subsurface injections of brine by the U.S. Bureau of Reclamation (BOR) at its Paradox Valley Unit, located in Bedrock, Colorado (see Sections 3.9.1.1, 3.4.1.2, and 3.4.3 for information on the Paradox Valley Unit). Most of these events registered magnitudes too small to be felt (less than M 2.5); however, at least 15 have been felt, including the M 4.3 event that occurred in May 2000. The BOR has modified its injection strategy since 1996, and these changes have reduced the frequency of induced seismic events to as low as 60 events per year (most of which are not felt).

[10] Surface wave magnitude (MLg) is used for earthquakes with magnitudes of 5 to 8 and is based on the amplitude of the Lg surface wave (USGS 2012b).

3.3.1.5 Topography and Geology of the Lease Tracts

3.3.1.5.1 Gateway Lease Tracts. The Gateway lease tracts are located southeast of the town of Gateway at the northern end of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). The two lease tracts, 26 and 27, are located on the tops and side slopes of Calamity and Outlaw Mesas, respectively. Sedimentary rocks cropping out on side slopes below the mesa rims range in age from Triassic to Cretaceous; Cretaceous sandstone and conglomerate cap the mesas (Figure 3.3-5). Uranium-vanadium deposits occur in the Salt Wash Member of the Morrison Formation (Upper Jurassic), and this unit has been mined extensively for nearly 100 years. Surface runoff from the mesas drains to Maverick and Calamity Creeks, tributaries of the Dolores River. Elevations of the Gateway lease tracts range from 5,700 to 7,000 ft (1,700 to 2,100 m) above sea level (Figure 3.3-7).

3.3.1.5.2 Uravan Lease Tracts. The six Uravan lease tracts are located immediately north, northwest, and west of the town of Uravan on the tops and side slopes of Atkinson Mesa (Lease Tracts 19, 19A, and 20), Spring Creek Mesa (Lease Tract 18), and Club Mesa (Lease Tracts 24 and 25) (Figure 3.3-8) in the central part of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). The lease tracts in this region sit on the northeastern flank of the Paradox Valley anticline, where regional folds have a northwestern trend. There are no known major faults in the region (Joesting and Byerly 1958; Boardman et al. 1957).

Sedimentary rocks exposed in the Club Mesa area dip slightly to the northeast and are of Mesozoic age (Figure 3.3-5). These include the pre-Morrison Formations of Triassic and Jurassic age, the Morrison Formation (Upper Jurassic), and remnants of the Burro Canyon Formation (Lower Cretaceous). In this region, the Morrison Formation is the host rock for all uranium-vanadium deposits. The Salt Wash Member of the formation ranges in thickness from about 200 to 300 ft (60 to 90 m); the overlying Brushy Basin Member is about 400 to 450 ft (120 to 140 m) thick. Most of the uranium-vanadium deposits occur in the Salt Wash Member; small deposits also occur near the base of the Brushy Basin Member (Boardman et al. 1957).

The Dolores River and its main tributary, the San Miguel River, flow in the valley bottoms below the lease tracts. The canyon bottoms consist of unconsolidated fluvial deposits. Bedrock formations exposed along the lower slopes of the canyons are the Wanakah Formation (formerly the Summerville Formation) and the Entrada Sandstone (both Middle Jurassic). Below the Entrada Sandstone are rocks of the Kayenta Formation (Lower Jurassic) and the Wingate and Chinle Formations (Upper Triassic). Elevations of the Uravan lease tracts range from 5,100 to 6,400 ft (1,560 to 1,950 m) above sea level (Figure 3.3-8).

3.3.1.5.3 Paradox Lease Tracts. The Paradox lease tracts are located on the high plateaus that flank Paradox Valley in the central part of the Uravan Mineral Belt (Figures 3.3-2 and 3.3-4). Lease Tracts 5, 5A, 6, and 7 and a portion of Lease Tracts 8 are on the steep northeast

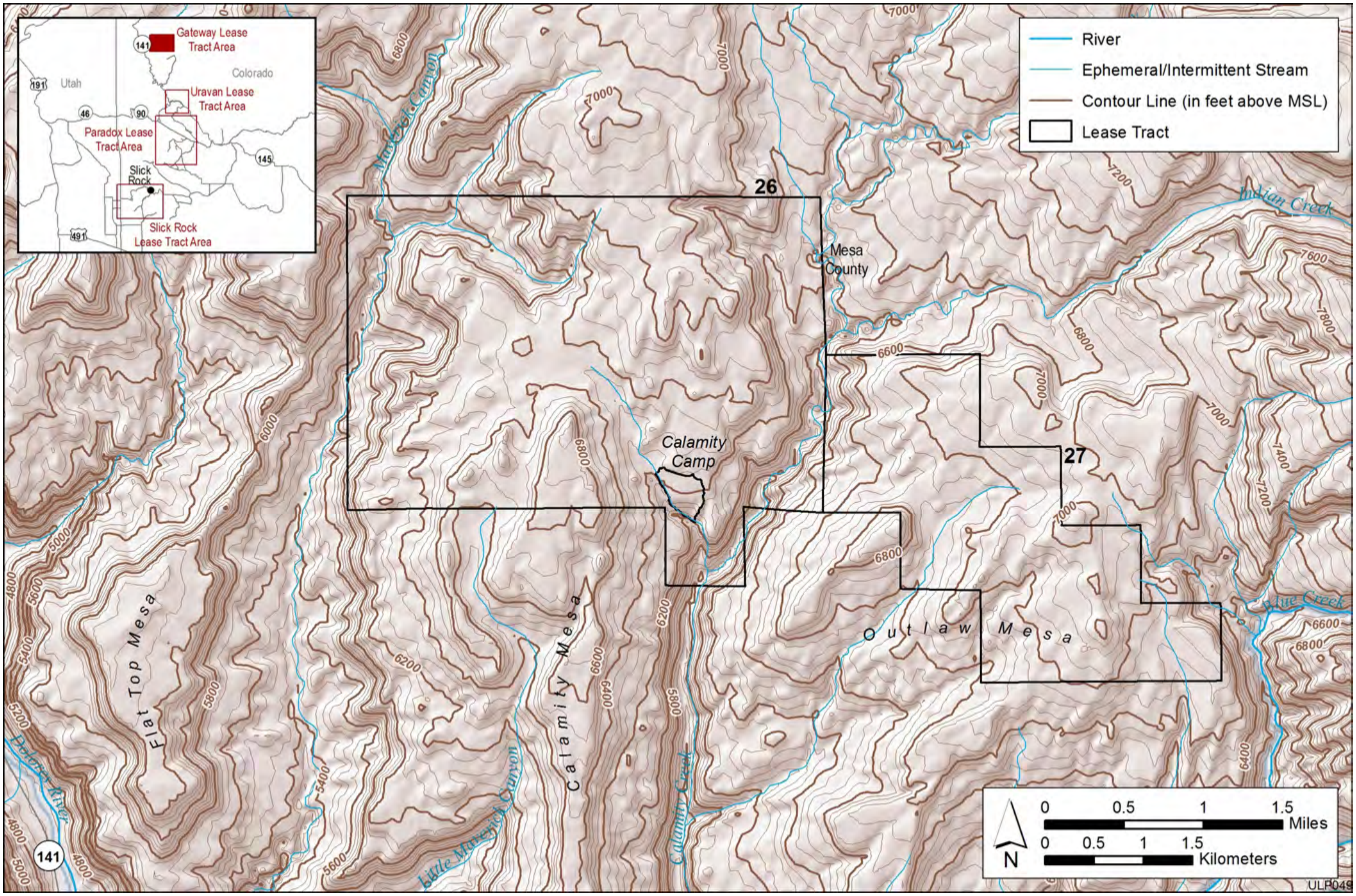

FIGURE 3.3-7 Topography of the Gateway Lease Tracts

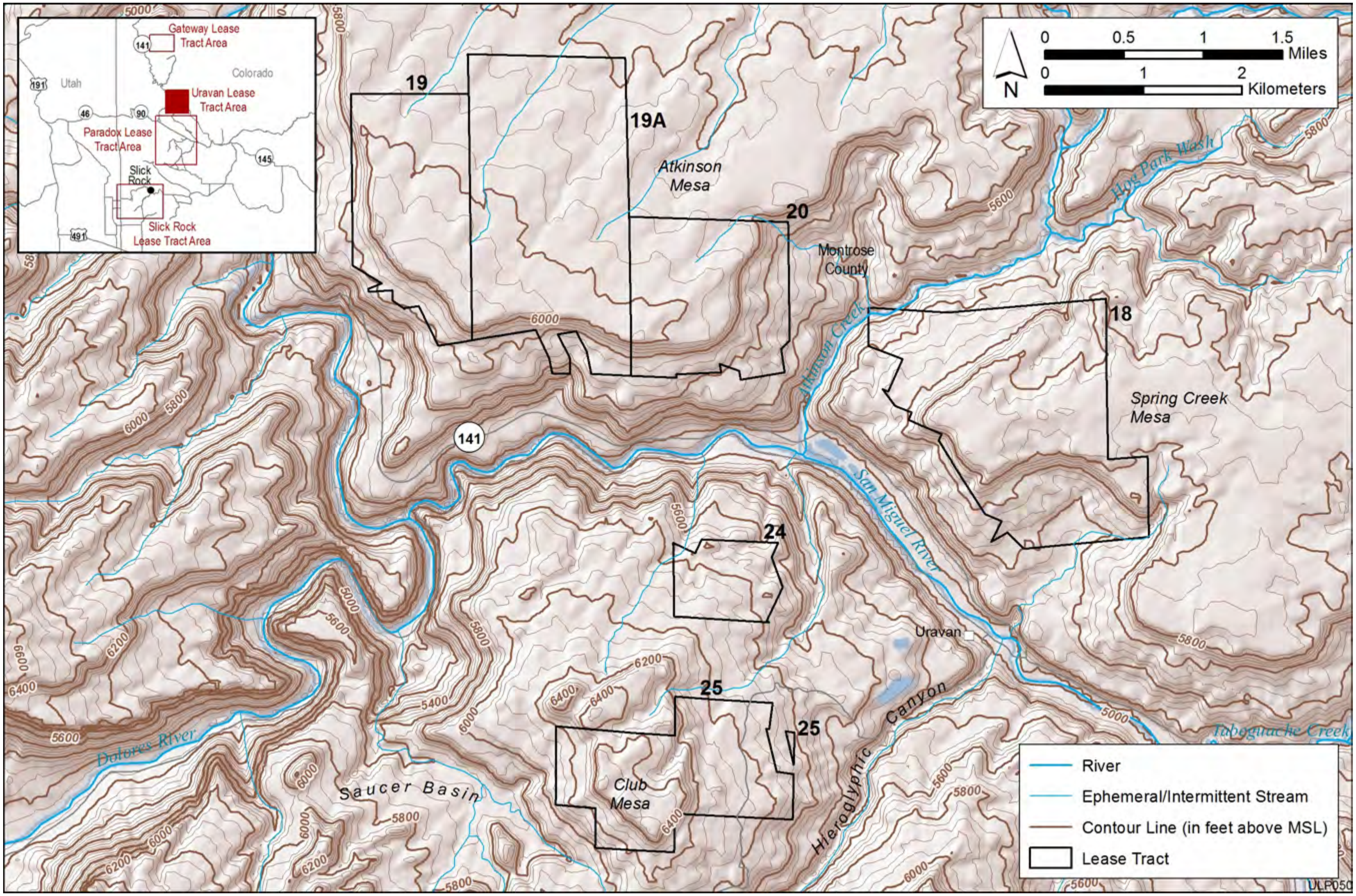

FIGURE 3.3-8 Topography of the Uravan Lease Tracts

aspect of Monogram Mesa along the southwestern flank of the valley. The remainder of Lease Tract 8 and all of Lease Tract 9 sit on the top of Monogram Mesa. The steep northeast aspect of Monogram Mesa is formed by a series of structurally complex, faulted slump blocks composed of the Brushy Basin and Salt Wash Members of the Morrison Formation (Upper Jurassic). Overlying the Morrison Formation and forming the caprock of the mesa are the Burro Canyon Formation (Lower Cretaceous) and the Dakota Sandstone (Upper Cretaceous) (Figure 3.3-5).

Lease Tracts 21, 22, 22A, and 23 are on a plateau know as Long Park, along the northeastern flank of Paradox Valley. Lease Tracts 17-1 and 17-2 are located farther to the southwest on top of Radium Mountain and Wedding Bell Mountain, respectively. The geology of the Long Park plateau area is similar to that of Monogram Mesa, except that the formations underlying Long Park plateau area (capped by the Brushy Basin Member of the Morrison Formation) dip to the northeast. Elevation of the Paradox Valley floor is 5,500 to 5,600 ft (1,680 to 1,700 m) above sea level, about 1,000 ft (300 m) below the tops of the adjacent mesas to the north and 1,600 ft (490 m) below the top of Monogram Mesa to the south (Figure 3.3-9).

Lease Tract 17 is located farther to the southwest and consists of two parcels, 17-1 and 17-2 (west and east). The west parcel is on top and along the sides of Wedding Bell Mountain. The east parcel is on top and along the sides of Radium Mountain. Both mountains are capped by the Burro Canyon Formation (Lower Cretaceous) and Dakota Sandstone (Upper Cretaceous), and the side slopes of both mountains contain exposures of both members (Brushy Basin and Salt Wash) of the Morrison Formation (Upper Jurassic).

3.3.1.5.4 Slick Rock Lease Tracts. The Slick Rock lease tracts are located in the Slick Rock mining district at the southern end of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). Major faults in the region have a northwest trend and run parallel to the collapsed Gypsum Valley salt anticline that lies to the northeast. The Disappointment syncline is just to the southwest of the Gypsum Valley anticline (Shawe 1970, 2011).

Sedimentary rocks cropping out in the region range in age from Permian to Cretaceous and are at least 4,700 ft (1,400 m) thick (Figure 3.3-5). These rocks and the older Paleozoic sedimentary rocks that underlie them together are about 13,000 ft (4,000 m) thick. Uranium and vanadium deposits occur in the Moss Back Member of the Chinle Formation (upper Triassic) and several levels of the Morrison Formation (upper Jurassic); however, most of the important ore production has been from the Salt Wash Member of the Morrison Formation (Shawe et al. 1968; Shawe 2011).

The 11 lease tracts in the Slick Rock area are located near the Dolores River, which flows northward through the narrow, steep-walled Dolores River Canyon. The canyon bottom and lower slopes consist of unconsolidated fluvial deposits and alluvial/colluvial deposits, respectively. In the northern part of the Canyon, near the town of Slick Rock, the canyon floor is underlain by the Entrada Sandstone. Bedrock formations exposed along the canyon walls and adjoining mesas include, in ascending order, the Salt Wash and Brushy Basin Members of the Morrison Formation (Upper Jurassic), and the Burro Canyon Formation and the Dakota

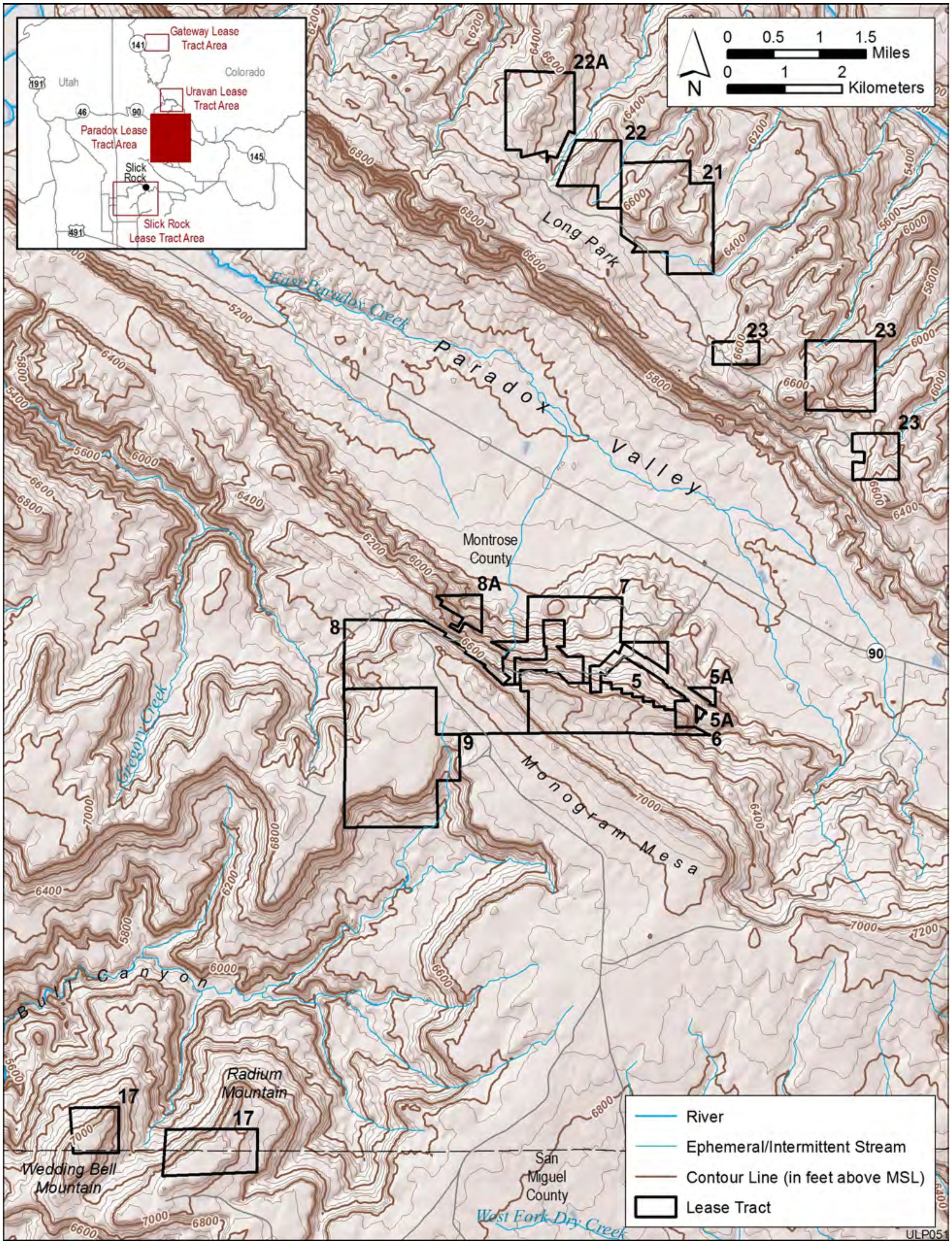

FIGURE 3.3-9 Topography of the Paradox Lease Tracts

Sandstone (Lower Cretaceous). Lease Tracts 13, 13A, and 14 lie within the Dolores River Canyon or on adjacent ridges. Lease Tracts 15 and 15A are located west of and above the Dolores River on the first topographic bench near Cougar Point. Lease Tracts 11 and 11A are to the southwest of the town of Slick Rock in the western part of Summit Canyon, near the top of Summit Point. Lease Tracts 10, 12, 16, and 16A lie just south of the top of Slick Rock Hill. Elevations of the Slick Rock lease tracts range from 5,400 ft (1,650 m) above sea level along the Dolores River to nearly 8,000 ft (2,400 m) above sea level on the mesa top east and north of Egnar, Colorado (Figure 3.3-10).

3.3.1.6 Paleontological Resources

Significant paleontological resources in the lease tracts are associated with Mesozoic age geologic units (formations), especially those from the Jurassic and Cretaceous Periods (206 to 65 million years ago). These units are of marine and nonmarine origin and yield important vertebrate fossils, including fish, frogs, salamanders, turtles, crocodiles, pterosaurs, mammals, birds, and dinosaurs (Armstrong 1982; USFS and BLM 2013). Invertebrate fossils (e.g., ammonites) and plants are also abundant. They generally have a high Potential Fossil Yield Classification (PFYC)[11] ranking that indicates a high fossil yield and a great sensitivity to adverse impacts. Table 3.3-1 lists the geologic units potentially affected in the lease tracts and their PFYC ranking. The Morrison Formation is the main source of uranium in the lease tracts and likely would be the geologic unit most affected by future mining. The table includes deeper (older) geologic units because uranium is also known to occur in the Chinle Formation in the Slick Rock area (see Section 3.3.1.3.1).

Various statutes, regulations, and policies govern the management of paleontological resources on public lands. Congress recently passed a paleontology law, titled “Paleontological Resources Preservation under the Omnibus Public Lands Act of 2009” (P.L. 111-11, codified at 16 USC 470aaa), also known as the PRPA (for Paleontological Resources Preservation Act). The PRPA establishes three main points: (1) paleontological resources collected under a permit are U.S. property and must be available for scientific research and public education and preserved in an approved facility; (2) the nature and location of paleontological resources on public lands must be kept confidential to protect those resources from theft and vandalism; and (3) theft and vandalism of paleontological resources on public lands can result in civil and criminal penalties including fines and/or imprisonment. The law also requires an expansion of public awareness and education regarding the importance of paleontological resources on public lands and the development of management plans for inventory, monitoring, and scientific and educational use of paleontological resources (BLM 2009c).

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[11] The PFYC system is used by the BLM to classify the potential for significant paleontological resources to occur in a geologic unit and to assess possible resource impacts and mitigation needs for Federal actions involving land disturbance. The PFYC rankings range from Class 1 (very low) to 5 (very high); units with an unknown potential are typically assigned a Class 3 (moderate) rank until further study can be conducted. Geologic units with high PFYC rankings (Classes 4 and 5) are highly fossiliferous and are most at risk of human-caused adverse impacts or natural degradation (BLM 2007c).

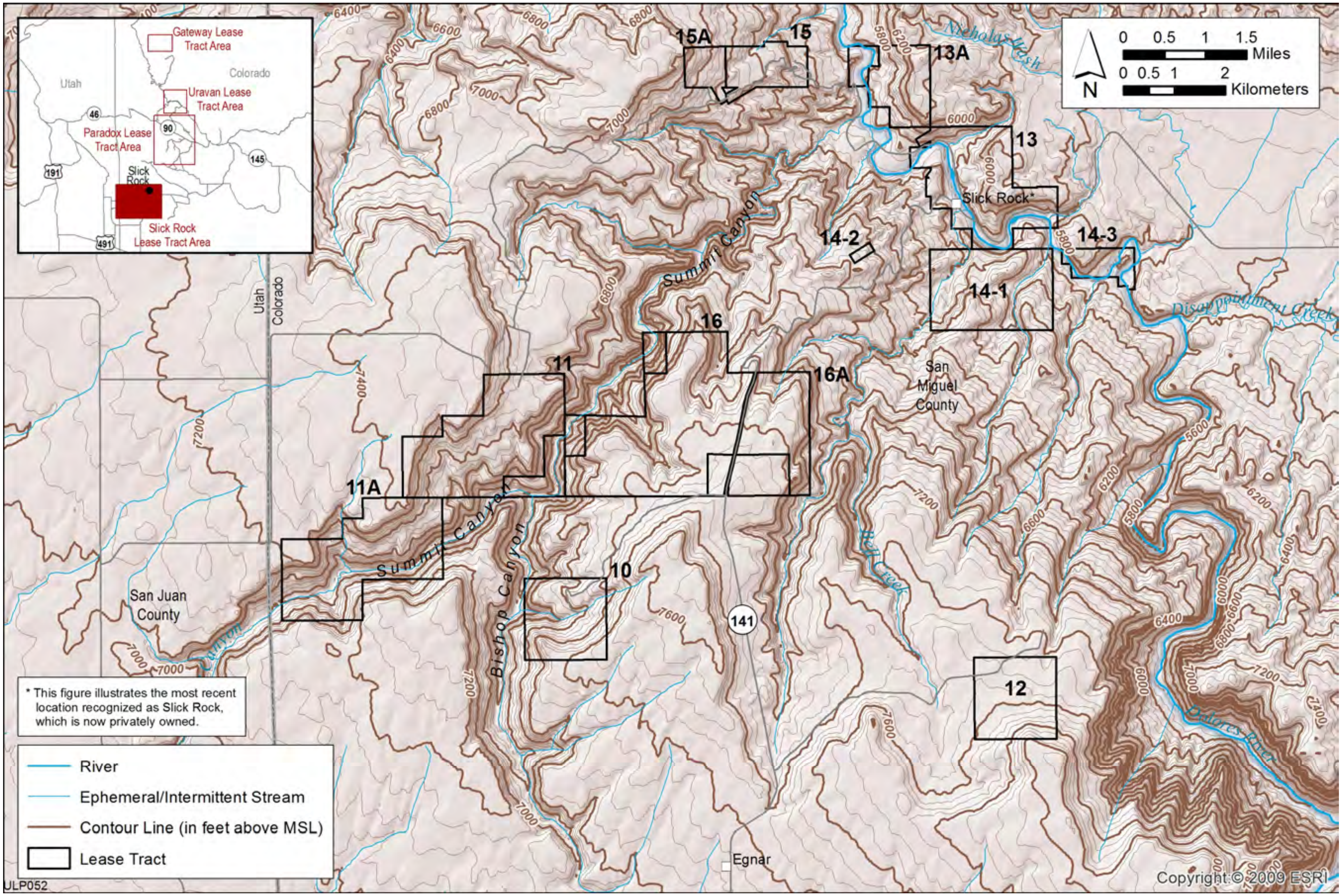

FIGURE 3.3-10 Topography of the Slick Rock Lease Tracts

TABLE 3.3-1 Geologic Units in the Lease Tracts and Their PFYC Ranking

Geologic Unit	PFYC	Known Fossil Resources
Alluvium (Quaternary)	2-3	Mammals (shrub ox)
Mancos Shale (Upper Cretaceous)	2-3	Invertebrates (ammonites, oysters, brachiopods, clams), sharks, large marine reptiles, fish, dinosaurs, pollen, plants, and trace fossils (e.g., crayfish borrows)
Dakota Sandstone (Upper Cretaceous)	5	Dinosaur bones and tracks; plants
Burro Canyon Formation (Lower Cretaceous)	3	Invertebrates and plants
Morrison Formation (Upper Jurassic)	5	Dinosaurs, lizards, other reptiles, birds, mammals, amphibians, fish, invertebrates, and plants
Wanakah Formation (Middle Jurassic)	4/5	Dinosaurs, early mammals, seed plants, ferns, marine reptiles, fish, sharks and rays, ammonites, and plankton
Entrada Sandstone (Middle Jurassic)	4/5	Dinosaurs, early mammals, seed plants, ferns, marine reptiles, fish, sharks and rays, ammonites, and plankton
Dolores Formation (Upper Triassic)	3	Flowering plants
Chinle Formation (Upper Triassic)	4/5	Vertebrate (fish) and plants

Source: USFS and BLM (2013)

Paleontological resources are also managed and protected under the Federal Land Policy and Management Act (FLPMA; P.L. 94-579, codified at 43 USC 1701-1782) and Theft and Destruction of Government Property (18 USC 641), which penalizes the theft or degradation of property of the U.S. Government; see BLM Manual 8270 (*Paleontological Resource Management*) for complete listing of applicable regulations (BLM 1998, 2007c, 2008f).

3.3.2 Soil Resources

Soil formation results from the complex interactions among parent (geologic) material, climate, topographic relief, natural vegetation, and soil organisms over long periods of time. The classification of soils is based on their degree of development into distinct layers or horizons and their dominant physical and chemical properties. In this section, soils in the lease tracts are represented by map units from soil surveys (originally mapped at the 1:24,000 scale) available through the Natural Resources Conservation Service's (NRCS's) online Web survey. Map units consist of soils of different series or of different phases within one series. On the maps that follow, the map units are typically of two types: soil complexes (two or more soils intermingled) or soil associations (adjacent soils that commonly occur together and are difficult to delineate). Rocky areas that have shallow or severely eroded soils are classified as rock outcrops (Spears and Kleven 1978; Hawn 2003).

Most of the soils in the lease tracts are formed in the residuum of weathered sandstone or shale. Soils that formed in weathered sandstone are generally sandy; soils formed in weathered shale are generally clayey. Soils formed in mixed alluvium (derived from both sandstone and shale) in major valleys and bordering uplands tend to be loamy (Spears and Kleven 1978). The potential for wind and water erosion of soils on the relatively flat mesa tops is slight to moderate (but can be higher in localized areas); however, the potential for soil erosion on steep side slopes (where soil is present) is moderate to severe.

Biological soil crusts are commonly found throughout the Colorado Plateau. They consist of surface crusts formed by soil particles bound together by living organisms and their by-products. Most of the biological soil crusts on the plateau are composed of *Microcoleus vaginatus* (a cyanobacteria). Lichens (*Collema* spp.) and mosses (*Tortula* spp.) are also common. Landscapes in which cyanobacteria predominate have a “pinnacle-type” microtopography created by soil heaving in response to winter freezing. Pinnacled crusts may reach heights of 4 in. (10 cm). Soil crusts play an important ecological role within an ecosystem (e.g., carbon and nitrogen fixation, solar energy absorption, and seed germination), and their presence can affect water infiltration rates and stabilize soil surfaces against wind and water erosion. Biological soil crusts are highly susceptible to compressional disturbance (from vehicles and trampling by animals or people), especially in sandy soils. Disturbance can affect their composition and may reduce the number and diversity of crust organisms found on the surface. In areas where biological crusts are abundant, these changes may increase the rate of soil loss due to surface runoff or wind erosion (USGS Canyonlands Research Station 2006; Belnap et al. 2001; Rosentreter et al. 2007). Biological soil crusts within the lease tracts have not been surveyed.

3.3.2.1 Gateway Lease Tracts

Soils within the Gateway lease tracts on Calamity and Outlaw Mesas (26 and 27) are predominantly the clay to gravelly loams of the following complexes: Bodot-Sili-rock outcrop (5 to 25% slopes); Gladel-Bond-rock outcrop (3 to 25% slopes); Wrayha-Dollard-Fergus (25 to 65% slopes); and Fergus-Zoltay (3 to 12% slopes). Together these complexes make up about 55% of the soil coverage at the two lease tracts (Figure 3.3-11). Rock outcrops (50–99% slopes) occur along the mesa rims (Map Unit 904) and cover about 27% of the two lease tracts. Soils on the mesa tops are formed from residuum weathered from clayey shale and sandstone. They are moderately deep to very deep and well-drained with slow to moderate infiltration rates when wet and slow to moderate rates of water transmission. Strewn cobbles, stones, and boulders

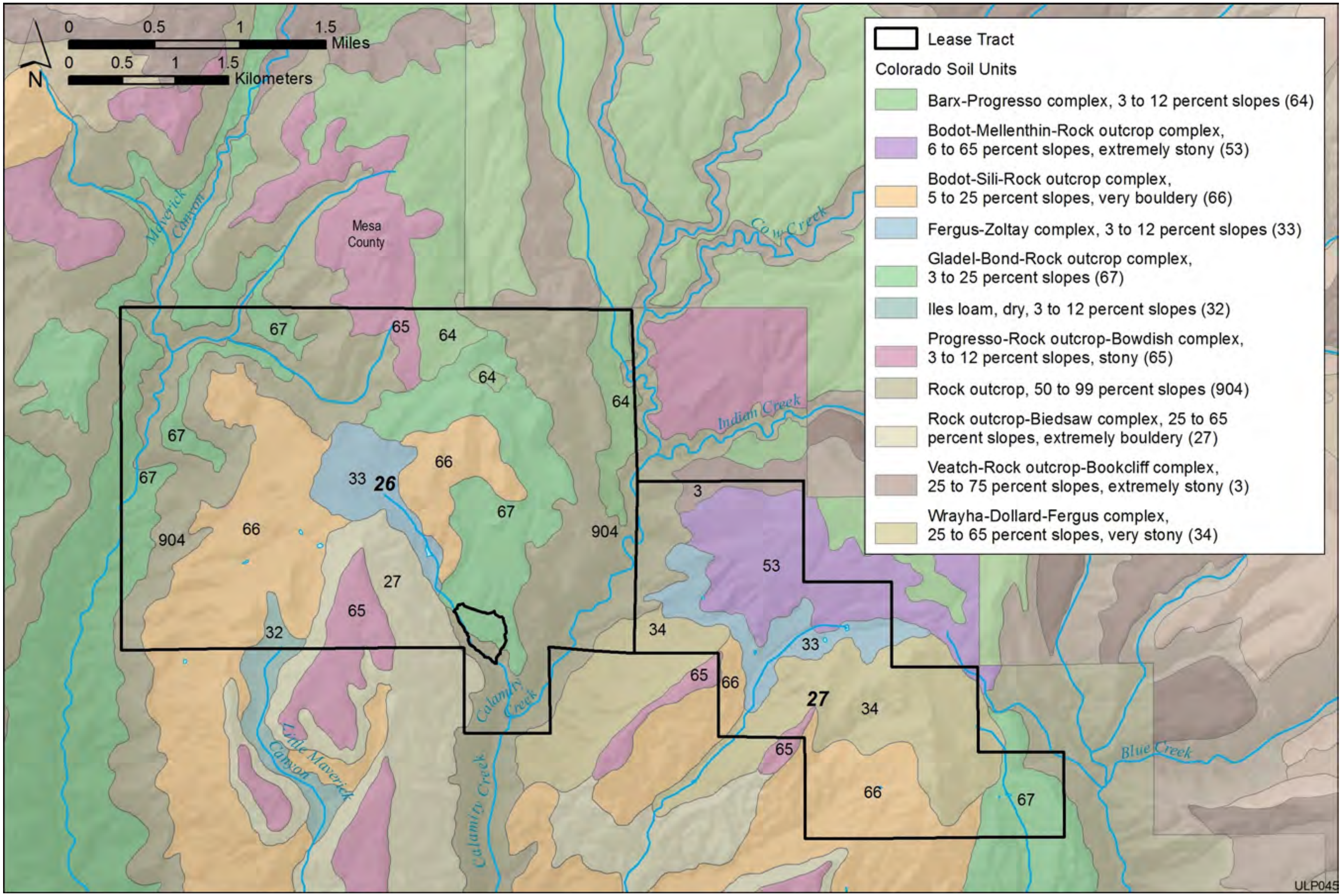

FIGURE 3.3-11 Soils within and around the Gateway Lease Tracts (NRCS 2009)

are common on the surface. Available water-holding capacity[12] is high for soils like the Fergus-Zoltay and Barx-Progresso complexes (Map Units 33 and 64), which have a relatively high organic content (NRCS 2012a).

Water erosion potential for mesa top soils is moderate (Kw factors range from 0.20 to 0.32),[13] with the highest potential occurring for soils of the Gladel-Bond-Rock outcrop complex on the slopes of Maverick Canyon on the west side of Lease Tract 26 (Map Unit 67). The susceptibility to wind erosion is low to moderate (wind erodibility groups [WEGs] 3 to 8),[14] but could be high in areas where vegetation is sparse. Soils on the mesa tops have a moderate to severe rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012a).

3.3.2.2 Uravan Lease Tracts

Soils within the Uravan lease tracts on Atkinson and Spring Creek Mesas (18, 19, 19A, and 20) are predominantly the loams and fine sandy loams of the Piñon-Bowdish-Rock outcrop (330% slopes) and the Barx-Progresso (3–12% slopes) complexes, which together make up about 74% of the soil coverage at the four lease tracts (Figure 3.3-12). The Rock outcrop-Orthents complex (40–90% slopes) occurs along the south rim of Atkinson Mesa and (Map Unit 88) and the southwest aspect of Spring Creek Mesa; below this complex (i.e., further downslope on terraces of the San Miguel River) is the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) (Map Unit 23). These units together cover about 24% of the four sites. To the south, within the lease tracts on Club Mesa (24 and 25), the cobbly clay loams of the Bodot, dry-

[12] Available water-holding capacity is the amount of water that a soil can store that is available for use by plants. In this report it is expressed in relative terms (or classes) of low, medium, and high. The capacity of soil to hold water is affected by various soil characteristics, including texture and the amount of rock fragments and organic matter present. Loams (followed by clays) tend to have higher water-holding capacity than sands; rock fragments in soil decrease its water-holding capacity while organic matter increases it (NRCS 2012h).

[13] K factor is the soil erodibility factor, one of six factors used in the Universal Soil Loss Equation and the Revised Universal Soil Loss Equation to predict average annual rate of soil loss by sheet and rill erosion in tons per acre per year. Values range from 0.02 to 0.69. Other factors being equal, the higher the K value, the more susceptible the soil is to sheet and rill erosion by water. The ratings provided in this section are defined as follows: low, 0.02 to 0.19; moderate, 0.20 to 0.49; and high, 0.50 to 0.69. The values are based on the percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity and also takes into account the presence of rock fragments. For this reason, it is referred to here as K factor, whole soil (or Kw) (NRCS 2012b).

[14] WEGs are based on soil texture, organic matter content, effervescence of carbonates, content of rock fragments, and mineralogy, and also take into account soil moisture, surface cover, soil surface roughness, wind velocity and direction, and the length of unsheltered distance (USDA 2004). WEG groups range in value from 1 (most susceptible to wind erosion) to 8 (least susceptible to wind erosion). The NRCS provides a wind erodibility index, expressed as an erosion rate in tons per acre per year, for each of the WEGs: WEG 1, 160 to 310 tons/acre/year; WEG 2, 134 tons/acre/year; WEGs 3, 4 and 4L, 86 tons/acre/year; WEG 5, 56 tons/acre/year; WEG 6, 48 tons/acre/year; WEG 7, 38 tons/acre/year; and WEG 8, 0 tons/acre/year. The ratings provided in this section are defined as follows: low, WEGs 7 and 8; moderate, WEGs 3 to 6; and high, WEGs 1 and 2.

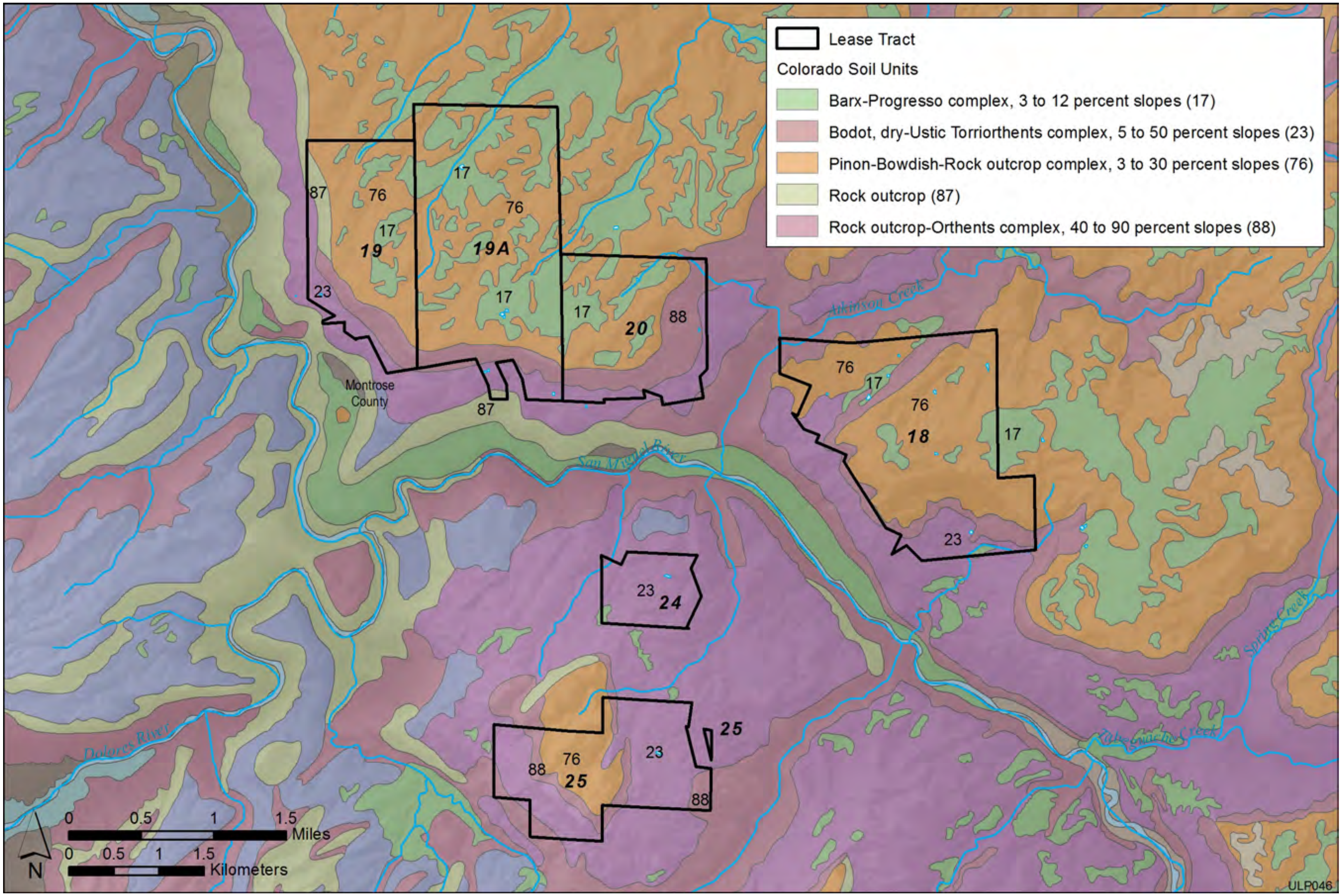

FIGURE 3.3-12 Soils within and around the Uravan Lease Tracts (NRCS 2009)

Ustic Torriorthents complex (5–50% slopes) predominate, constituting about 68% of the soil coverage at the two lease tracts.

Soils on the Atkinson and Spring Creek Mesas are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-Rock outcrop complex) and from alluvium derived from sandstone exposed along drainages (Barx-Progresso complex). The soils of the Piñon-Bowdish-Rock outcrop complex are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. In contrast, soils of the Barx-Progresso complex have moderate infiltration rates when wet and moderate rates of water transmission; available water-holding capacity of these soils is high (NRCS 2012b).

Water erosion potential for soils on Atkinson and Spring Creek Mesas is moderate (Kw factor for the Barx-Progresso complex is 0.20; the Piñon-Bowdish-Rock outcrop complex is not rated). The susceptibility to wind erosion is also moderate (WEGs 3 and 4L) but could be high in areas where vegetation is sparse. Soils on the mesa tops have a moderate to severe rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012b).

Soils on Club Mesa are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for soils on the mesa is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. Soils on the mesa top have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012b).

3.3.2.3 Paradox Lease Tracts

3.3.2.3.1 Long Park Area. Soils within the Long Park area Lease Tracts 21, 22, and 22A are predominantly the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5–50% slopes), which makes up about 47% of the soil coverage at the three lease tracts (Figure 3.3-13). The Paradox fine sandy loam (Map Unit 73) covers portions of intermittent stream valleys that cut the plateau surface (streams flow to the northeast toward the San Miguel River), especially within Lease Tracts 21 and 22. Soils in lease tracts to the southeast (23-1, 23-2, and 23-3) occupy high-elevation areas cut by intermittent streams. Soils in the high-elevation areas are the loams of the Piñon-Bowdish-rock outcrop complex (3 to 30%); those in the valleys are the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5 to 50% slopes) (NRCS 2012c).

Soils in the high-elevation areas are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-rock outcrop complex; Map Unit 75). These soils are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff)

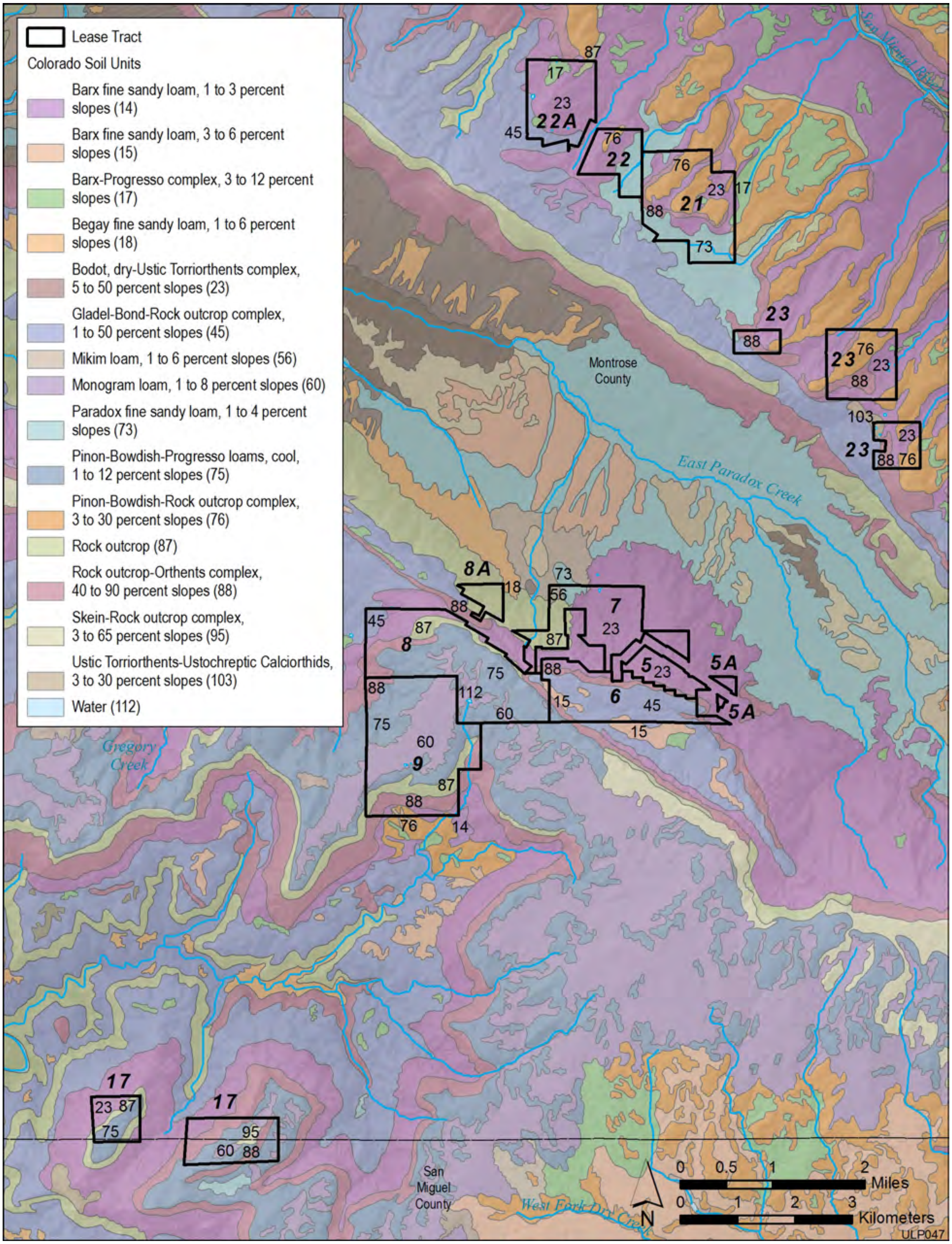

FIGURE 3.3-13 Soils within and around the Paradox Lease Tracts (NRCS 2009)

when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for high-elevation soils is not rated. The susceptibility to wind erosion is moderate (WEG 4L) but could be high in areas where vegetation is sparse. High-elevation soils have a moderate to severe rutting hazard (NRCS 2012c).

Soils in the intermittent stream valleys are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for stream valley soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. These soils have a moderate rutting hazard (NRCS 2012c).

Of all the soils in the Long Park area, only the Paradox fine sandy loam (Map Unit 73) is classified as prime farmland, if irrigated (NRCS 2012c).

3.3.2.3.2 Monogram Mesa Area. Soils within the lease tracts on top of and along the northeast aspect of Monogram Mesa (5, 5A, 6, 7, 8, 8A, and 9) have compositions that vary with elevation (Figure 3.3-13). On the top of the mesa (within Lease Tracts 8 and 9), soils are predominantly loams: the Piñon-Bowdish-Progresso loams, cool (1–12% slopes) and the Monogram loam (1–8% slopes), which together make up about 68% of the soil coverage at the two lease tracts. Lease Tract 8A sits almost exclusively on sandstone outcrops (Map Unit 87) along the mesa side slopes where soil is not well developed. Soils within the remaining lease tracts occur at lower elevations, along the mesa side slopes (Lease Tract 6) where the Gladel-Bond-Rock outcrop complex (1–50% slopes) predominates, covering about 63% of the site, and along the lower terraces above the southeast end of Paradox Valley (5, 5A, and 7) where the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) predominates, covering about 78% of the three lease tracts (NRCS 2012d).

Soils on the mesa top are formed from residuum weathered from interbedded sandstone and shale and from windblown (eolian) deposits (Monogram loam) over sandstone. They are moderately deep to deep and well-drained with slow to moderate infiltration rates when wet and slow to moderate rates of water transmission. Available water-holding capacity is very low (Piñon-Bowdish-Progresso loams) to high (Monogram loam). Water erosion potential for mesa top soils is moderate (Kw factors range from 0.32 to 0.43), with the highest potential occurring for the Monogram loam on Lease Tract 9 (Map Unit 60). The susceptibility to wind erosion is also moderate (WEGs 4L and 6) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. Only the Monogram loam is classified as prime farmland, if irrigated (NRCS 2012d).

Soils on the mesa side slopes are formed from residuum and eolian material weathered from sandstone (Gladel-Bond-Rock outcrop complex; Map Unit 45). These soils are very shallow to shallow and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for soils on the mesa side slopes is moderate (Kw factor is 0.20). The susceptibility to wind erosion is also moderate (WEG 3) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

Soils on the lower terraces above Paradox valley are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for mesa top soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. These soils have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

3.3.2.3.3 Wedding Bell and Radium Mountains. Soils within the lease tracts on top of Wedding Bell and Radium Mountains (17-1 and 17-2) are predominantly the fine sandy loams of the Piñon-Bowdish-Rock outcrop (3 to 30% slopes), which make up about 40% of the soil coverage at the two lease tracts (Figure 3.3-13). The mountain tops are rimmed by rock outcrops, including the Rock outcrop-Orthents complex (Map Units 87 and 88), covering about 29% of the sites. Soils at lower elevations (e.g., toward Bachelor Draw that separates the two landforms) are composed of the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) (NRCS 2012d).

The soils on the mountain tops are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-Progresso loams; Map Unit 76). They are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for mountain top soils is moderate (Kw factor is 0.32). The susceptibility to wind erosion is also moderate (WEG 4L) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. Except for the Monogram loam, which occurs on Lease Tract 17-1, none of the soils are classified as prime or unique farmland (NRCS 2012d).

Soils at lower elevations are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for these soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. Soils at lower elevations have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

3.3.2.4 Slick Rock Lease Tracts

Soils within the Slick Rock lease tracts can be divided regionally into those that occur on the flanks of Summit Canyon (11, 11A, 16, and 16A), those that occur in Dolores River Canyon (13, 13A, and 14), those that sit on a topographic bench above the Dolores River (15 and 15A), and those that sit on hill slopes to the south of Slick Rock (10 and 12). Soils along Summit Canyon and on the topographic bench above the Dolores River are similar in composition and characteristics to those previously described that form on mesa tops (see Sections 3.3.2.1 and 3.3.2.2; NRCS 2012e, f). They are predominantly Piñon-Bowdish-Progress loams, cool (1–12% slopes) and the sandy loams of the Gladel-Bond-rock outcrop (1–50% slopes) and the Gladel-Bond-rock outcrop, cool (3–25% slopes) complexes; sandstone outcrops (Map Unit 87), where soil is not well developed, are also common along the canyon walls (Figure 3.3-13).

Soils within lease tracts along the Dolores River Canyon (13, 13A, and 14) are predominantly the sandy and stony loams of the Farb-Rock outcrop (1–30% slopes) and Rock outcrop-Orthents (40–90% slopes) complexes, which together make up about 63% of the soil coverage at the three lease tracts (Figure 3.3-14). Soils of the Farb-Rock outcrop complex formed in residuum weathered from sandstone; soils of the Rock outcrop-Orthents complex formed from colluvium and slope alluvium weathered from sandstone and shale. The soils are shallow and well to excessively drained with a very slow infiltration rates (i.e., very high surface runoff) when wet. Available water-holding capacity is very low for most soils within the three lease tracts. Water erosion potential is moderate (Kw factors range from 0.20 to 0.49; the Farb-Rock outcrop complex is not rated), with the highest potential occurring for the Killpack-Deaver loams (Map Unit 52) on the high-elevation slopes along the Dolores River. The susceptibility to wind erosion is low to moderate (WEGs 3 to 8). Soils in the canyon bottom (Fluvaquents; Map Unit 43) are poorly drained and prone to flooding. These soils cover only a small portion of the site (about 3%) and have a moderate water erosion potential (Kw factor 0.37) (NRCS 2012e).

Soils within Lease Tract 10 are predominately the very stony loams of the Borolls-Rock outcrop complex (40 to 90% slopes) and the Beje fine sandy loam (3 to 25% slopes), which together make up about 74% of the soil coverage at the site (Figure 3.3-14). Soils of the Borolls-Rock outcrop complex formed from colluvium and residuum weathered from sandstone and shale; Beje fine sandy loams formed from residuum weathered from sandstone. The soils are shallow and well=drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission; the Borolls-Rock outcrop complex is characterized by a more moderate infiltration rate. Available water-holding capacity is low to very low. Water erosion potential for soils within the lease tract is moderate (Kw factor is 0.24). The susceptibility to wind erosion is also moderate (WEG 6) but could be high in localized areas where vegetation is sparse. None of the soils are classified as prime or unique farmland (NRCS 2012f).

Soils within Lease Tract 12 are predominantly the Nortez loam (1 to 6% slopes), the Nortez-Fivepine loams (1 to 12% slopes), and the Nortez-Acree loams (1 to 12% slopes), which together make up about 87% of the soil coverage at the site (Figure 3.3-14). These soils are formed from mixed alluvium derived from sandstone and shale. They are moderately deep and

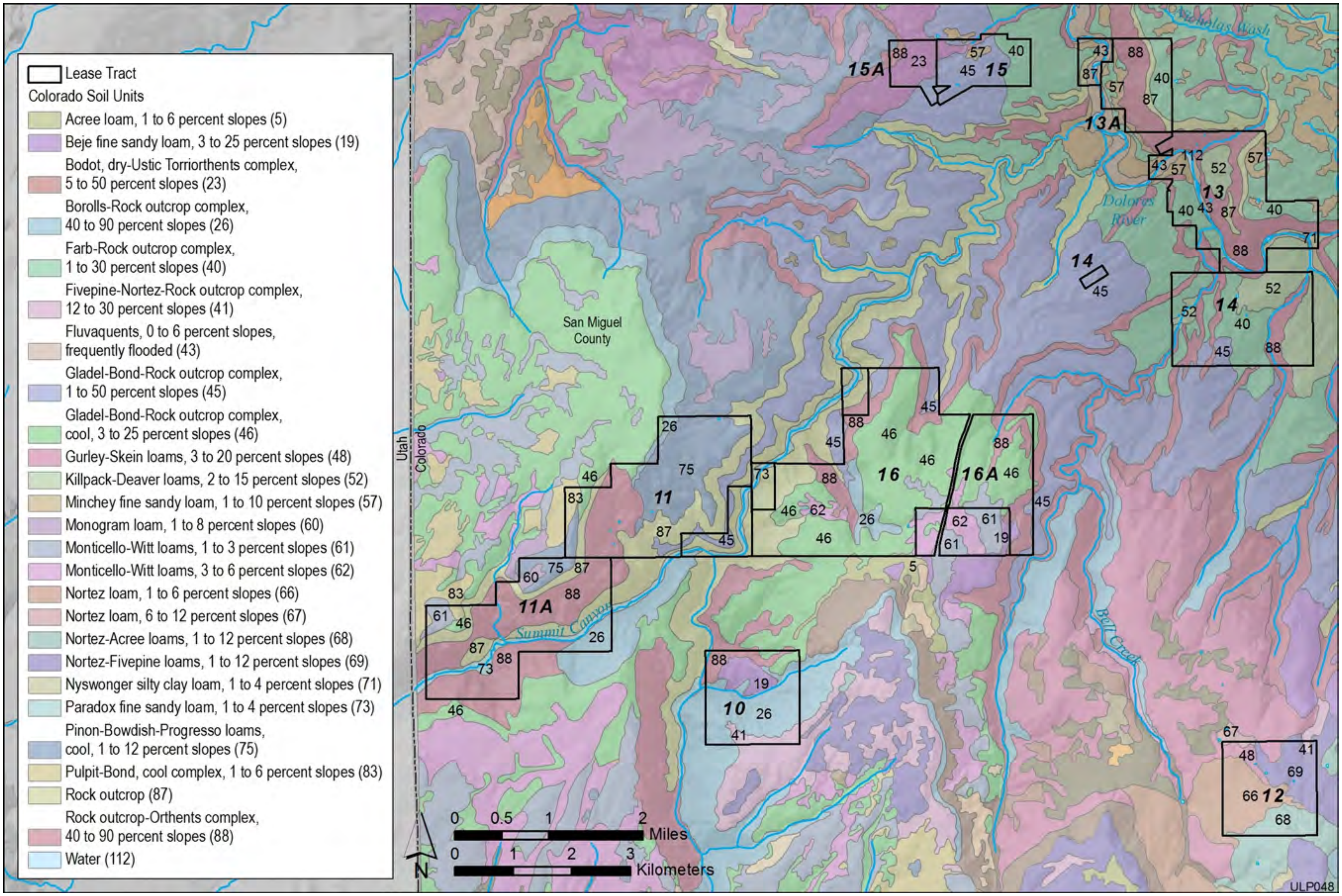

FIGURE 3.3-14 Soils within and around the Slick Rock Lease Tracts (NRCS 2009)

well-drained with a slow infiltration rate when wet. Available water-holding capacity is low to very low. Water erosion potential for soils within the lease tract is moderate (Kw factor is 0.32). The susceptibility to wind erosion is also moderate (WEG 6) but could be high in areas where vegetation is sparse. None of the soils are classified as prime or unique farmland (NRCS 2012g).

3.4 WATER RESOURCES

Water resources in southwestern Colorado are primarily governed by semiarid climate conditions and rugged topography. The DOE ULP tracts are located in the Colorado Plateaus physiographic region, which contains characteristic, high-elevation plateaus and vast canyon regions (USGS 2003). The lease tracts span the Upper Dolores (14030002), San Miguel (14030003), and Lower Dolores (14030004) hydrologic cataloging units (Hydrologic Unit Codes, HUC8), which cover a combined 4,600 mi^2 (12,000 km^2) in southwestern Colorado and portions of eastern Utah (USGS 2011a). The surficial geology of the region is described in Section 3.3. The climatic conditions of southwestern Colorado can vary over short distances because of the mountainous terrain; they can be generally characterized as having cold winters with snow cover and high summer temperatures (WRCC 2011b). Average annual precipitation patterns are relatively high in the Mountain area, with decreasing precipitation heading west across the study area, as shown in Figure 3.4-1. Monthly precipitation and snowfall amounts have been recorded at Uravan, Colorado (NOAA CO-OP ID 58560; NCDC 2012) since 1960. Average monthly precipitation totals range from 0.5 to 1.5 in. (1.3 to 3.8 cm), and snowfall occurs between October and April, with monthly totals averaging 0.2 to 4.2 in. (0.5 to 10.7 cm), but with maximum monthly snowfalls exceeding 30 in. (76 cm). The average annual precipitation at Uravan was 12.5 in. (31.8 cm), with a range of 7.1 to 21.4 in (18.0 to 54.4 cm) from 1960 to 2012. The potential annual evaporation rate is estimated to be 38 in. (97 cm) by Golder Associates (2009), based on the climate data at the Uravan station. The soil water content is usually deficient, and direct groundwater recharge is thus minimal under the condition of low annual precipitation and the high potential for evaporation in the area.

3.4.1 Surface Water

3.4.1.1 Stream and Drainage Systems

The Dolores River and its tributary, the San Miguel River, are the main perennial rivers that flow through the lease tracts, as shown in Figure 3.4-2. The Gunnison River flows into the Colorado River near Grand Junction, Colorado, but it is on the order of 50 mi (80 km) northeast of the lease tracts and separated by a drainage divide. The Dolores River Basin includes three watersheds, Upper Dolores, San Miguel, and Lower Dolores, which are drained by the Dolores and San Miguel Rivers and their tributaries, as well as numerous intermittent and ephemeral streams.

Legend (in inches)

Under 10	35 to 40
10 to 15	40 to 45
15 to 20	45 to 50
20 to 25	50 to 55
25 to 30	Above 55
30 to 35	

Period: 1961–1990

This map is a plot of 1961–1990 annual average precipitation contours from NOAA Cooperative stations and (where appropriate) USDA–NRCS SNOTEL stations. Christopher Daly used the PRISM model to generate the gridded estimates from which this map was derived; the modeled grid was approximately 4x4 km latitude/longitude, and was resampled to 2x2 km using a Gaussian filter. Mapping was performed by Jenny Weisburg. Funding was provided by USDA–NRCS National Water and Climate Center.

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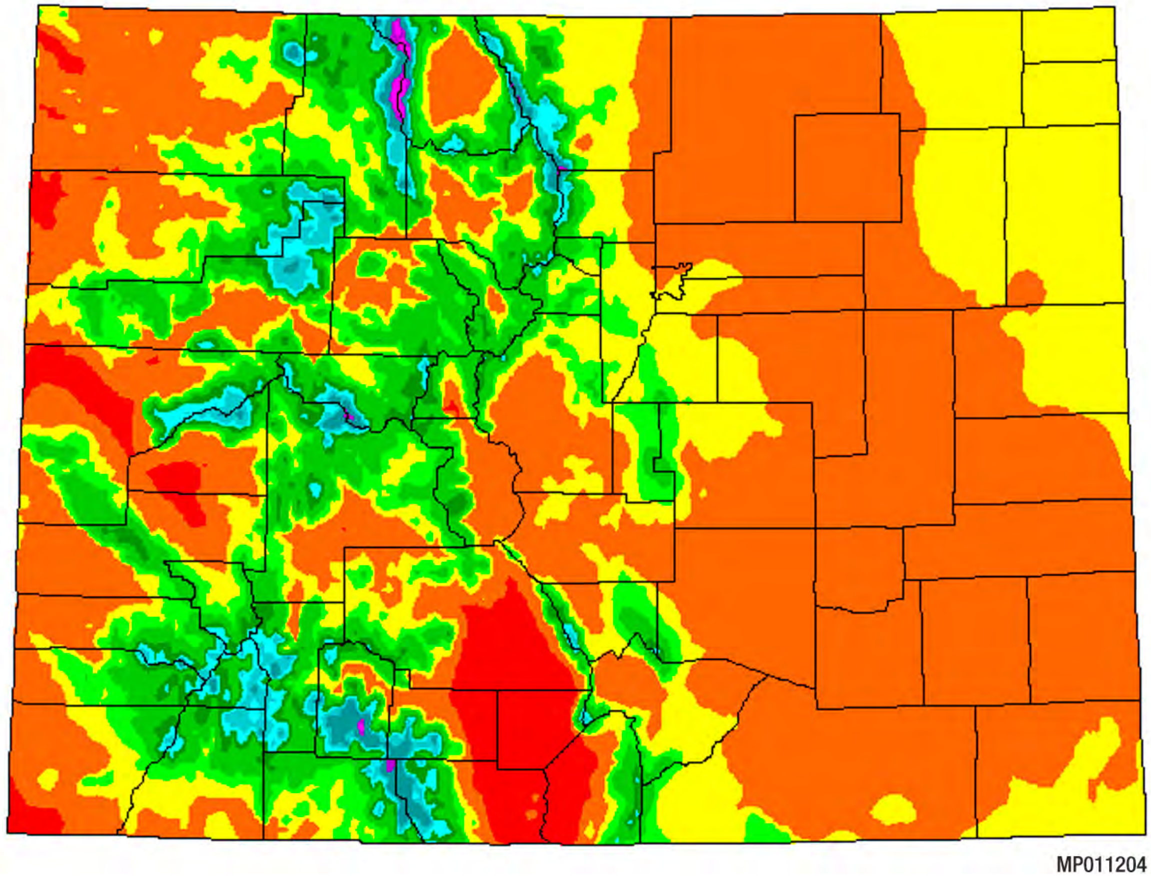


FIGURE 3.4-1 Average Annual Precipitation in Colorado, 1961–1990 (WRCC 1997)

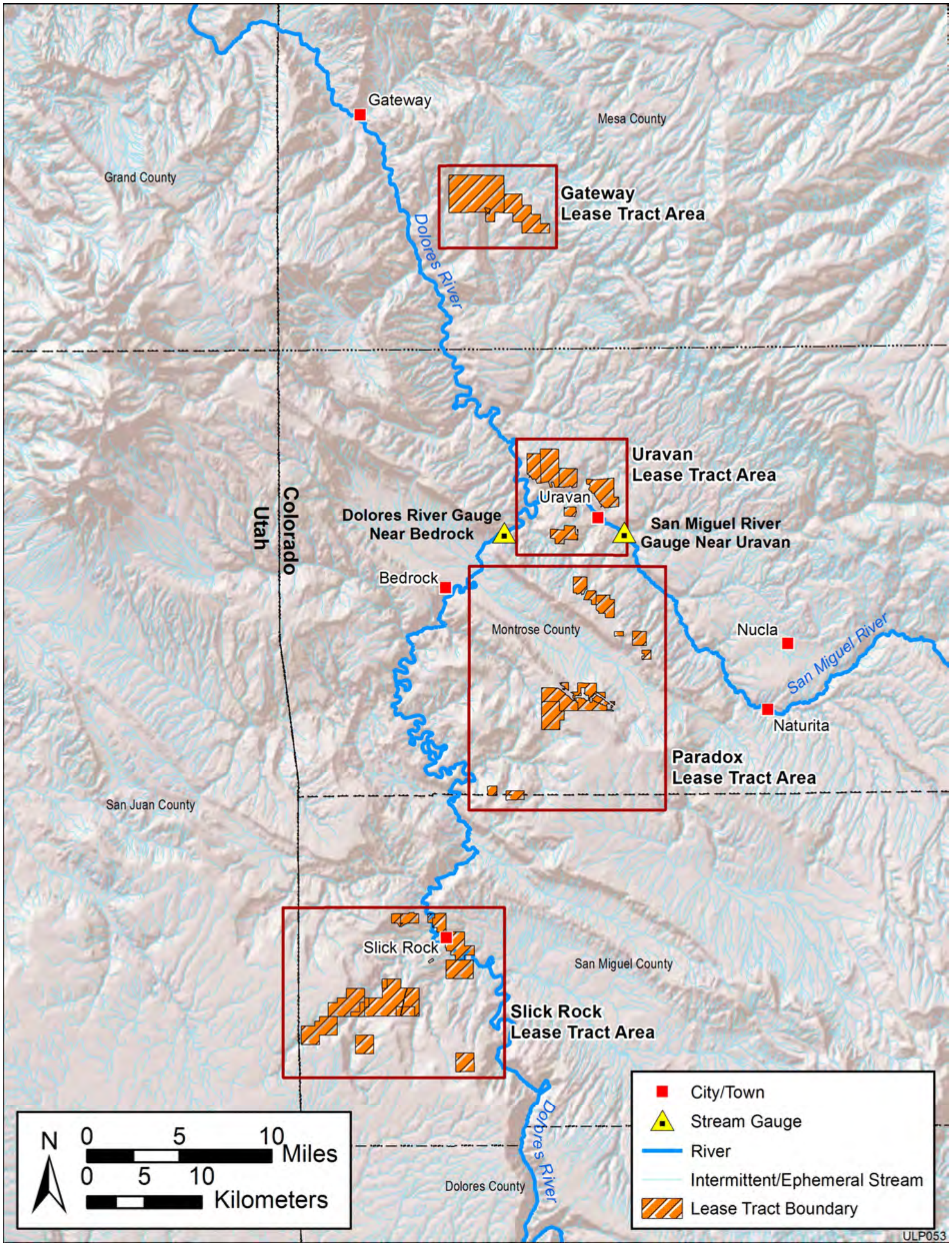


FIGURE 3.4-2 Map of Surface Water Features in the Region of the DOE ULP Lease Tracts

The Dolores and San Miguel Rivers originate in the Rico, La Plata, and San Juan Mountains of southwest Colorado, with topographic elevations ranging from 14,200 ft (4,300 m) near the Dolores River headwaters to 4,100 ft (1,250 m) at their combined confluence with the Colorado River near the Colorado–Utah border. The Dolores River flows north and northwest through the Slick Rock lease tract and flows northeast adjacent to the Uravan lease tract near its confluence with the San Miguel River, which flows through the Uravan region. The Dolores River and San Miguel River flow primarily through canyons, with the exception being in low-relief alluvial regions of Paradox Valley that are crossed by the Dolores River. Several ephemeral streams drain the uranium lease tracts and eventually reach the Dolores River and the San Miguel River (Figure 3.4-2).

The Dolores River reach that flows through the lease tracts is regulated by the McPhee Dam and reservoir located upstream of the lease tracts in Montezuma County, Colorado. The McPhee Dam was constructed in 1984, and its reservoir was filled by 1987 as a part of the Dolores Project for irrigation and water supply (BOR 2009). Downstream of McPhee Dam, flow in the Dolores River is affected by reservoir releases and runoff in the surrounding watershed. Surface runoff below McPhee Dam was estimated to be 2.5 in./yr (64 mm/yr), representing 15% of the precipitation in this region (Weir et al. 1983). Flow in the San Miguel River is largely unregulated except for some water extractions and is primarily controlled by snowmelt in the spring and heavy, short-duration rains in the late summer (Allred and Andrews 2000). Surface runoff in the lower part of the San Miguel River watershed was estimated to range between 2.4 and 9.8 in./yr (60 and 250 mm/yr) (Ackerman and Rush 1984).

Both the Dolores and San Miguel Rivers have large seasonal fluctuations in flow, with high runoff in spring and low flow in winter (Figures 3.4-3 and 3.4-4). Flows are largest during the snowmelt period of April through June each year, with daily averaged discharges ranging between 1,000 and 3,500 ft^3/s (28 and 99 m^3/s) in the Dolores River near Bedrock (USGS Gage 09171100), and between 500 and 2,000 ft^3/s (14 and 57 m^3/s) in the San Miguel River near Uravan (USGS Gage 09177000). Instantaneous peak discharges can often exceed daily averaged discharge records, and historical peak discharges in the Dolores River near Bedrock, Colorado (USGS Gages 09169500 and 09171100) ranged between 1,300 and 10,000 ft^3/s (37 and 280 m^3/s) before the McPhee Dam was built in the mid-1980s, and between 500 and 5,400 ft^3/s (14 and 150 m^3/s) after the dam was built (USGS 2011b). Discharge in the Dolores River typically increases as it flows downstream as a result of groundwater discharge (Weir et al. 1983), with the exception being as the river flows through Paradox Valley, where groundwater extraction associated with the Paradox Valley Unit (BOR) reduces river flow (Golder Associates 2009). Discharge in the San Miguel River typically increases as it moves downstream, with localized regions that lose flow to groundwater recharge (Ackerman and Rush 1984). Peak discharges in the San Miguel River near Uravan, Colorado (USGS Gage 09177000) occurred throughout the spring, summer, and fall between 1954 and 2010 and ranged between 1,000 and 9,000 ft^3/s (28 and 260 m^3/s) (USGS 2011b).

Intermittent and ephemeral streams, which primarily flow in response to seasonal snowmelt and precipitation events, occur throughout many of the lease tracts. More than 150 intermittent and ephemeral stream segments occur within the DOE ULP lease tracts

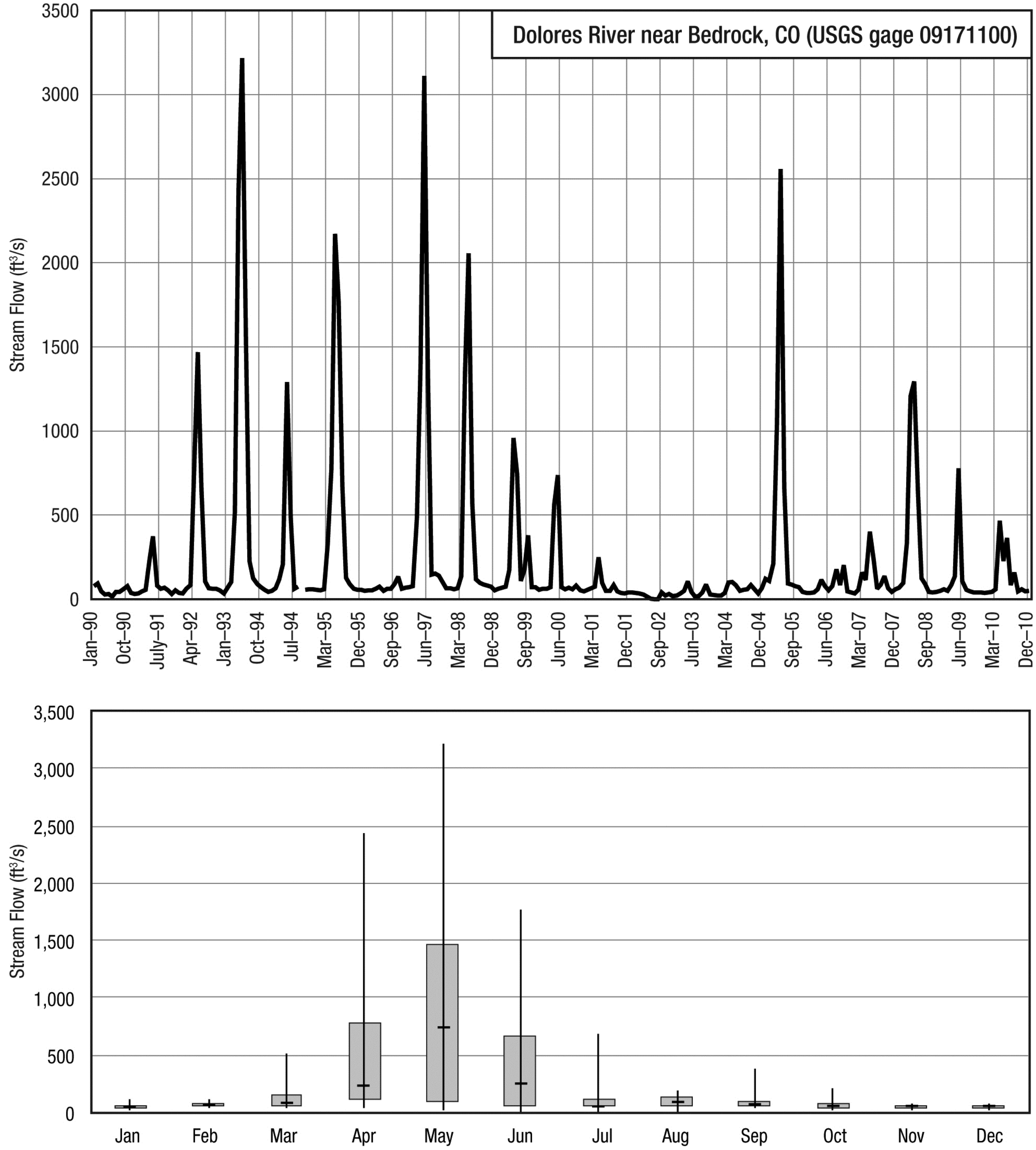


FIGURE 3.4-3 Seasonal Hydrograph and Monthly Discharge Values in the Dolores River near Bedrock, Colorado (USGS Gage 09171100), 1990–2010 (Top shows seasonal hydrographs; bottom shows monthly percentile; 50% = tick mark; 25% and 75% = grey box; minimum and maximum values = vertical line)

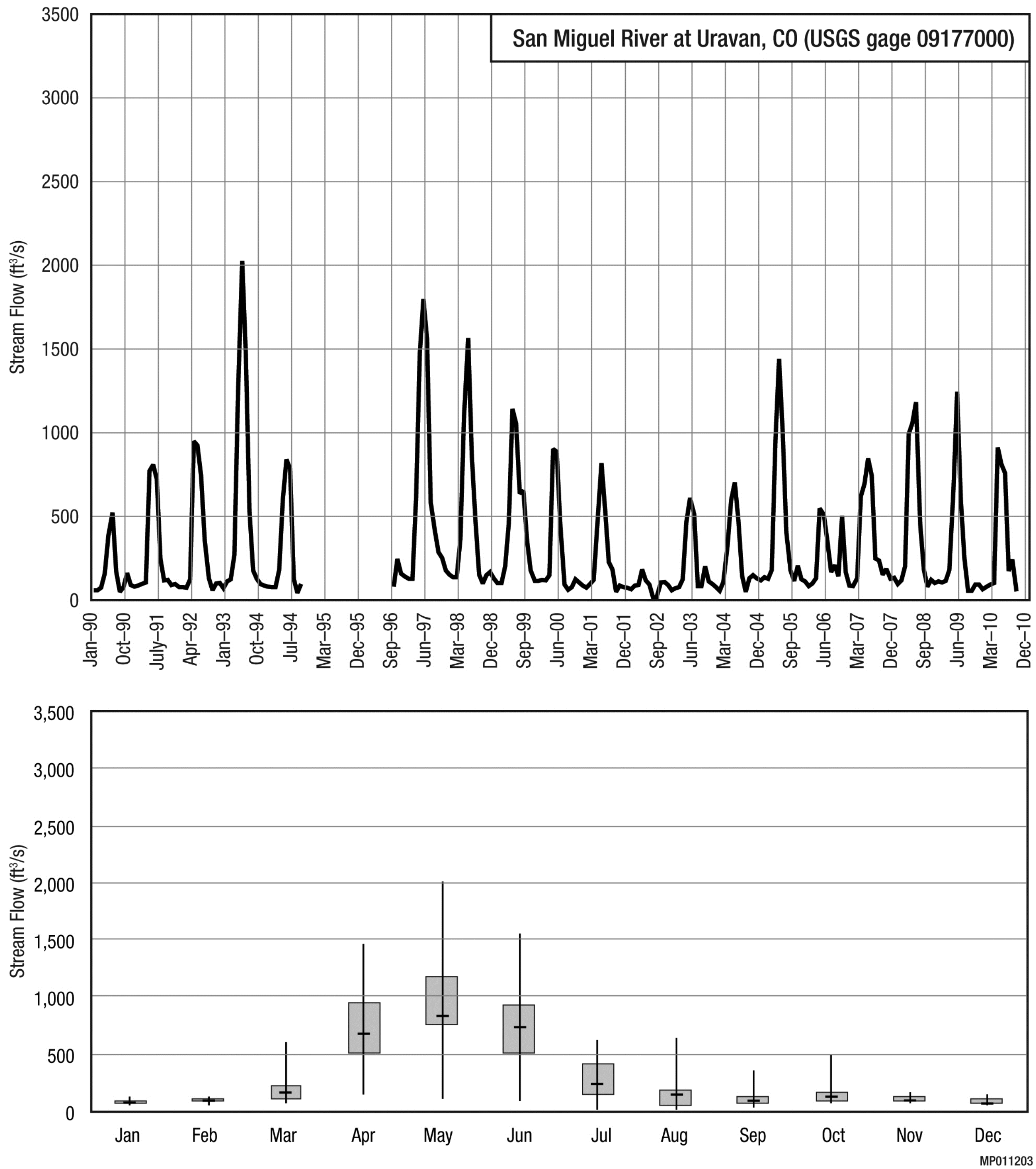


FIGURE 3.4-4 Seasonal Hydrograph and Monthly Discharge Values in the San Miguel River near Uravan, Colorado (USGS Gage 09177000), 1990–2010 (Top shows seasonal hydrographs; bottom shows monthly percentile; 50% = tick mark; 25% and 75% = grey box; minimum and maximum values = vertical line)

(Figure 3.4-2). Total intermittent and ephemeral stream channel lengths within each lease tract are 18 mi (29 km) in Gateway, 11 mi (18 km) in Uravan, 9 mi (14 km) in Paradox, and 20 mi (32 km) in Slick Rock. Peak discharges in these intermittent and ephemeral stream channels have been reported to vary from 2 to 5,660 ft^3/s (0.06 to 160 m^3/s), as shown in Table 3.4-1. Precipitation and snowmelt runoff conveyed overland, primarily in intermittent and ephemeral streams within the Dolores River basin, was estimated to be as high as 270 million m^3/yr (Weir et al. 1983).

3.4.1.2 Existing Water Quality

Section 303(d) of the Clean Water Act (CWA), as amended, requires states to develop lists of water bodies that do not meet water quality standards and to submit updated lists to the EPA every two years, along with the integrated report on water quality conditions that is required in Section 305(b). The latest Colorado 305(b) report and 303(d) list were issued in April 2012 by the CDPHE Water Quality Control Division, covering the 2010–2011 two-year period.

In the current listing cycle (2012), more than 71,048 river miles and more than 151,827 lake acres in Colorado were assessed, and their attainment status was determined according to five reporting categories (CDPHE 2012a). Stream segments or reservoirs that are not attaining their classified water uses (Category 5) are defined as impaired and placed in the 303(d) list, which requires development of the total maximum daily load (TMDL) to correct impairment. If water bodies are suspected to be impaired but there are not enough data to address the uncertainties, CDPHE places them on the Monitoring and Evaluation (M&E) List to collect more data. The results of CDPHE's assessment in the 2012 reporting cycle represent a current understanding of the existing water quality for Colorado water bodies. All water bodies in the

TABLE 3.4-1 Range in Reported Peak Discharge Values for Intermittent and Ephemeral Streams in the Region of the DOE ULP Lease Tracts

Stream	USGS Gage	Peak Discharge (ft^3/s)
Disappointment Creek Tributary near Slick Rock, CO	9168700	36–260
East Paradox Creek Tributary near Bedrock, CO	9169800	26–368
West Paradox Creek near Bedrock, CO	9171000	16–5,200
West Paradox Creek near Paradox, CO	9170500	18–678
Cottonwood Creek near Nucla, CO	9174500	32–321
Dead Horse Creek near Naturita, CO	9175800	10–1,250
Dry Creek near Naturita, CO	9175900	290–5,660
Tabeguache Creek near Nucla, CO	9176500	114–303
Deep Creek near Paradox, CO	9178000	2–22
Salt Creek near Gateway, CO	9179200	25–2,670
Taylor Creek near Gateway, CO	9177500	13–555
West Creek Tributary near Gateway, CO	9179400	19–277

2012 303(d) and M&E lists, within the three watersheds (Upper Dolores, San Miguel, and Lower Dolores) that encompass the lease tracts, are presented in Table 3.4-2. The locations of the impaired water bodies are shown in Figure 3.4-5.

In the Upper Dolores watershed (HUC8: 14030002), impaired water was identified in McPhee Reservoir (located upstream of the lease tracts) because of elevated mercury concentration in fish tissues and in Silver Creek, a tributary to the Dolores River (upstream of McPhee Reservoir), for non-attainment of dissolved cadmium and zinc standards. The McPhee Reservoir has been on the 303(d) list since 1998 and ranked as high priority, requiring development of the TMDL to reduce the mercury concentration (Table 3.4-2). Phase I of TMDL development has been completed by CDPHE. The main suspected sources of mercury in the reservoir include historic mining activities (i.e., hard rock mining), atmospheric deposition from nearby and distant sources, such as coal-based power plants, and naturally occurring background in local geologic formations and soils (CDPHE 2003). An estimated load reduction is 75% assigned to atmospheric deposition load and 50.8 % to loads from the former mining areas. The impaired Silver Creek is currently under implementation of the TMDL established in 2008 and has been removed from the 303(d) list. The high concentrations of cadmium and zinc are primarily the result of mining activity in the watershed between the1880s and the late 1970s (CDPHE 2008a). A range of monthly allowed TMDLs for cadmium and zinc is presented in Table 3.4-2. Along the downstream segment of the Dolores River within the Upper Dolores, the river water is found impaired for their nonattainment of iron standards. A TMDL assessment for the segment is required with a high priority. The sources of elevated iron in the river segment will be analyzed in the TMDL assessment. However, the previous USGS study indicates that iron is not typically enriched in water from the uranium mines in this area (Nash 2002). The Paradox and Uravan lease tract areas near the impaired segment are unlikely to be contributing to impairment. In addition, three stream segments are on the 2012 monitoring and evaluation (M&E) list for their excessive *E. coli* and selenium, requiring collection of more data.

In the San Miguel watershed (HUC8: 14030003), seven stream segments and one reservoir (located upstream of the lease tracts) were identified as being impaired for their depleted dissolved oxygen, elevated concentrations of cadmium and zinc, or non-attainment of the Colorado multi-metric index for aquatic life (Table 3.4-2). The impairment of Miramonte Reservoir and of Howard Fork and Maverick Draw, tributaries to the San Miguel River (located upstream of Naturita), resulted from excess nutrients, requiring further assessment and TMDL development. The impairment of the other five stream segments was identified as due to exceedance of cadmium and zinc standards. Among them, four segments are located in the San Miguel River headwaters, whose tributaries flow through historical mining areas near Telluride. In the 2012 listing cycle, TMDLs developed for these four stream segments were approved for implementation, and the segments were removed from the 2012 303(d) list. The TMDL assessment indicates that stream impairment is attributed to remnants of mining activities, such as tailings piles, abandoned tunnels, mining equipment, and mills generated from gold, silver, and lead mining from 1875 to 1978. These mining remnants have been exposed to infiltration and runoff, which leaches metals (cadmium and zinc) into surface water (CDPHE 2010). The established TMDLs provide a substantial reduction of loads, as shown in Table 3.4-2. In addition, 12 stream segments were identified as impaired with some uncertainties requiring

TABLE 3.4-2 Impaired Water Bodies on the Colorado 2012 303(d) and M&E Lists or in the Process of Implementing TMDL within the Upper Dolores, San Miguel, and Lower Dolores Watersheds

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
Upper Dolores (HUC-8 Basin: 14030002)						
COGULD03a	All tributaries to the Dolores River from the bridge at Bradfield Ranch to the Colorado/Utah border	Disappointment Creek	Selenium, *E. coli*			
COGULD04	Mainstem of West Paradox Creek from the source to the confluence with the Dolores River; mainstem and all tributaries to Blue Creek from the source to the confluence with the Dolores River	West Paradox Creek	*E. coli*, Iron (Trec)			
COSJDO04b	McPhee Reservoir and Summit Reservoir	McPhee Reservoir		Aquatic Life Use (mercury*in fish tissue)	High	
COSJDO09_743D	Silver Creek, from Rico's Diversion to Dolores River					Cadmium 0.0002–0.0013 lb/day; zinc: 0.091–0.377 lb/day (35101)
COSJDO11	All tributaries to Dolores River, from the confluence of the W. Dolores River, to bridge at Bradfield Ranch (Forest Rt. 505, near Montezuma/Dolores County Line	Lost Canyon Creek	*E. coli*			
COGULD02	Dolores River from Little Gypsum Valley bridge to Colorado–Utah border	Downstream of Upper Dolores	*E. coli*	Iron (Trec)	High	

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003)						
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Bear Creek	Lead	Cadmium, zinc (sc)	High	
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Cornet Creek	Lead			
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Howard Fork above Swamp Canyon		pH, dissolved oxygen	High	
COGUSM03b	Mainstem of the San Miguel River Marshall Creek to South Fork San Miguel River	All	Lead			
COGUSM03B_7500	San Miguel River–Marshall Creek to South Fork San Miguel River					Cadmium 0.03–0.59 lb/day; zinc 2.6–108.9 lb/day (35252)
COGUSM04a	Mainstem of the San Miguel River from the South Fork of the San Miguel to below the CC ditch	From South Fork San Miguel to confluence with Leopard Creek	Lead			
COGUSM06a	Ingram Creek, source to San Miguel River	All	Manganese. copper			

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM06A_7500	Ingram Creek, mainstem of Ingram Creek including all tributaries					Cadmium 0.003 lb/day (38985)
COGUSM03A_7500	San Miguel River –Bridal Veil and Ingram Creek to Marshall					Zinc 4.1 lb/day (35251)
COGUSM06b	Marshall Creek, source to San Miguel River	All	Copper			
COGUSM06B_7500	Marshall Creek, mainstem of Marshall Creek including all tributaries, lakes, reservoirs, and wetlands from source to confluence with San Miguel River					Cadmium 0.003 lb/day; zinc 0.6–13.6 lb/day (38986)
COGUSM07a	Mainstem of Howard Fork and tributaries Swamp Gulch the South Fork of the San Miguel	Chapman Creek	Iron (Trec)			
COGUSM07a	Mainstem of Howard Fork and tributaries from a point immediately below the confluence of Swamp Gulch to its confluence with the South Fork of the San Miguel River	Iron Bog Creek	pH, dissolved oxygen			

TABLE 3.4-2 (Cont.)

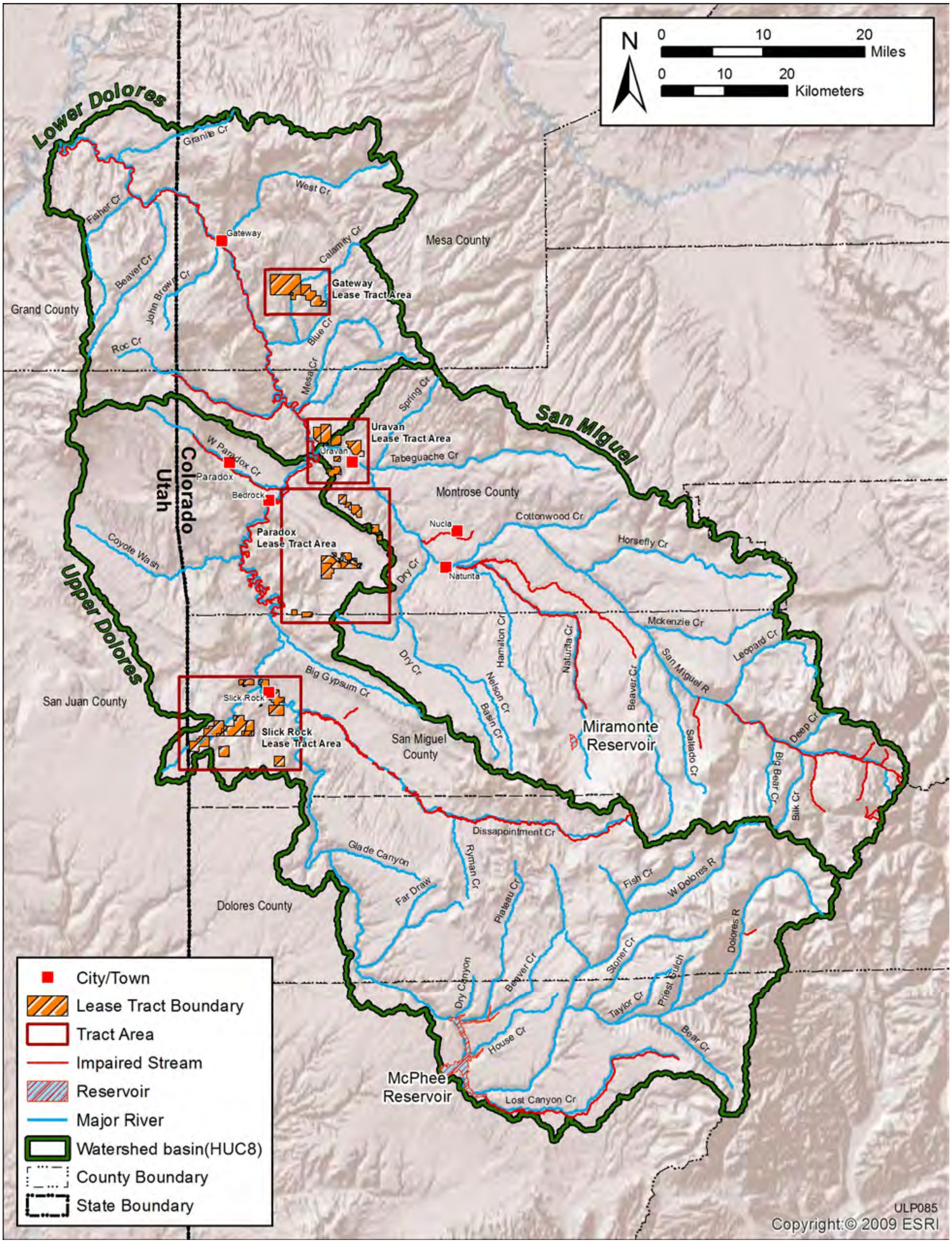
Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM08	Mainstem of South Fork of San Miguel River from the Howard and Lake Forks to the San Miguel River	All	Manganese (WS)			
COGUSM10	Mainstem of Naturita Creek from the Uncompahgre National Forest boundary to its confluence with the San Miguel River, and Gurley Reservoir; Tabeguache Creek from its source to the confluence with San Miguel River	Naturita Creek	Dissolved oxygen, *E. coli*			
COGUSM11	West Fork of Naturita Creek, Miramonte Reservoir, the mainstem of Beaver, Horsefly, and Saltado Creeks from the Uncompahgre National Forest boundary to their confluence with the San Miguel River	Miramonte Reservoir		Dissolved oxygen (temperature)	High	
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Mesa Creek	Selenium			

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Calamity Draw, Specie Creek	Dissolved oxygen			
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Maverick Draw		Aquatic life (provisional)	Low	
Lower Dolores (HUC-8 Basin: 14030004)						
COGULD02	Dolores River from Little Gypsum Valley bridge to Colorado–Utah border	All	*E. coli*	Iron (Trec)	High	
COGULD05	Mainstem of West Creek from the source to the confluence with the Dolores River; Roc Creek; La Sal Creek and Mesa Creek from their sources to their confluences with Dolores River	Roc Creek	*E. coli*	Copper, iron (Trec)	High	

[a] If the TMDL varies with the monthly mean flow, a range of TMDL for 12 months is presented.

Sources: CDPHE (2008a,b, 2010, 2012a,b)



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2 **FIGURE 3.4-5 Location of Impaired Water Bodies**

further data collection (M&E list). Most of them were added in the 2012 listing cycle. The leading causes of impaired water on the M&E list are elevated concentrations of Pb and other metals in the upper San Miguel River and its tributaries and depleted dissolved oxygen in the lower San Miguel River.

In the Lower Dolores watershed (HUC: 14030004), the lower Dolores River and Roc Creek, a tributary of the Dolores River, located downstream of the Uravan lease tracts, were identified as impaired for their non-attainment of iron and copper standards. A TMDL assessment for these two segments is required with a high priority. The sources of elevated metal in the river segments will be analyzed in the TMDL assessment.

Along the Dolores River near the lease tracts, the total dissolved solids (TDS) content is a primary concern because of the high salinity of the groundwater discharge that occurs as it crosses Paradox Valley, which has a geologic structure that naturally causes the saline groundwater (more details on the geology are provided in Section 3.3). The saline concentration in groundwater in this area has been found in excess of 250,000 mg/L (BOR 2013a). The resulting discharge of saline groundwater to the Dolores River propagates through the river, and it historically increases the TDS loading of the Colorado River by 115,000 to 205,000 tons/yr (Watts 2000; Chafin 2003). The Paradox Valley Unit was built by the BOR in order to capture the high TDS groundwater before it could enter the Dolores River (further information on the Paradox Valley Unit is provided in Section 3.4.3 on water management). By 2001, the Paradox Valley Unit had reduced TDS loads to the Dolores River to 10,600 tons/yr (Chafin 2003). The salinity control program funded by the BOR has been continued along the Dolores River near Bedrock through the Colorado 2012 reporting cycle (CDPHE 2012a,b). Because the existing brine disposal well in the unit is nearing the end of its useful life, a new injection well alternative and an evaporation pond alternative are being considered for future brine disposal (BOR 2013b).

In summary, the existing surface water quality as evaluated by CDPHE (2012a,b) indicates that 10 stream segments and 2 reservoirs are currently impaired in the region of lease tracts that span three watersheds. None of the impaired water is evidently associated with the historical mining activities within the ULP lease tracts. One main segment along the Dolores River near or downstream of the ULP lease tracts is impaired by elevated iron, which is unlikely contributed to the uranium mines in the area. The other impaired waters are located upstream from the lease tracts. In addition, 15 stream segments are suspected to be impaired (M&E list) in the region requiring more data. Most of them are either located upstream of the lease tracts or impaired with nonmetal constituents. Near or downstream of the ULP leased tracts, elevated E. coli is the main concern for the river segment requiring further monitoring and evaluation.

In addition to the state surface water quality database, local monitoring data are also available at the two former uranium mill tailing processing sites located along the Dolores River at Slick Rock, Colorado. These processing sites, Slick Rock East (SRE) and Slick Rock West (SRW), are located in the floodplain of the Dolores River overlying the shallow alluvial aquifer (see Figure 3.4-5). SRE is located entirely within the bounds of ULP Lease Tract 13 (in the northwest corner of the tract), and SRW is located approximately 1 mile downstream of SRE (approximately 2,000 feet west of ULP Lease Tract 13 and 400 feet southwest of Lease Tract 13A). The sites were remediated by removal of tailings and other residual materials as part of the Uranium Milling Tailings Radiation Control Act (UMTRCA) project. The remediation was completed in 1996, and a monitoring program, for both surface water and groundwater, was subsequently established. The groundwater cleanup compliance strategy for the sites is natural flushing, combined with institutional controls and compliance monitoring. COCs at SRE and SRW are mainly manganese, molybdenum, nitrate, selenium, and uranium (DOE 2013). Seven surface water monitoring points are located within the Dolores River upstream from, adjacent to, and downstream from the site, respectively, for both sites. The results from the recent annual sampling event in 2012 indicate that COCs in all samples are currently below the EPA drinking water standard or UMTRCA maximum concentration limit (MCL), except for manganese in SRW downstream sample 0694 (0.055 mg/L), which slightly exceeds the standard (0.05 mg/L). For historical sampling events since 1997, one sample from surface water near the SRE site showed a slightly high concentration of uranium (0.055 mg/L) in 2006. Results are summarized in Table 3.4-3 (DOE 2013).

3.4.2 Groundwater

Groundwater is primarily located in bedrock aquifers and small, isolated alluvial aquifers in the region of the uranium lease tracts. The alluvial aquifers within the study region are primarily composed of gravel, silts, and clays of Quaternary age and located in isolated canyon margins of the Dolores River and the San Miguel River (Topper et al. 2003). Mapped alluvial aquifers near the lease tracts are concentrated along a 19-mi (31-km) reach of the Dolores River west of the Gateway lease tracts, a 20-mi (32-km) reach of West Creek north of the Gateway lease tracts, and a 7-mi (11-km) segment of the San Miguel River east of the Paradox lease tract (CDWR 2011). Near the Slick Rock lease tracts, a limited, shallow alluvial aquifer was also reported along the Dolores River bounded by the canyon wall (DOE 2013). The alluvial aquifers of the Dolores River and the San Miguel River are under unconfined conditions, with depths to groundwater ranging from 2 to 90 ft (0.6 to 27 m) below the surface (Topper et al. 2003). Groundwater yields in the alluvial aquifers of the Dolores River and the San Miguel River range between 1 and 200 gal/min (4.5 and 910 L/min) (CDWR 2011).

The bedrock aquifers within the region of the uranium lease tracts are a part of the regional Paradox Basin, which consists of upper and lower groundwater systems that are separated by confining layers, including salt beds (Topper et al. 2003). Figure 3.4-6 depicts the hydrogeologic stratigraphy of the Paradox Basin, which shows the lower groundwater system as the Paleozoic carbonate aquifer and the upper groundwater system as the Mesozoic sandstone aquifer. The lower groundwater system consists of fractured limestone units overlain by confining salt beds in the Hermosa Group. Groundwater from the lower system is typically saline (Weir et al. 1983). The upper groundwater system consists of layered sedimentary rock beds overlain by a confining shale layer in certain regions and unconsolidated alluvial material in other parts of the basin. Groundwater in the upper sandstone units is typically unconfined where the units crop out along the eastern edge of the Paradox Basin, whereas confined conditions exist farther into the basin (Topper et al. 2003). Groundwater in the sandstone units is typically low in salinity, and these units vary with respect to the amount of fracturing, which controls their groundwater yields (Weir et al. 1983). Reported groundwater yields in the sandstone units are

TABLE 3.4-3 COC Concentrations in the Dolores River at SRE and SRW Sites near Slick Rock Lease Tract 13

	COCs (mg/L)				
Standard or Location	Manganese	Molybdenum	Nitrate as NO_3	Selenium	Uranium
Drinking water standard[a]					
MCL			10	0.05	0.030
SMCL	0.05	0.1[b]			
2012 Monitoring Data[c]					
SRE Site					
0696 (upstream)	–[c]	–	–	–	0.00057
0692 (adjacent)	–	–	–	–	0.0007
0700 (downstream)	–	–	–	–	0.00049
SRW Site					
0693 (upstream)	0.0037	0.0009	<0.044	0.00027	0.00055
0347 (adjacent)	0.0056	0.0009	<0.044	0.00032	0.00057
0349 (adjacent)	0.024	0.0011	<0.044	0.0003	0.00062
0694 (downstream)	**0.055**[d]	0.0016	0.11	0.00032	0.00083
Historical Results (Maximum Concentration since 1996)					
SRE Site					
0696 (upstream)	0.01	0.004	1.55	0.0059	**0.055**[e]
0692 (adjacent)	0.008	0.0041	0.99	0.0043	0.0022
0700 (downstream)	–	–	–	–	0.0014

a EPA (2013), http://water.epa.gov/drink/contaminants/index.cfm#List. MCL = maximum contaminant level for primary standard; SMCL = maximum contaminant level for secondary standard.

b UMTRCA MCL.

c Data obtained from DOE (2013). Monitoring data are rounded to two significant figures. A dash indicates not analyzed.

d Bold indicates that the concentration at the sampling point is higher than the standard.

e One sample collected in 2006 exceeding the EPA MCL or SMCL.

Era	Period	Million Years before Present	Stratigraphic Unit	Unit Thickness (feet)	Hydrogeologic Unit	Hydrologic Characteristics
Cenozoic	Quaternary	0–2.6	Alluvium	0–100	Alluvium	Yields large quantities for domestic, stock, and municipal
Mesozoic	Upper Cretaceous	65.5–99.6	Mesaverde Group	100–1,000	Cretaceous confining beds	Confining unit; none
			Mancos Shale	1,000–5,000		
			Dakota Sandstone	0–200		Yields some water, stock and domestic
	Lower Cretaceous	99.6–145.5	Burro Canyon Fm	0–250	Mesozoic sandstone aquifer (Upper Aquifer)	Yields water to springs
	Upper Jurassic	145.5–161	Morrison Formation – Brushy Basin Member	400–500		None
			Morrison Formation – Salt Wash Member	300		Yields small quantities, stock and domestic
	Lower and Middle Jurassic	161–201.6	Wanakah Fm (Summerville Fm)	0–120		None
			Entrada Sandstone	15–170		Yields water
			Carmel Formation	0–40		None
			Navajo Sandstone	0–125		Small to moderate amounts from fractures, stock and domestic
			Kayenta Formation	0–200		Yields little to no water
	Upper Triassic	201.6–235	Wingate Sandstone	0–400		Yields water to numerous springs
			Dolores Formation	150–230	Mesozoic-Upper Paleozoic confining beds	Not water bearing
			Chinle Formation	0–500		Yields small quantities where fractured, stock and domestic
	Lower Triassic	235–251	Moenkopi Formation	0–480		Yields small quantities stock and domestic
Paleozoic	Permian	251–299	Cutler Formation	0–3,500		Yields small quantities where fractured, stock and domestic
	Pennsylvanian	299–318	Hermosa Group	0–3,900	Confining salt beds	None
	Mississippian	318–359	Leadville Limestone	20–100	Lower Paleozoic carbonate aquifer (Lower Aquifer)	Transmits saltwater through fractures
	Devonian to Cambrian	359–542	Ouray, Elbert, and Ignacio Formations	0–150		

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FIGURE 3.4-6 Conceptual Diagram of the Hydrogeologic Stratigraphy of the Paradox Basin (based on Topper et al. 2003 and Walker and Geissman 2009)

typically less than 20 gal/min (91 L/min), except for isolated regions of high fracturing, which have groundwater yields up to 230 gal/min (1,000 L/min) (CDWR 2011).

Depth to groundwater and groundwater surface elevations are highly dependent on their locations between mesas and valley regions. Depth to groundwater in alluvial aquifers along the rivers ranges from 2 to 90 ft (0.6 to 27 m) below the ground surface, with shallow depths quite commonly found (Topper et al. 2003). Depth to groundwater is greatest beneath mesas; the local groundwater table can be more than 650 ft (200 m) below ground surface in the San Miguel River basin (Ackerman and Rush 1984). However, there are numerous, locally perched aquifers found throughout the Paradox Basin with much shallower groundwater tables (Weir et al. 1983). Table 3.4-4 lists values for the depth to groundwater for USGS monitoring wells within the HUC8 basins of the study region.

Groundwater flow in the alluvium is typically toward the Dolores River and the San Miguel River. Regionally, groundwater from the upper groundwater system flows to the northwest, discharging to the rivers and providing base flow (Weir et al. 1983; Golder Associates 2009). Disruptions of groundwater flow by folds and faults are common in the upper groundwater system, but the effects of similar geologic structures on flow in the lower groundwater system are not known (Weir et al. 1983). Groundwater recharge in the upper groundwater system is primarily from precipitation infiltration, with interbasin inflow considered to be minor (Weir et al. 1983). Groundwater discharge occurs through evapotranspiration and discharge to springs in the study area, but groundwater is primarily discharged to the base flow of the Dolores River and the San Miguel River (Topper et al. 2003). Springs are typically found at high elevations on the flanks of mesas, with more than 200 springs identified in the Dolores River watershed that have an average discharge of 14 gal/min (53 L/min) (Weir et al. 1983). Additional monitoring data for springs in the vicinity of the DOE ULP tracts collected by the USGS are shown in Table 3.4-5.

Groundwater quality in the Paradox Basin is variable; the best quality typically is found in the shallower or more productive units, and the TDS content typically increases with depth (Topper et al. 2003). The sandstone units of the upper groundwater system are typically dominated by calcium- or sodium-bicarbonate, with several units containing TDS and sulfate concentrations that exceed secondary drinking water standards (Weir et al. 1983). The limestone unit of the lower groundwater system is brackish (high salinity) and is not suitable to drink without substantial desalinization treatment (Topper et al. 2003). As described previously, the geologic structure of the Paradox Valley generates a highly saline groundwater discharge to the Dolores River, where the brine has a higher salinity than seawater (Chafin 2003).

Groundwater wells for domestic and municipal water supply were identified for the area within 5 mi (8 km) from the lease tracts based on the Colorado well permit database maintained by the Colorado Division of Water Resources (CDWR). The locations of 88 domestic wells and one municipal well in the area are shown in Figure 3.4-7. The number of wells in the vicinity of each of four lease tracts areas is presented in Table 3.4-6. Among 89 wells, some are owned by mining companies as required water rights for mining activities but are not used for the drinking water supply. Examples of these wells include three “domestic” wells and one “municipal” well located at or near Uravan.

TABLE 3.4-4 Depths to Groundwater Observed in USGS Monitoring Wells Located within the Upper Dolores, San Miguel, and Lower Dolores Basins (HUC8)

USGS Well No.	Elevation[a] (ft)	Well Depth (ft)	No. of Observations	Depth to Groundwater (ft)
Upper Dolores				
382025108530401	5,010	91	10	32.78–39.24
381932108542801	5,130	205	10	107.09–132.03
380258108544400	5,450	125	7	12.88–19.96
375733108370501	6,190	65	1	7.25
375504108353201	6,370	115	1	42.5
372742108300901	6,930	240	11	6–12.99
372930108244800	7,110	132	11	7.25–12.51
375115108242601	7,400	80	4	12.97–41
382043109110201	7,535	160	1	50
373515108094901	8,060	63	4	25–37.27
374242108020501	8,955	49	5	36.68–38.33
San Miguel				
382145108434401	5,020	516	1	58
382229108442101	5,032.75	550	1	117
382131108413901	5,115	200	1	106
381452108321201	5,770	290	1	165
381817108335601	5,802	202	5	90.91–97.83
381212108270301	6,230	92	1	17.2
381029108250801	6,470	50	1	32
381028108243001	6,510	53	10	5.47–22.62
380400108300601	6,880	448	2	106–106.35
380844108163601	7,030	58	8	5.48–19.27
380945108164001	7,102	250	1	74.3
380356108274501	7,125	80	4	5.83–22.3
380646108172001	7,220	96.1	1	60.65
380620108131701	7,450	123	1	41.42
381203108103301	7,830	80	10	34–45.15
380512108083401	8,030	80	1	4.45
375606107482801	8,765	116	1	2.67
375604107483001	8,768	89.8	1	4.22
375534108005801	8,960	180	1	41.75
375602108004401	9,230	180	1	73.1
Lower Dolores				
384026108575701	4,595	140	4	30–95.45
384531108470501	6,230	47	4	17.07–20
390421106533400	7,984	40	1	18

[a] Surface elevations of the wells below 5,500 ft are typically located in canyons and along alluvial areas, and wells located above 5,500 ft are typically located on mesas.

Source: USGS (2011b)

TABLE 3.4-5 Monitoring Data Collected at Springs Located within the Vicinity of the DOE ULP Tracts

USGS Site Number	Elevation (ft)	No. of Observations	Temperature (°C)	Conductivity (μS/cm)	Flow (gal/min)
Upper Dolores (HUC8 Basin)					
375433108244301	9,675	1	15	500	–[a]
375435108244401	9,635	1	10	140	–
375802108362601	6,320	1	11.5	3600	15
381957109051601	6,160	3	11–15	315–332	2–5
382446109022101	7,152	1	8	343	–
San Miguel (HUC8 Basin)					
375710108170901	8,230	1	8.5	290	–
375744108252601	8,385	1	7	498	10
375930108274101	7,315	1	7	2,380	
380205108215401	7,798	2	6.5–7.5	420–590	4
380324108214001	7,490	1	6.5	680	2
380439108185901	7,780	1	17	417	0.32
381427108304201	5,795	1	10	1,400	–
381616108212101	6,235	1	8	775	3
381821108455001	6,615	1	16	700	–
381950108202001	8,425	1	16	220	–
382154108160801	9,485	1	28	180	–
382432108312801	7,400	1	9	490	–
382503108363101	6,470	1	16	600	–
382714108304101	9,265	1	15	600	–
382817108325801	9,385	1	5	440	–
Lower Dolores (HUC8 Basin)					
382756108522001	4,750	1	12	860	20
383326108384801	9,180	1	16	522	–
383521108385301	9,300	1	6	372	–

[a] A dash indicates not available.

The database for the public water supply (PWS) system maintained by the Source Water Assessment and Protection Program at CDPHE indicates that none of PWS wells are located within 5 mi (8 km) of the ULP lease tracts (CDPHE 2012c). In general, the aquifer system in the area has a lower production rate at shallow depths and poorer quality (relatively high TDS, sulfate, etc.) with increasing depths.

On the basis of the registered water well records in the lease tract area, the main water-bearing formations include (a) alluvium along the Dolores River, San Miguel River, and Paradox Valley; (b) Dakota Sandstone and Burro Canyon Formation near the top of Mesa; (c) Saltwash Sandstone in the Morrison Member and Entrada Sandstone near the floor of the valley or river canyon; and (d) underlying Navajo Sandstone and Wingate Sandstone (Figure 3.4-6). All the lease tracts are located upgradient from the main rivers. Within the lease tract areas, the primary

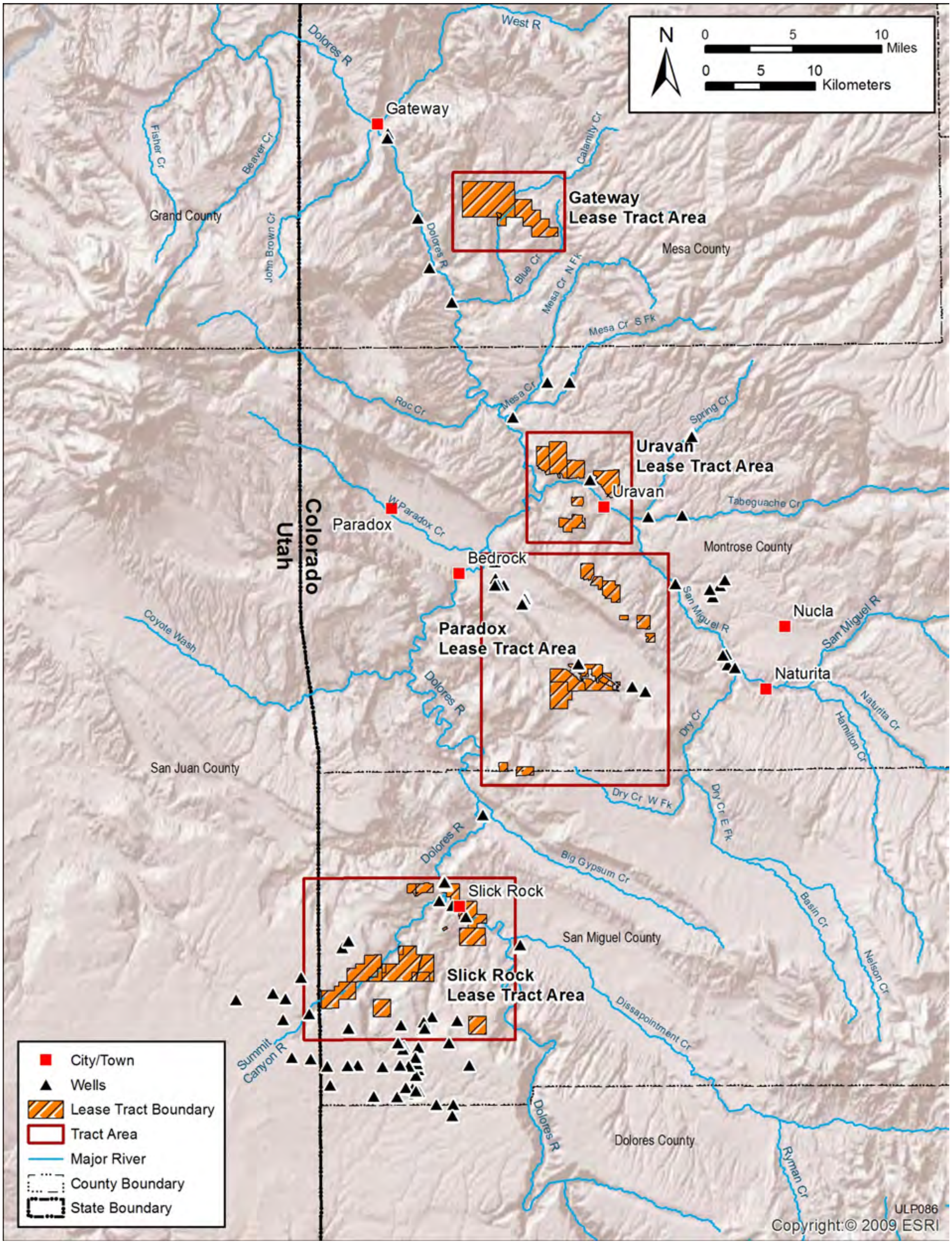

FIGURE 3.4-7 Locations of 88 Domestic Wells and One Municipal Well in and near the Lease Tracts

TABLE 3.4-6 Domestic and Municipal Wells in the Area 5 mi (8 km) from the DOE ULP Lease Tracts

Lease Tract	Number of Wells[a]	Well Depth (ft)	Water Use	Number of Wells within or at the Edge of Lease Tracts[b]	Number of Wells along the Groundwater Flow Pathways[c]
Gateway	5	40–62	Domestic	0	0
Uravan	8	15–204	Domestic	0	1
	1	229	Municipal[d]	0	0
Paradox	22	36–600	Domestic	1	13
Slick Rock	53	24–300	Domestic	5	1

[a] Any wells that are located within 5 mi (8 km) from the lease tracts or along the potential pathways of groundwater flow from the lease tracts to the areas of groundwater discharge. Groundwater quality data from these wells are not available.

[b] Number of wells located within 1,000 ft (300 m) from the lease tracts.

[c] Number of wells located along the potential pathways from lease tracts to the major rivers.

[d] The “Municipal” well (as shown in the database) has been owned by a mining company at Uravan for mining activities and not used for a drinking water supply.

Source: CDWR (http://www.dwr.state.co.us/WellPermitSearch/default.aspx)

source of groundwater recharge is from infiltration of precipitation. The low annual precipitation (12.5 in. [31.8 cm]) and high annual evaporation rate (38 in. [97 cm]; Golder Associates 2009) result in an extremely low quantity of groundwater in the water-bearing formations in the lease tract areas. The highest water well yields are 0.05–1.5 gal/min (0.2–5.7 L/min) (Weir et al. 1983). Some alluvial aquifer along the main rivers outside the lease tract areas may have higher yields above 20 gal/min (76 L/min) (CDWR 2011). The underground mines that penetrate through Alluvium, Dakota, or Burro Canyon water-bearing formations into Saltwash Sandstone were often dry or encountered minimal seepage in the lease tract areas. A “moist” zone identified on the basis of 559 exploration drill holes at Paradox Valley lease tracts area is located in an aquitard, Brushy Basin Member, and inferred as formation water (Cotter Corp. 2012a). Brushy Basin Member (shale interbedded with minor fine-grained sandstone) overlies the ore horizon in the upper Saltwash Sandstone and contains bentonite, preventing water movement (Cotter Corp. 2012a). The uppermost aquifer varies across lease tract areas from Entrada Sandstone, to Navajo Sandstone, Wingate Sandstone (which underlies the confining layers), Summerville Formation, Carmel Formation, and Kayenta Formation, respectively (Figure 3.4-6). In the floodplains of the Dolores River, an alluvial aquifer may directly overlie the Entrada aquifer. A local upward vertical hydraulic gradient from Navajo to Entrada and further to alluvial aquifers may occur in the floodplain as identified in the Slick Rock lease tract area along the Dolores River (DOE 2013).

Information on groundwater quality is limited in lease tract areas. The shallow water-bearing formations (Alluvium, Dakota, and Burro Canyon) are relatively fresh (TDS: 302 to 2,570 mg/L). The water quality of the deep water-bearing formations decreases with increasing depth. The TDS of the Saltwash Member varies from 517 to 13,900 mg/L, and that of the underlying Entrada Sandstone varies from 204 to 14,300 mg/L (Weir et al. 1983). Groundwater from the uranium-containing formation (Saltwash Member) may also have elevated levels of radionuclides and sulfate (DOE 2007; Denison 2008). Although Saltwash Member is unsaturated in most of the ULP lease tracts except for Lease Tract 9 (and possibly 7), groundwater quality in the saturated Saltwash is poor (Cotter Corp. 2012b). The results from one monitoring well completed in the Saltwash Member at Lease Tract 9 over a monitoring period of 2007–2011 indicate that the average concentration is highly elevated for sulfate (2,139 mg/L), selenium (0.68 mg/L), uranium (0.498 mg/L), and radium (5.9 pCi/L for combined radium 226 and 228).

Elevated concentrations of constituents associated with uranium mines have been found in groundwater at the two former uranium mill tailing processing sites, SRE and SRW, located along the Dolores River at Slick Rock, Colorado. These processing sites are located in the floodplain of the Dolores River overlying the shallow alluvial aquifer that resulted in contamination in shallow groundwater. The sites were remediated by removal of tailings and other residual materials as part of the UMTRCA project. The remediation was completed in 1996, and a monitoring program for groundwater was subsequently established. The groundwater cleanup compliance strategy for the sites is natural flushing, combined with institutional controls and compliance monitoring. Groundwater contamination includes selenium and uranium at the SRE site and manganese, molybdenum, nitrate, selenium, and uranium at the SRW site. Most of the contaminants remain on site except for manganese, which exceeds the standard at a downgradient off-site location. The monitoring results are shown in Table 3.4-7.

A few domestic wells (one in Paradox and five in Slick Rock) are within or at the edge of the lease tracts (less than 1,000 ft [310 m] in distance) where groundwater flow might be affected by pumping at these wells. Most of the water wells have shallow to intermediate depths, taking water from alluvial, perched, and/or upper aquifers (sandstone aquifers). Groundwater generally flows directly to the rivers in the alluvial aquifer or flows from the mesa area to springs on the flank of mesas and to the Dolores River and the San Miguel River in upper aquifer. Water wells located along the pathways of groundwater flow from the lease tracts to the areas of groundwater discharge would have relatively high potential to be affected if groundwater within the lease tracts is adversely affected. A total of 15 domestic wells were identified as being located along the potential pathways of groundwater flow, as shown in Table 3.4-6.

3.4.3 Water Management

Water resources and water rights are primarily the responsibility of the CDWR, but several other agencies also address water management issues, including the CDPHE, which oversees stormwater management and water quality issues. Water rights in Colorado are governed by using the Doctrine of Prior Appropriation as the cornerstone; water rights are granted by a water court system and administered by the CDWR (BLM 2001). The DOE ULP lease tracts are located within the boundaries of Divisions 4 and 7 of the CDWR, where both

TABLE 3.4-7 COC Concentrations in Groundwater at SRE and SRW Sites near Slick Rock Lease Tract 13

Standard or Location	COCs (mg/L) Manganese	Molybdenum	Nitrate as NO_3	Selenium	Uranium
Drinking water standard[a]					
MCL			10	0.05	0.030
SMCL	0.05	0.1[b]			
2012 Monitoring Data[c]					
SRE Site					
0300 (upgradient)	–[c]	–	–	–	–
0303 (on site)	–	–	–	–	**0.26**[d]
0305 (on site)	–	–	–	0.014	**0.69**
0307 (on site)	–	–	–	0.0029	**0.59**
0309 (on site)	–	–	–	–	**0.043**
0310 (~600 ft downgradient from site)	–	–	–	–	0.016
SRW Site					
0317 (on site)	–	**0.15**	–	0.0058	–
0318/0318A (on site)	**0.85**	**1.0**	**34**	**2.2**	0.026
0339 (on site)	**1.7**	**1.1**	**44**	**1.8**	**0.030**
0340 (on site)	**5.4**	**1.5**	**320**	**2.4**	**0.045**
0508 (on site)	**2.7**	**1.2**	**200**	**1.1**	**0.080**
0510 (on site)	**3.7**	**0.81**	**210**	**1.1**	**0.083**
0319 (on site)	–	–	–	0.0013	–
0320 (on site)	**0.47**	0.0096	<0.01	0.00033	0.010
0684 (~800 ft downgradient from site)	**0.44**	0.0058	<0.01	0.00012	0.0092

a EPA (2013), http://water.epa.gov/drink/contaminants/index.cfm#List. MCL = maximum contaminant level for primary standard; SMCL = maximum contaminant level for secondary standard.

b UMTRCA MCL.

c Monitoring data are rounded to two significant figures. A dash indicates not analyzed.

d Bold indicates that the concentration at the sampling point is higher than the standard.

surface water and groundwater are considered overappropriated (CDWR 2007). In addition, instream flow water rights (nonconsumptive water rights for ecological benefits, which are administered by the Colorado Water Conservation Board [CWCB]) have been established on segments of the Dolores River and the San Miguel River in the vicinity of the DOE ULP lease tracts (CWCB 2012). Surface waters are the dominant water supply source used in southwestern Colorado, and they are primarily used for irrigation (Table 3.4-8).

TABLE 3.4-8 Water Use by Category for Mesa, Montrose, and San Miguel Counties in 2005

	Daily Water Withdrawals (10^6 gal)		
Category of Water Use	Mesa County	Montrose County	San Miguel County
Irrigation	866.3	679.1	27.3
Public supply	14.6	8.9	0.8
Domestic	0.2	0.4	0.1
Industrial	0.6	1.8	0
Livestock	0.6	0.6	0.1
Mining	0.2	0.6	0
Thermo-electric	43.9	1.7	0
Total surface water withdrawals	925.2	691.5	28.0
Total groundwater withdrawals	1.1	1.5	0.3

Source: Ivahnenko and Flynn (2010)

A major water management issue associated with the Dolores River Basin is the Paradox Valley Unit, which was constructed under authorization of the Salinity Control Act (P.L. 93-320) of 1974 to help alleviate the high TDS concentrations that occur in the Dolores River. The Paradox Valley Unit captures highly saline groundwater in the Paradox Valley area before it enters the Dolores River, treats the saline water, and then disposes of the brine by deep well injection (BOR 2013a). The Paradox Valley Unit consists of a series of shallow production wells that intercept saline groundwater and send it to a surface treatment facility, where the brine is removed and re-injected to the lower groundwater system (Paleozoic carbonate aquifer, Figure 3.4-6) that lies 14,000–16,000 ft (4,300–4,800 m) below the land surface (Chafin 2003). The Paradox Valley Unit was built and operated by the BOR, and it removes 110,000 tons of salt per year at a cost of approximately $71/ton (BOR 2013b). 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).

The BOR also built and operates the McPhee Dam located on the Dolores River, which was built in 1984 as a part of the Dolores Project (BOR 2009). The Dolores Project provides water for irrigation (90,900 ac-ft/yr) and municipal and industrial use (8,700 ac-ft/yr). In addition, the McPhee Dam provides water for recreation and hydroelectric power generation (BOR 2011).

3.5 HUMAN HEALTH

3.5.1 Exposure to Radiation

Terrestrial radioactive materials in rocks and soils are one of the causes of the natural background radiation that people are exposed to daily. The radionuclides of concern in the area where DOE uranium lease tracts are located are mainly uranium-238 and uranium-235 and their decay products. Among the decay products of uranium isotopes, radium-226 is of primary concern because of the radon gas generated during decay. The radon gas generated underground can diffuse through the pore space in soils and become airborne. The hazard from radon arises from its decay products, which are not gases; when they are inhaled, they deposit on the interior surfaces of the lungs and affect human health.

3.5.1.1 Radiation and Its Effects

Radiation, either man-made or naturally occurring, is released when an unstable atom of an element (an isotope) transforms (decays) into a more stable configuration. The radiation that is released can be in the form of particles (e.g., neutrons, alpha particles, beta particles) or waves of pure energy (e.g., gamma rays and x-rays).

Radiation can be broadly classified into two categories: ionizing and non-ionizing. Ionizing radiation is generally more energetic than non-ionizing radiation and can knock electrons out of the molecules with which the particles or gamma rays and x-rays interact, creating ion pairs. Non-ionizing radiation, such as that emitted by a laser, is different in that it does not create ions when it interacts with matter but generally dissipates its energy in the form of heat. The radiation associated with uranium ore is ionizing radiation.

> **Radiation**
>
> The health effect of concern from exposure to radiation at levels typical of environmental and occupational exposures is the inducement of cancer. Radiation-induced cancers may take years to develop following exposure and are generally indistinguishable from cancers caused by other sources. Current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, can result in detrimental health effects (cancer) and that the number of effects produced is in direct proportion to the radiation dose. Therefore, doubling the radiation dose is assumed to result in doubling the number of induced cancers. This approach is called the "linear-no-threshold hypothesis" and is generally considered to result in conservative estimates (i.e., overestimates) of the health effects from low doses of radiation.

Ionizing radiation is a known human carcinogen, and the relationship between radiation dose and health effects is relatively well characterized for high doses of most types of radiation. Some of these cancers can be fatal, and this is referred to as latent cancer fatality (LCF) because the cancer may take many years to develop and cause death. Lower levels of exposure might constitute a health risk, but it is difficult to establish a direct cause-and-effect relationship because a particular effect in a specific individual can be produced by different processes. The features of cancers resulting from radiation are not distinct from those of cancers produced by other causes. Hence, the risk of cancer from chronic exposures of ionizing radiation must be extrapolated from data for increased rates of cancer observed at much higher dose rates. Chronic doses of low-level radiation have not been shown to cause cancer directly, although this assumption has been made in order to be protective.

The amount of energy deposited in ionizing radiation per unit mass of any material is the absorbed dose and is generally expressed in the unit identified as rad (for radiation-absorbed dose). Certain types of radiation are more effective at producing ionizations than others. For the same amount of absorbed dose, alpha particles will produce significantly more biological harm than beta particles or gamma rays. The dose equivalent approach was developed to normalize the unequal biological effects produced by different types of radiation. The dose equivalent is the product of the absorbed dose (in rad) and a quality factor that accounts for the relative biological effectiveness of the radiation. The dose equivalent is typically expressed in a unit identified as rem (for roentgen equivalent man).

The dose delivered to internal organs as a result of radionuclides being systemically incorporated into the body may continue long after intake of the radionuclide has ceased. After being taken into the body, some radionuclides are eliminated fairly quickly, while others are incorporated into tissues or ultimately deposited in bones and can be retained for many years. This internal dose process contrasts with the external dose process, which occurs only when a radiation field is present. The committed dose equivalent was developed to account for doses to internal organs from radionuclides taken into the body. The committed dose equivalent is the integrated dose equivalent to specific organs for 50 years following intake.

The International Commission on Radiological Protection (ICRP) developed the concepts of effective dose equivalent (EDE) and committed effective dose equivalent (CEDE) to account for the differing cancer rates from chronic exposures to radiation by different organs and tissues in the body. The EDE and CEDE are weighted sums of the organ-specific dose equivalents and committed dose equivalents. The weighting factors used in these calculations are based on selected stochastic risk factors and are used to average organ-specific dose equivalents. The total effective dose equivalent (TEDE) is the sum of the EDE for external radiation and the 50-year CEDE for internal radiation. The calculated doses given in the ULP PEIS are the TEDEs, as defined here.

The most common forms of radiation associated with uranium ore are alpha and beta particles and electromagnetic radiation in the form of gamma rays and x-rays. An alpha particle consists of two protons and two neutrons and is identical to the nucleus of a helium atom. Beta particles can be either positive (positron) or negative (negatron); a negatron is identical to an electron. Gamma rays and x-rays have no electrical charge or mass and can travel long distances in air, body tissues, or other materials.

Ionizing radiation can impart sufficient localized energy to living cells to cause cell damage. This damage may be repaired by the cell; the cell may die; or the cell may reproduce other altered cells, sometimes leading to the induction of cancer. An individual may be exposed to radiation from outside the body (external exposure) or, if the radioactive material has entered the body through inhalation or ingestion, from inside the body (internal exposure).

Everyone is exposed to radiation on a daily basis, primarily from naturally occurring cosmic rays, radioactive elements in the soil, and radioactive elements incorporated into the body (such as potassium-40 [K-40]). Man-made sources of radiation include medical x-rays and fallout from previous aboveground nuclear weapons tests and nuclear reactor accidents (such as the accident involving the Chernobyl nuclear reactor in the Soviet Union in 1986). Ionizing radiation causes biological damage only when the energy released during radioactive decay is absorbed by tissue.

Radiation exposures associated with mining uranium ore are expected to be limited to chronic effects. The main health concern associated with chronic exposure to radiation is an increased likelihood of developing cancer, and this impact is assessed in the ULP PEIS. Relatively large doses are required to cause acute effects, and potential mechanisms for such exposures are not expected from activities associated with uranium mining. Acute doses above 25 rad delivered over a short time period can induce a number of deleterious effects, including nausea and vomiting, malaise and fatigue, increased body temperature, blood changes, epilation (hair loss), and temporary sterility; bone marrow changes have not been identified until the acute doses reach 200 rad (Cember 1983). Such exposures are highly unlikely from uranium mining of low-grade ore.

The EPA has developed dose conversion factors (DCFs) for internal and external exposures, and these factors are given in Federal Guidance Report (FGR) 11 (EPA 1988) and FGR 12 (EPA 1993). For internal exposures, the DCF represents the 50-year CEDE per unit intake of radionuclide, and for external exposures, the DCF represents the EDE per unit of time at 1 m (3 ft) above the ground surface per unit of activity concentration of the specified radionuclide. These DCFs given in the two EPA documents are based on the dosimetry models and results given in ICRP 26 (ICRP 1977) and ICRP 30 (ICRP 1979, 1980, 1981). These DCFs were developed on the metabolic and anatomical model of an adult male: the ICRP reference man weighing 70 kg (150 lb).

The ICRP updated its radiation dosimetry models for members of the general public (spanning a range of ages, including adults) in ICRP 72 (ICRP 1996), and the concepts and models included in ICRP 72 are gaining wide acceptance in the scientific community. For the ULP PEIS, the DCFs given in ICRP 72 for adults are used to calculate the doses associated with uranium isotopes and their decay progenies and members of the general public (ICRP 1996). These are the most recent values and provide a reasonable estimate of doses for comparing the various alternatives evaluated in the ULP PEIS.

In addition to estimating the radiation doses (TEDE) for potentially affected individuals, potential collective doses to specific groups of people were also estimated. A collective dose is the sum of the radiation dose each individual in the group received and provides an indication of the potential impact on the group of people as a whole. Other than radiation doses, potential cancer risks associated with radiation exposures were also estimated in this PEIS. For individuals, the estimated cancer risks represent the probabilities of developing a latent fatal cancer due to the radiation each individual received. For a population (i.e., a group of people), the estimated cancer risk represents the amount of latent cancer fatality (LCF) that could occur among the population. The estimated LCF for a population should also be interpreted statistically. For example, if the estimated LCF is 0.006 for a population size of 10,000, this means the average number of deaths for each group of 10,000 people, if the same radiation exposure was applied to many groups of 10,000 people, would be 0.006. In most groups, no one would incur an LCF from the radiation. In a very small percentage of groups (about 0.6%), one LCF would occur. In an extremely small percentage of groups, two or possibly more LCFs would occur. An LCF value of 0.006 for a population can also be viewed as a 0.6% chance of one radiation-induced LCF in that population.

For uranium isotopes and their decay progenies, the LCF risks estimated in the ULP PEIS were obtained by using the EPA slope factors (SFs) from FGR 13 (Eckerman et al. 1999). The SFs are estimated cancer risks per unit intake of radionuclides for internal exposures or per unit time of external exposure associated with a unit radionuclide concentration in a contaminated medium. The SFs for radionuclides were developed by considering the radiation imparted to each critical organ, the age-dependent and organ-specific cancer statistics cause by radiation, and the statistics of life expectancy of the U.S. population. Detailed discussions on the SF methodology can be found in EPA (1994).

An exception to the assessments of radiation doses and cancer risks using DCFs and SFs, respectively, as described above, is the assessment of potential doses and cancer risks associated with radon exposures. Radon is a noble gas generated by the decay of radium that is present in uranium ores and in the natural environment. The risk to human health from radon exposure (through inhalation) is caused by the decay progenies of radon, which are particles and can deposit on the interior surfaces of lung and, potentially, cause a lung cancer. The exposure concentration of radon is usually expressed in terms of working level (WL), which is a measure of the alpha energy released by the short-lived progenies of radon as they decay. Potential exposure to radon is measured in terms of working level month (WLM). One WLM is equivalent to an exposure of 170 hours to a concentration of one WL. UNSCEAR (2008, 2010) recommends that one WLM be equivalent to an effective dose of 506 mrem for workers and 388 mrem for the general public. The different conversions for workers and the general public lie in the different inhalation rates considered for these two groups of receptors. For estimating potential cancer risks, the ICRP (2011) recommends a conversion factor of 5×10^{-4} per WLM.

Another common practice for estimating LCF risks associated with radiation exposures is by converting estimated radiation doses with a dose-to-risk conversion factor. This approach is used in the ULP PEIS for assessing potential LCF risks to different groups of receptors resulting from transportation of uranium ores. The exposures associated with transportation are considered to be mainly from external radiation. The conversion factor relates the radiation dose to the potential number of expected LCFs on the basis of comprehensive studies of groups of people historically exposed to large doses of radiation, such as the Japanese atomic bomb survivors. For the ULP PEIS, a health risk conversion factor of 0.0006 LCF/person-rem was used. This value was identified by the Interagency Steering Committee on Radiation Standards as a reasonable factor to use in the calculation of potential LCFs associated with radiation doses as given in DOE guidance and recommendations (DOE 2003, 2004). This factor means that if a population receives a total collective dose of 10,000 person rem, on average, six additional LCFs will occur among the population.

The LCF estimates provided in the ULP PEIS are in addition to those from other causes. In 2011, the American Cancer Society estimated 572,000 people would die of cancer in the United States, and about three times that number (1,600,000) would be diagnosed with cancer (ACS 2011). Also, the likelihood of developing an LCF from background radiation is about 0.03, based on an average background radiation dose rate of 620 mrem/yr as given by the National Council on Radiation Protection and Measurements (NCRP 2009), a 70-year lifetime, and an LCF factor of 0.0006/rem. The estimate of 620 mrem/yr for background radiation (given in NCRP 2009) includes about 310 mrem/yr from natural sources and 310 mrem/yr from man-made sources, including medical procedures and consumer products. This value is significantly larger than the previous NCRP estimate of 360 mrem/yr primarily because of the increased use of ionizing radiation in diagnostic and interventional medical procedures (NCRP 2009). In the ULP PEIS, estimates of LCFs are given to one significant figure. Table 3.5-1 lists the uranium-mining-related regulations and guidelines for workers and members of the public.

The radionuclides present in the uranium ore occur naturally in the environment and already contribute to background radiation levels. These radionuclides include isotopes of uranium, thorium, and radium and their radioactive decay products. The radiological impacts given in the ULP PEIS are incremental to those from natural and man-made sources of radiation; that is, the impacts are those that an average individual would incur in addition to the 620 mrem/yr noted above. The radiological impacts from uranium ore mining and transportation are analyzed and reported separately without consideration of the background radiation contribution.

A major source of the dose from natural background radiation is indoor radon gas, largely because of its short-lived decay products. Most of this dose is due to radon-222 (and its progeny products), which is a decay product of radium-226, itself a decay product of uranium-238. The doses from the other two naturally occurring isotopes of radon (radon-219 and radon-220) are much lower than the dose from radon-222. The annual radiation dose from the decay products of radon-222 is estimated to be about 200 mrem/yr (NCRP 2009). This dose is from naturally occurring radon gas in soil, rock, and water that infiltrates into houses; in the houses, the gas's decay products (which are charged particles) can build up and attach to dust particles in the air.

3.5.1.2 Baseline Radiological Dose and Risk

The radiation exposure an individual could incur by working or living near the ULP lease tracts could be greater than the national average exposure from background sources, which was estimated to be about 310 mrem per year per person (NCRP 2009). Table 3.5-2 compares these radiation dose estimates with the national average doses.

The information in Table 3.5-2 provides a baseline for gauging human health consequences that could result from the potential increase in human radiation exposures associated with the alternatives evaluated in the ULP PEIS. An additional perspective on background radiation levels in this area can be obtained by studying the environmental monitoring data collected for the proposed Piñon Ridge Mill. The plant would be located in Paradox Valley in western Montrose County, approximately 7 mi (11 km) east of the

TABLE 3.5-1 Uranium-Mining-Related Regulations and Guidelines for Workers and Members of the Public

Regulation/Standard/Guideline	Worker	Member of the Public
40 CFR 61.2,2 Subpart B: National Emission Standards for Radon Emissions from Underground Uranium Mines[a] (Clean Air Act)		Emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed an effective dose equivalent of 10 mrem/yr.
40 CFR 61.92, Subpart H: National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities (Clean Air Act)		Emissions of radionuclides to the ambient air from DOE facilities shall not exceed an effective dose equivalent of 10 mrem/yr.
40 CFR 440.32, Subpart C: Uranium, Radium, and Vanadium Ores Subcategory (Clean Water Act, National Pollution Discharge Elimination System)		Radium-226 (dissolved) mine drainage in pCi/L: 1-day maximum, 10; 30-day average radium-226 (total) mine drainage in pCi/L: 1-day maximum, 30; 30-day average, 10
30 CFR 57.5039: Maximum Permissible Concentration (Federal Mine Safety and Health Act)	Persons shall not be exposed to air containing concentrations of radon progeny exceeding 1.0 WL[b] in active workings.	
30 CFR 57.5038: Annual Exposure Limits (Federal Mine Safety and Health Act)	4 WLM in any calendar year	
30 CFR 57.5046: Protection against Radon Gas (Federal Mine Safety and Health Act)	Where radon progeny concentrations exceed 10 WL, respirator protection against radon gas shall be provided in addition to protection against radon progeny.	
30 CFR 57.5047: Gamma Radiation Surveys (Federal Mine Safety and Health Act)	Individual gamma radiation exposure shall not exceed 5 rem/yr.	
29 CFR 1910.1000, Table Z-1: Limits for Air Contaminants (Occupational Health and Safety Act)	Averaged over an 8-h workday: soluble uranium: 0.05 mg U/m^3 insoluble uranium: 0.25 mg U/m^3	
10 CFR 835.202: Occupational Dose Limits for General Employees (DOE)	Total effective dose of 5 rem (0.05 Sv). The sum of the equivalent dose to the whole body for external exposures and the committed	

TABLE 3.5-1 (Cont.)

Regulation/Standard/Guideline	Worker	Member of the Public
10 CFR 835.202(Cont.)	equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rem (0.5 Sv). An equivalent dose to the lens of the eye of 15 rem (0.15 Sv). The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rem (0.5 Sv).	
10 CFR 835.208: Limits for Members of the Public Entering a Controlled Area (DOE)		Total effective dose limit for members of the public exposed to radiation and/or radioactive material during access to a controlled area is 0.1 rem (0.001 Sv) per year.
DOE Order 458.1: Radiation Protection of the Public and the Environment, Section 4.b		Total effective dose exceeding 100 mrem (1 mSv) per year, equivalent dose to the lens of the eye exceeding 1,500 mrem (15 mSv) per year, or equivalent dose to the skin or extremities exceeding 5,000 mrem (50 mSv) per year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose.
National Institute for Occupational Safety and Health recommendation	Averaged for a workday of up to 10 hours: soluble uranium: 0.05 mg U/m^3 insoluble uranium: 0.2 mg U/m^3 Exposure to soluble uranium should not exceed 0.6 mg U/m^3 for more than 15 minutes.	

[a] Applies if mined, will mine, or is designed to mine over 100,000 tons of ore during the life of the mine; or has had or will have an annual ore production rate greater than 10,000 tons, unless the mine will not exceed total ore production of 100,000 tons during the life of the mine.

[b] Working level (WL) is defined as any combination of the short-lived radon progeny in 1 L of air that will result in ultimate emissions of 1.3×10^5 MeV (million electron volts) of potential alpha energy, and exposure to these radon progeny over a period of time is expressed in terms of working level months (WLMs). Inhalation of air containing a radon daughter concentration of 1 WL for 173 hours results in an exposure of 1 WLM (30 CFR 57.2).

TABLE 3.5-2 Comparison of Radiation Exposures from Natural Background Sources near ULP Lease Tracts Versus the U.S. National Average

Source	Exposure Pathway	Radiation Dose (mrem/yr) U.S. Average Natural Background[a]	Near ULP Lease Tracts
Cosmic and cosmogenic radioactivity[b]	External radiation	30	68[c]
Terrestrial radioactivity[d]	External radiation	20	74[c]
Internal radioactivity[e]	Food ingestion	30	30[f]
Radon and airborne particulates	Inhalation	230	260[g]
Rounded total		310	430

[a] Data for the national averages are from NCRP (2009).

[b] Radiation exposures are from cosmic rays from outer space filtered by the atmosphere.

[c] Based on data for Blanding, Utah.

[d] Radiation exposures are caused by external radiation from radioactive materials in soils, primarily the uranium and thorium decay series.

[e] The internal dose accounts for radiation caused by radionuclides (mainly K-40) deposited inside human bodies through food ingestion.

[f] Radiation exposure from internal radioactivity for the ULP lease tracts is expected to be about the same as the national average.

[g] Based on IUC (2003). The radiation dose is primarily from radon exposure.

unincorporated community of Bedrock and 12 mi (19 km) west of the town of Naturita (Figure 3.5-1). The environmental data collected during 2007–2009 (Edge Environmental, Inc. 2009) include samples of on-site and off-site surface soils, surface water, groundwater, radon, airborne radionuclides, and ambient gamma levels.

To estimate potential radiation exposures from background sources by using the monitoring data, two hypothetical exposure scenarios were developed. The first one considers an individual who lives near the ULP lease tracts and is exposed to radiation for 24 hours a day and 350 days a year. This individual was also assumed to pump out groundwater from a well for drinking. Potential dose estimates reveal that this individual could receive a dose of about 120 mrem/yr from ambient gamma radiation contributed by terrestrial radioactivity and cosmic and cosmogenic radioactivity, a dose of about 290 mrem/yr from inhalation of radon, a dose of about 0.47 mrem/yr from breathing in airborne radionuclides that are contained in resuspended dust particles, and a dose of about 25 mrem/yr from drinking untreated well water. In total, this hypothetical resident could receive a radiation dose of up to 430 mrem/yr, which is about the same as the total listed in Table 3.5-2. Inhalation of radon is the predominant exposure pathway, followed by the external gamma radiation pathway. The contribution to the dose from the inhalation of dust particles is insignificant compared with that from the inhalation of radon. The dose estimate for drinking contaminated groundwater is conservative (i.e., it is greater than the

FIGURE 3.5-1 Location of the Proposed Piñon Ridge Mill (Edge Environmental Inc. 2009)

dose that would actually be incurred by an on-site resident), because (1) no treatment was assumed for the groundwater, (2) the water quality and yield of many wells in the area do not meet the requirements for making them a potable water source, and (3) the estimated dose is associated with the monitoring well that would result in the greatest exposure.

The second hypothetical scenario considers a recreationist who camps, bikes, and hunts in the uranium lease tracts. In addition to camping, biking, and hunting, this recreationist was also assumed to raft, float, and fish in the Dolores River. An exposure duration of 14 days per year was assumed for the inland activities. For the surface water activities, an exposure duration of 100 hours per year was assumed. When the same monitoring data collected by Energy Fuels Resources Corp. were used, it was estimated that the recreationist would receive a total dose of about 10.3 mrem/yr from inland activities, with 6.1 mrem/yr coming from ambient gamma radiation, 2.4 mrem/yr from inhalation of radon, 0.03 mrem/yr from inhalation of radionuclides contained in the airborne dust particles, and 1.8 mrem/yr from ingestion of wildlife animals caught from hunting activities. For dose estimates, an ingestion rate of 100 lb (45 kg) of deer meat was assumed. For the activities in Dolores River, a total dose of 3.3 mrem/yr was estimated, 3.1 mrem/yr resulting from ingestion of fish caught from the river and 0.24 mrem/yr resulting from ingestion of the surface water, which was assumed to be used for cooking the fish. An ingestion rate of 2.6 gal (10 L) for water and 2.2 lb (1 kg) for fish was assumed for dose calculation. A much higher dose for ingestion of fish was calculated than for ingestion of water because of the accumulation potential of radionuclides in fish. While aquatic activities could also occur in the San Miguel River, monitoring data for the San Miguel River are not available for this analysis. Because conservative assumptions were made to estimate the exposures associated with the Dolores River, the estimated results with the Dolores River are considered to be also the upper bound of the potential exposures that could be incurred with the San Miguel River. (For comparison with these dose estimates, the DOE radiation dose limit for the general public resulting from DOE activities is 100 mrem/yr for an individual from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose [DOE 2011b].)

3.5.2 Exposure to Hazardous Chemicals

In addition to resulting in radiation exposures, uranium could also affect human health because of its chemical toxicity. Another chemical of concern is vanadium, which is found to have higher ore concentrations than uranium.

3.5.2.1 Chemical Hazards

Human exposure to chemicals in air, water, and soil may occur through ingestion, inhalation, or contact with skin. Methods used to assess hazards associated with chemical exposures may simply involve a comparison of concentrations in air, water, or soil with health-risk-based standards or guidelines available from state and Federal agencies. More detailed assessments estimate the extent of human exposure due to a particular source and compare that exposure with benchmark levels for noncarcinogenic risks [“hazard index” (HI) approach] or benchmarks for carcinogenic risks. The chemicals of concern in the ULP PEIS are uranium and vanadium, both of which are noncarcinogens.

In estimating noncancer risks (i.e., noncancer adverse health outcomes, such as kidney damage or developmental impairment) due to chemical exposures, the first step is to estimate the chemical concentration in air, water, and/or soil, either present from natural sources or attributable to anthropogenic sources. The concentration estimate is combined with an estimate of the human intake level to produce a chemical-specific daily intake estimate. (The intake level is usually from the upper end of the expected range of possible intakes in order to make sure risk estimates account for individuals who have unusually high intakes.) Estimated intakes are compared with chemical-specific reference doses. The reference doses are developed by the EPA for many commonly used chemicals and are based on a broad range of toxicological data. See the text box for further information on risk estimation procedures.

3.5.2.2 Baseline Chemical Risks

Potential chemical risks that could result from potential exposure to uranium and vanadium were assessed by comparing the estimated exposures with threshold values. The threshold values used are reference concentrations (RfCs) for inhalation exposures and reference doses (RfDs) for ingestion exposures. On the basis of the monitoring data obtained by Energy Fuels Resources Corp. (Edge Environmental, Inc. 2009) and by using the same exposure parameters as those used for calculating radiation doses, HIs (sum of HQs for exposures to uranium and vanadium) for the inhalation of particulates and ingestion of water, fish, and wildlife pathways were calculated (Table 3.5-3). The estimates indicate that potential risks from inhaling suspended dust particles containing the uranium and vanadium

Key Concepts in Estimating Risks from Low-Level Chemical Exposures

Reference Dose

Oral reference doses and inhalation reference concentrations (RfDs and RfCs, respectively) have been developed by the EPA for estimating the noncarcinogenic effects of substances. The RfD and RfC provide quantitative information for use in risk assessments for an estimate of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Hazard Quotient (HQ)

- A comparison of the estimated intake level or dose of a chemical with its reference dose.
- Expressed as a ratio of estimated intake level to reference dose.
- Examples:
  - The EPA reference level (reference dose) for ingestion of soluble compounds of uranium is 0.003 mg/kg of body weight per day.
  - If a 150-lb (70-kg) person ingested 0.1 mg of soluble uranium per day, the daily rate would be 0.1 ÷ 70 ≈ 0.001 mg/kg, which is below the reference dose and thus unlikely to cause adverse health effects. This would yield a hazard quotient of 0.001 ÷ 0.003 = 0.33.

Hazard Index

- Sum of the hazard quotients for all chemicals to which an individual is exposed.
- Used as a screening tool. A value of less than one indicates that the exposed person is unlikely to develop adverse human health effects. A value of more than one, however, does not necessarily mean adverse health effects will occur, because different chemicals may react differently in the human body (i.e., they may have different, nonadditive kinds of toxicity).

TABLE 3.5-3 Estimated Radiation and Chemical Exposures for Receptors in the DOE Lease Tracts Based on Environmental Monitoring Data from Energy Fuels Resources Corp.[a]

Receptor	Radiation Source	Exposure Pathways	Dose to Individual (mrem/yr)	Total Hazard Index
Recreationist[b]	Ambient gamma radiation (including terrestrial radioactivity and cosmic and cosmogenic radioactivity)	External radiation and air submersion	6.05[c]	NA[d]
	Radon	Inhalation	2.41[e]	NA
	Contaminated airborne dust particles	Inhalation	0.031[f]	3.4×10^{-5} [g]
	Contaminated wildlife animals	Ingestion	1.78[h]	0.26[i]
	Contaminated surface water	External radiation and ingestion while rafting/boating/fishing in Dolores River	<0.24[j]	0.002[i]
	Contaminated fish	Ingestion	<3.07[k]	0.03[i]
Resident[l]	Ambient gamma radiation (including terrestrial radioactivity and cosmic and cosmogenic radioactivity)	External radiation and air submersion	121[c]	NA
	Radon	Inhalation	288[e]	NA
	Contaminated airborne dust particles	Inhalation	0.47[f]	8.6×10^{-4} [g]
	Contaminated groundwater	Ingestion	<25[m]	<0.66[i]

Footnotes on next page.

1 **TABLE 3.5-3 (Cont.)**

[a] The environmental monitoring data were obtained from Edge Environmental, Inc. (2009).

[b] The recreationist scenario considers a receptor spending a total of 14 days per year camping, biking, or hunting in the DOE lease tract and 100 hours per year rafting, floating, or fishing in the Dolores River.

[c] The external dose was estimated based on the average monitoring data from five different monitoring stations installed to measure ambient gamma radiation. A conversion factor of 0.9 rem/per roentgen or R was used to convert the measured exposure to radiation dose. A shielding factor of 0.7 was assumed for indoor exposure.

[d] Exposure pathway is not applicable.

[e] The radon inhalation dose was calculated based on the average measured Rn-222 concentration of 1.4 pCi/L. A soil concentration corresponding to the measured radon concentration was derived with the RESRAD computer code (Yu et al. 2001), which was then used to calculate the potential outdoor and indoor radon exposures. For a resident, the resulting outdoor dose was 20.7 mrem/yr, and the resulting indoor dose was 267 mrem per yr. For a recreationist, the resulting dose was 2.4 mrem/yr, considering outdoor exposure. A dose conversion factor of 388 mrem per working level month (WLM) (UNSCEAR 2010) was used to estimate the radon dose.

[f] The radiation dose from inhalation of dust particles was calculated with the monitoring data for airborne radionuclide concentrations and ICRP-60 dose conversion factors (ICRP 1991). An inhalation rate of 8,000 m^3/yr and a dust filtration factor of 0.4 for indoor exposure were assumed. The average radiation dose associated with the concentrations measured for each radionuclide at each monitoring station was calculated first. The individual doses were then added together to obtain the total dose for each monitoring station. The maximum among the five monitoring stations was then reported in this table.

[g] The total inhalation HI was the sum of the HQs for exposures to uranium and vanadium. The vanadium air concentration was assumed to be five times the uranium concentration; this ratio was selected on the basis of the mining production rate of vanadium versus that of uranium. The RfCs used in the calculation were 0.0001 mg/m^3 for V_2O_5 (ATSDR 2012) and 0.0008 mg/m^3 for uranium (ATSDR 2012).

[h] The radiation dose was estimated by assuming the recreationist hunted down a deer and took it home for consumption. The soil concentration derived for radon exposures (see note e above) and an ingestion rate of 100 lb (45.4 kg) were used in the RESRAD calculation. The RESRAD default radionuclide transfer factors for meat were used as surrogates to obtain the radionuclide concentrations in the tissues of deer.

[i] The total ingestion HI was the sum of the HQs for exposures to uranium and vanadium. The reference doses (RfDs) used in the calculation were 0.009 mg/kg-d for V_2O_5 from the Integrated Risk Information System (IRIS) (EPA 2012a) and 0.003 mg/kg-d for uranium, also from IRIS.

Footnotes continued on next page.

TABLE 3.5-3 (Cont.)

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[j] The radiation dose was estimated by using the maximum measured concentration of each radionuclide in the Dolores River. The radiation dose estimated includes exposure from external radiation, assuming the receptor sits inside a boat in the middle of the river, and from ingestion of surface water (used for cooking), assuming a total ingestion rate of 10 L/yr.

[k] The radiation dose was estimated by assuming the recreationist caught fish from the Dolores River and cooked the fish with river water. An ingestion rate of 2.2 lb (1 kg) was assumed in the RESRAD dose calculation. Because of the high accumulation potential of radionuclides in fish tissue, the radiation dose calculated for fish ingestion is much higher than that calculated for water ingestion.

[l] The resident scenario assumes a receptor stays in the uranium lease tract for 350 days per year and uses groundwater for drinking.

[m] The radiation dose was obtained with the measured groundwater concentrations from different monitoring wells and ICRP-60 dose conversion factors (ICRP 1991). The radiation dose associated with the average concentrations for each monitoring well was calculated, and the maximum value among the monitoring wells was then reported in this table. A water ingestion rate of 700 L/yr was assumed for the dose calculation.

compounds would be very small. The potential exposures would result primarily from ingestion; with an HI of 0.29 for the recreationist scenario and an HI of 0.66 for the resident scenario. Because the hazard index is less than 1 for all pathways combined for both scenarios, potential adverse effects on human health are not expected from exposures to the uranium and vanadium in the background environment.

3.6 ECOLOGICAL RESOURCES

3.6.1 Vegetation

An ecoregion is an area in which there is a general similarity in ecosystems. Ecoregions are characterized by the spatial patterns and compositions of biotic and abiotic features. EPA has mapped ecoregions of North America features in a hierarchy of four levels, with Level I being the broadest classification and Level IV being the most local classification. Each level consists of subdivisions of the previous (next-highest) level. The ULP lease tracts are located primarily within the Level III Ecoregion 20 (Colorado Plateaus); however, the northeast portion of lease tract 26 occurs within Ecoregion 21 (Southern Rockies) (Chapman et al. 2006).

The Colorado Plateaus ecoregion is characterized by a rugged tableland of mesas, plateaus, mountains, and canyons, often with abrupt changes in local relief (Chapman et al. 2006). Habitat types within this ecoregion include Douglas-fir forest, piñon-juniper woodlands, and Gambel oak, as well as sagebrush steppe, desert shrubland, and salt desert scrub. Within the Colorado Plateaus ecoregion, there are three Level IV ecoregions in which ULP lease tracts are located: Monticello-Cortez Uplands and Sagebrush Valleys; Shale Deserts and Sedimentary Basins; and Semiarid Benchlands and Canyonlands. Figure 3.6-1 shows Level IV ecoregions in the area encompassing the ULP lease tracts. Each of the tracts is located, at least in part, within the Level IV Ecoregion 20c Semiarid Benchlands and Canyonlands. In this ecoregion, sandy soils support sagebrush steppe with warm season grasses, such as galleta grass (*Pleuraphis jamesii*) and blue grama (*Bouteloua gracilis*), and shrubs, primarily black sagebrush (*Artemisia nova*), winterfat (*Krascheninnikovia lanata*), Mormon tea (*Ephedra viridis*), fourwing saltbush (*Atriplex canescens*), and shadscale (*Atriplex confertifolia*). Stony soils support piñon-juniper woodlands of two-needle piñon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Scattered woodlands of Gambel oak (*Quercus gambelii*) occur at the higher elevations. Woodlands have expanded beyond their original range because of fire suppression and erosion. The average annual precipitation is about 10 to 18 in. (25 to 46 cm) in lower areas and 20 to 25 in. (51 to 64 cm) at the highest elevations.

Western portions of Lease Tracts 11, 11A, and 12 include the Monticello-Cortez Uplands and Sagebrush Valleys Level IV ecoregion. Within this ecoregion, sagebrush steppe occurs on broad areas of silty soils and is characterized by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), western wheatgrass (*Pascopyrum smithii*), and Indian ricegrass (*Achnatherum hymenoides*) (Chapman et al. 2006). Scattered piñon-juniper woodlands occur on shallow or stony soils along the rims of benches and minor escarpments. Two-needle piñon pine, bitterbrush (*Purshia tridentata*), and serviceberry (*Amelanchier* sp.) also occur in some areas.

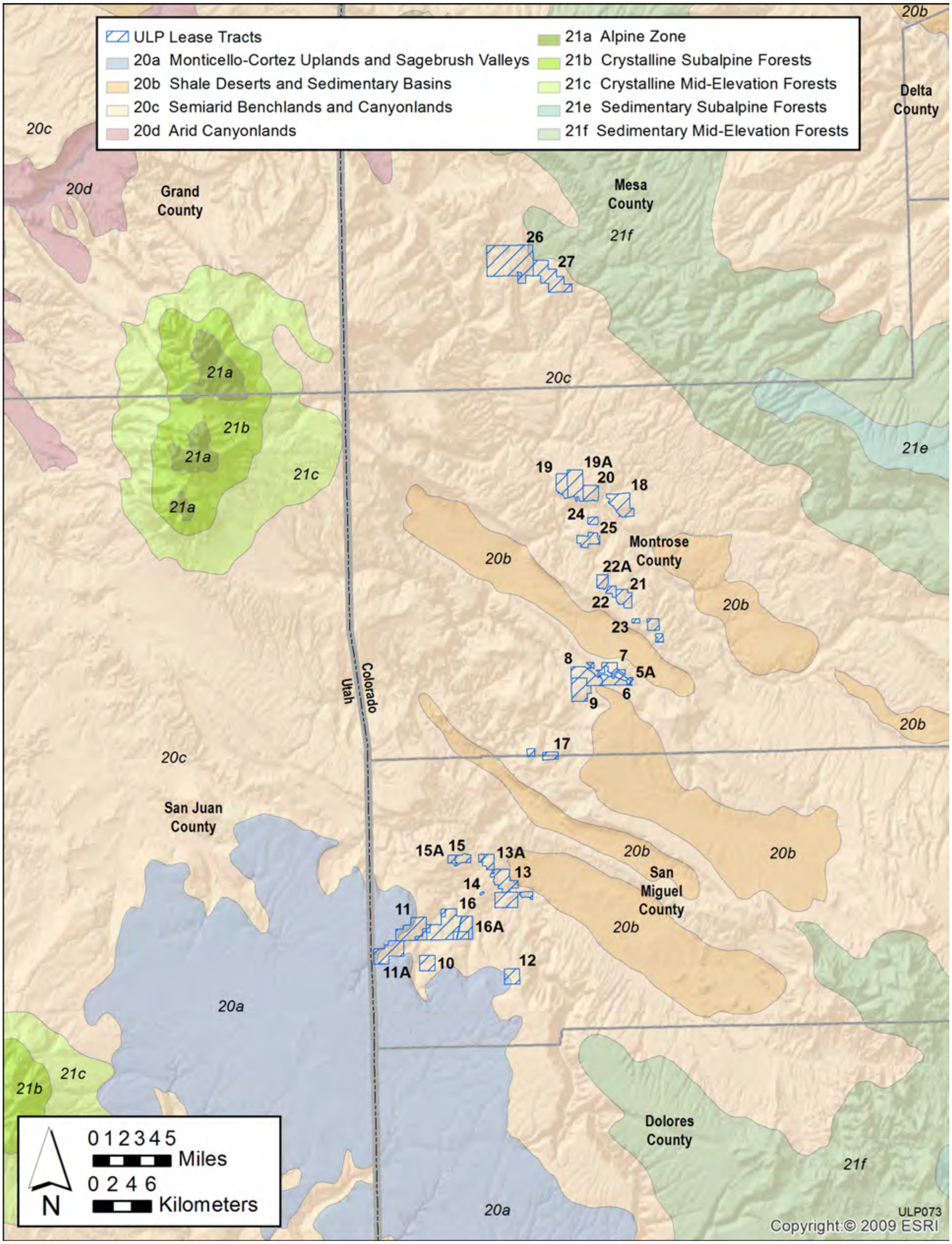


FIGURE 3.6-1 Level IV Ecoregions in the Vicinity of DOE ULP Lease Tracts (Source: Chapman et al. 2006)

A small area in the eastern portion of Lease Tract 13 is located within the Shale Deserts and Sedimentary Basins Level IV ecoregion. This arid ecoregion generally supports sparse mat saltbush shrubland and salt desert scrub (Chapman et al. 2006). Characteristic species include mat saltbush (*Atriplex corrugata*), shadscale, Nuttall's saltbush (*Atriplex nuttallii*), blackbrush (*Coleogyne ramosissima*), fourwing saltbush, Wyoming big sagebrush, bud sagebrush (*Picrothamnus desertorum*), galleta grass, and desert trumpet (*Eriogonum inflatum*). The alkaline soils of floodplains support greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), seepweed (*Suaeda* sp.), and shadscale. Badland areas support little to no vegetation.

A small portion in the northeast corner of Lease Tract 26 is located within the Sedimentary Mid-Elevation Forests Level IV ecoregion of the Southern Rockies Level III ecoregion. This ecoregion supports ponderosa pine (*Pinus ponderosa*) forest, aspen (*Populus tremuloides*) forest, and Gambel oak woodland (Chapman et al. 2006). Some areas include mountain mahogany (*Cercocarpus* sp.) and two-needle piñon pine. Shrubs occurring within the habitats of this ecoregion include antelope bitterbrush (*Purshia tridentata*), fringed sage (*Artemisia frigida*), serviceberry, and snowberry (*Symphoricarpos* sp.). Grasses within these habitats include Arizona fescue (*Festuca arizonica*), bluegrass (*Poa* sp.), junegrass (*Koeleria macrantha*), needlegrasses (*Stipa* spp.), mountain muhly (*Muhlenbergia montana*), pine dropseed (*Blepharoneuron tricholepis*), and mountain brome (*Bromus marginatus*).

Land cover types described and mapped under the Southwest Regional Gap Analysis Project (USGS 2004) were used to evaluate plant communities in and near the lease tracts (Figures 3.6-2 through 3.6-5). Each cover type encompasses a range of similar plant communities or other land cover (e.g., quarries, mines, gravel pits, and oil wells). Land cover types occurring within the lease tracts are listed in Table 3.6-1. Summary descriptions of land cover types are given in Table 3.6-2. The predominant land cover type in most of the tracts is Colorado Plateau Piñon-Juniper Woodland. Large areas of Inter-Mountain Basins Big Sagebrush Shrubland occur in Lease Tracts 9, 12, 19A, 20, and 21; Colorado Plateau Piñon-Juniper Shrubland occurs over large areas of Lease Tracts 13, 13A, 14 (T1), and 18; and large areas of Rocky Mountain Gambel Oak-Mixed Montane Shrubland occur in Lease Tracts 10 and 12. While Cultivated Cropland is identified as occurring in many of the lease tracts, it is unlikely that pasture or cultivated lands are present.

Lease Tracts 19A, 20, and 21 consist primarily of a composite of Colorado Plateau Piñon-Juniper Woodland and Inter-Mountain Basins Big Sagebrush Shrubland. Lease Tracts 13A, 14, and 18 are primarily composed of Colorado Plateau Piñon-Juniper Woodland and Colorado Plateau Piñon-Juniper Shrubland. Lease Tract 12 is a mosaic of Inter-Mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, and Rocky Mountain Gambel Oak-Mixed Montane Shrubland. Lease Tract 13 is a mosaic of Colorado Plateau Piñon-Juniper Woodland, Colorado Plateau Piñon-Juniper Shrubland, Inter-Mountain Basins Greasewood Flat, Inter-Mountain Basins Shale Badland, and Inter-Mountain Basins Mixed Salt Desert Scrub.

Noxious weeds and invasive plant species occur in each of the counties containing uranium lease tracts. The Colorado Department of Agriculture (CDA) maintains an official state list of weed species that are designated noxious species (CDA 2011). Table 3.6-3 provides a

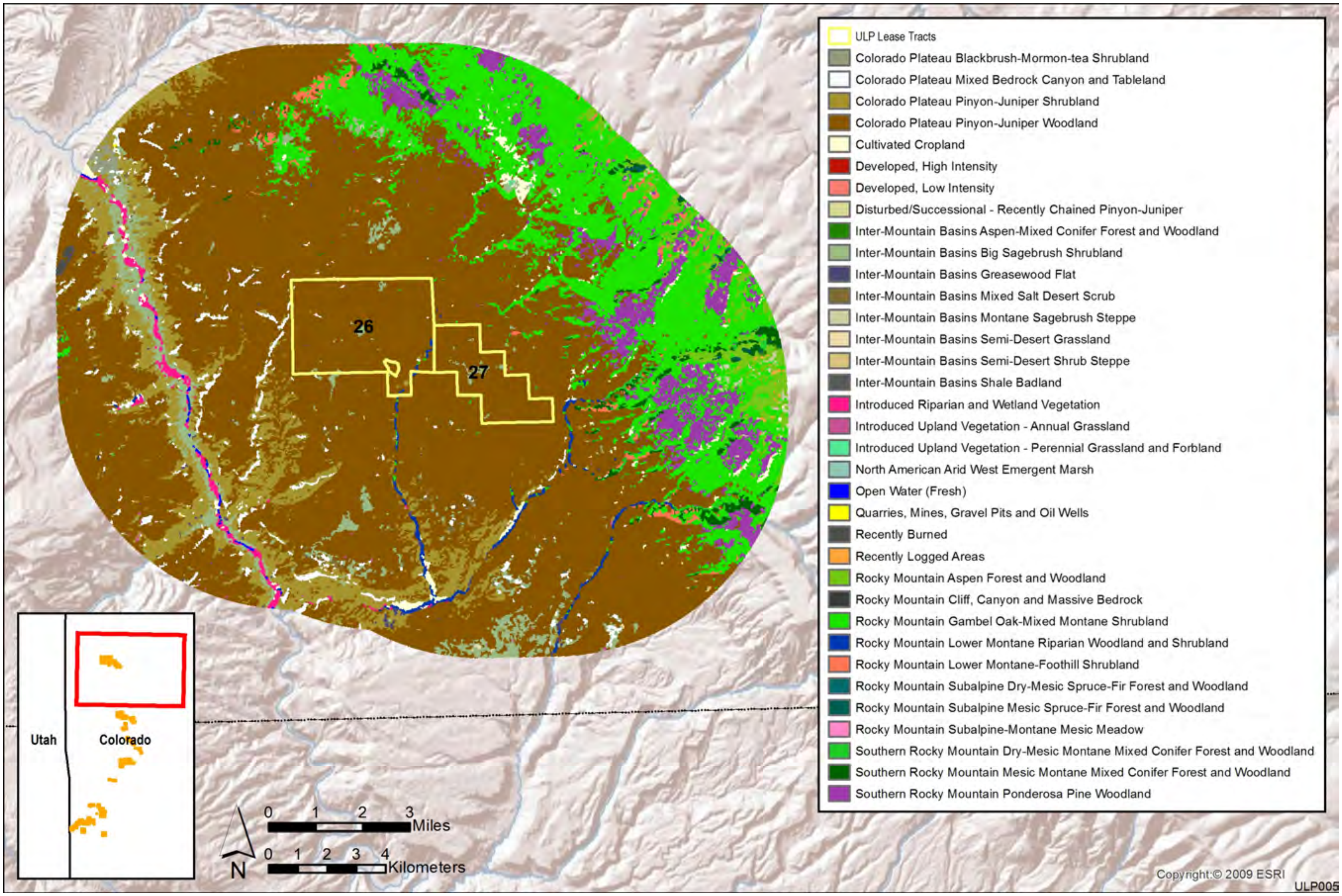


FIGURE 3.6-2 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 26 and 27 (USGS 2004)

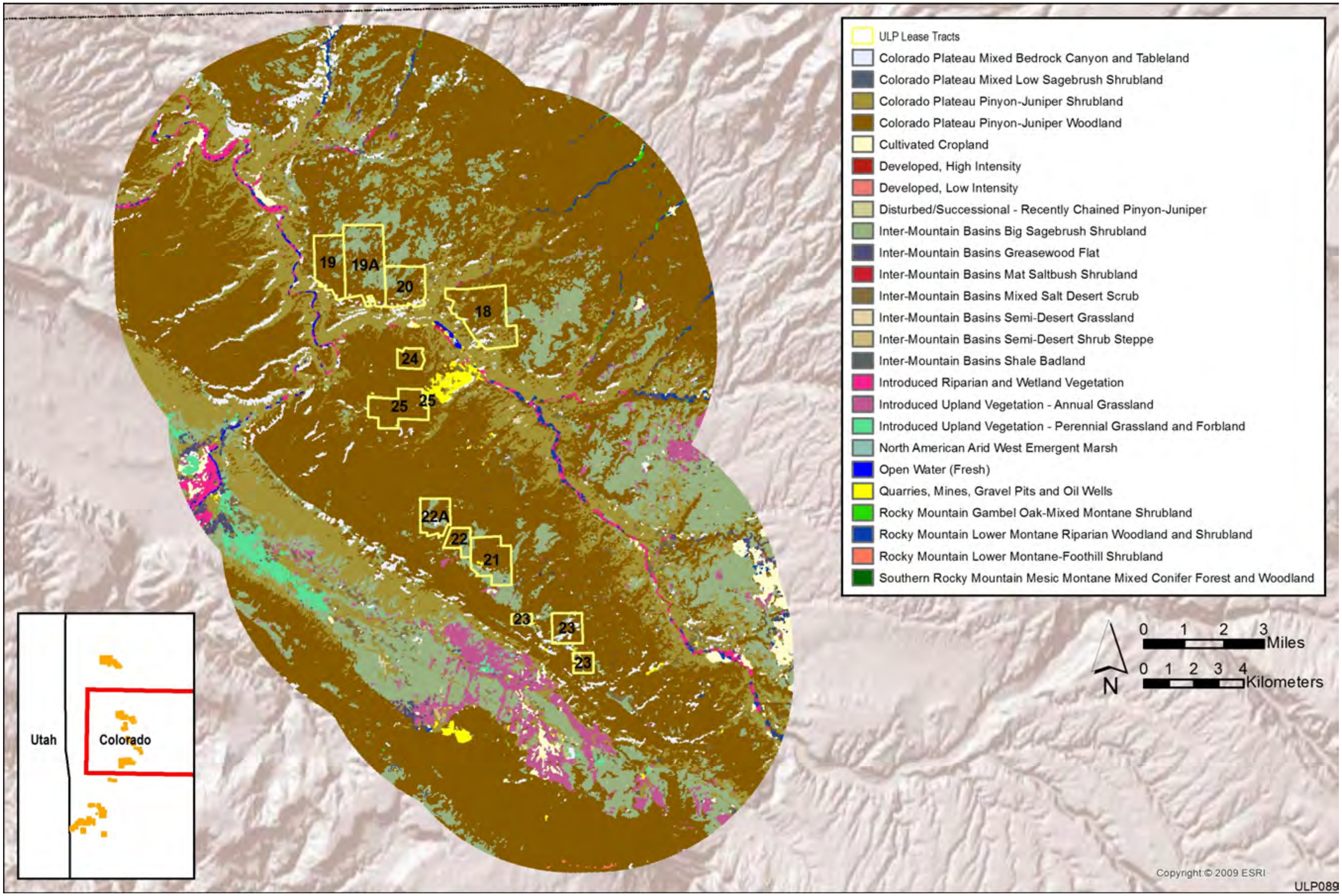


FIGURE 3.6-3 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 18–20, 24, and 25 (USGS 2004)

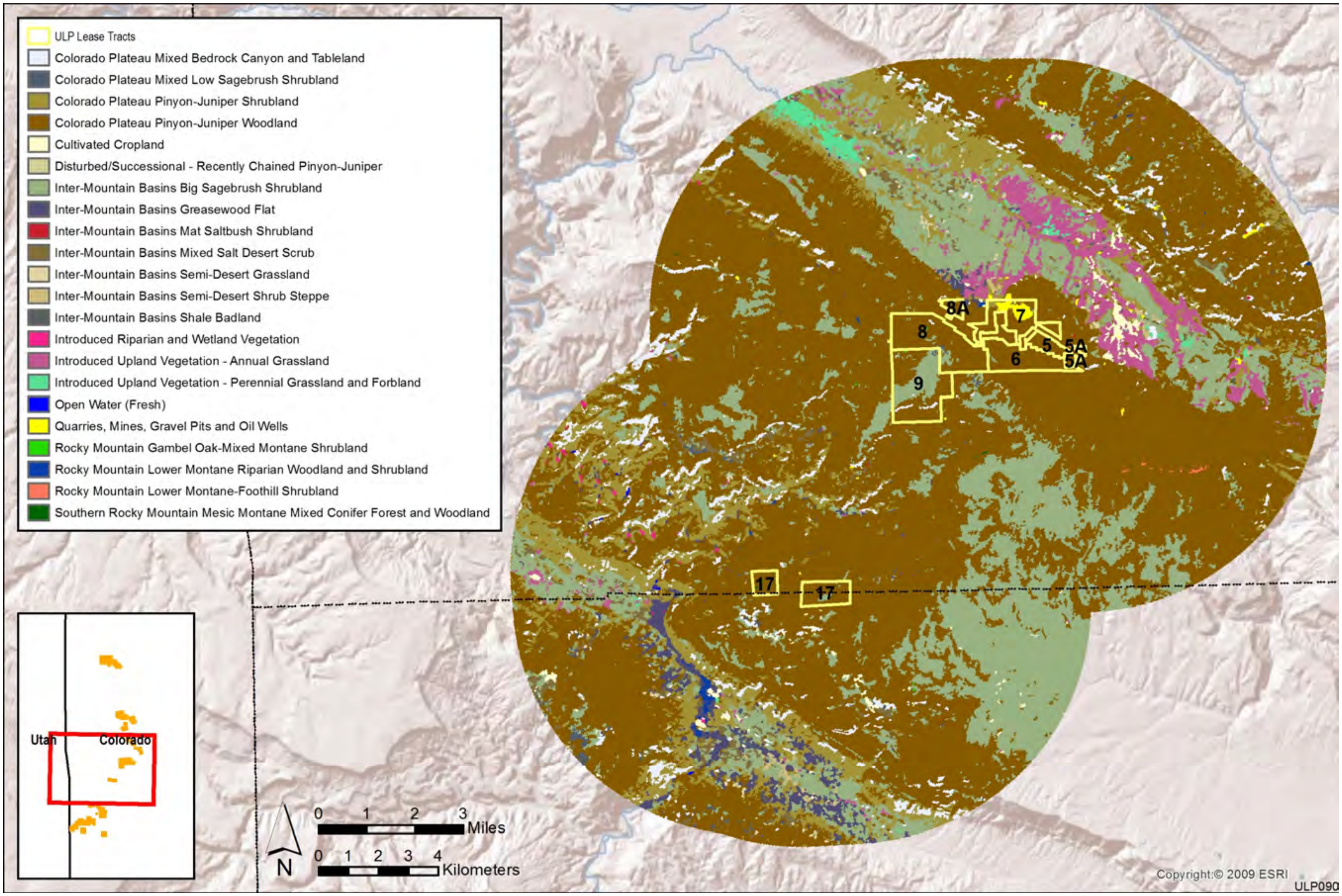


FIGURE 3.6-4 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 5–8, 17, and 21–23 (USGS 2004)

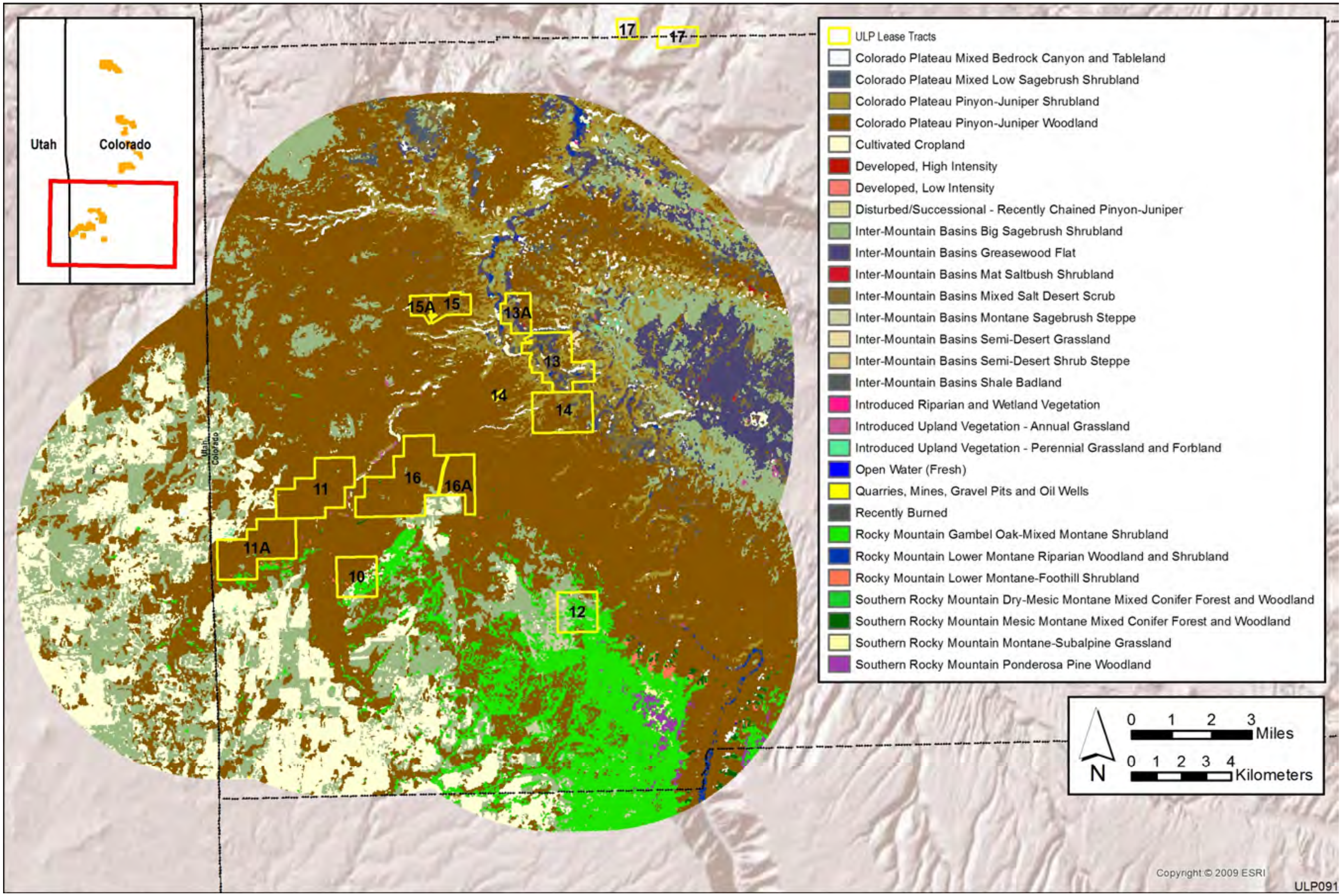


FIGURE 3.6-5 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 10–16 (USGS 2004)

TABLE 3.6-1 Land Cover Types within DOE ULP Lease Tracts

	Acreage by Lease Tract Number							
Land Cover Type[a]	5	5A	6	7	8	8A	9	10
Colorado Plateau Mixed Bedrock Canyon and Tableland			1		4		25	2
Colorado Plateau Mixed Low Sagebrush Shrubland					11		5	
Colorado Plateau Piñon-Juniper Shrubland				21		4	1	
Colorado Plateau Piñon-Juniper Woodland	151	23	522	354	876	75	635	417
Cultivated Cropland					1			71
Disturbed/Successional–Recently Chained Piñon-Juniper					<1			
Inter-Mountain Basins Big Sagebrush Shrubland		2	8	1	62		369	31
Inter-Mountain Basins Greasewood Flat						<1		
Inter-Mountain Basins Mat Saltbush Shrubland								
Inter-Mountain Basins Mixed Salt Desert Scrub				8				
Inter-Mountain Basins Montane Sagebrush Steppe								
Inter-Mountain Basins Semidesert Grassland								
Inter-Mountain Basins Semidesert Shrub Steppe								
Inter-Mountain Basins Shale Badland				2				
Introduced Riparian and Wetland Vegetation								
Introduced Upland Vegetation–Annual Grassland								
Introduced Upland Vegetation–Perennial Grassland and Forbland								
Quarries, Mines, Gravel Pits and Oil Wells				107				
Rocky Mountain Gambel Oak–Mixed Montane Shrubland					2		1	109
Rocky Mountain Lower Montane–Foothill Shrubland								5
Rocky Mountain Lower Montane Riparian Woodland and Shrubland								
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland								<1
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland								2
Southern Rocky Mountain Ponderosa Pine Woodland								

TABLE 3.6-1 (Cont.)

Land Cover Type	Acreage by Lease Tract Number							
	11	11A	12	13	13A	14	15	15A
Colorado Plateau Mixed Bedrock Canyon and Tableland	<1			29	2	8		
Colorado Plateau Mixed Low Sagebrush Shrubland				<1				1
Colorado Plateau Piñon-Juniper Shrubland	4			340	112	238	53	
Colorado Plateau Piñon-Juniper Woodland	1,289	1,242	59	200	154	596	279	168
Cultivated Cropland	2	4	10	6	1			
Disturbed/Successional–Recently Chained Piñon-Juniper								
Inter-Mountain Basins Big Sagebrush Shrubland	4	15	156	21	8	14		1
Inter-Mountain Basins Greasewood Flat	<1			143	67	14		
Inter-Mountain Basins Mat Saltbush Shrubland					3			
Inter-Mountain Basins Mixed Salt Desert Scrub				136	34	77	18	3
Inter-Mountain Basins Montane Sagebrush Steppe			112					
Inter-Mountain Basins Semidesert Grassland				26	12	2		
Inter-Mountain Basins Semidesert Shrub Steppe				2				
Inter-Mountain Basins Shale Badland				163	28	24		
Introduced Riparian and Wetland Vegetation								
Introduced Upland Vegetation–Annual Grassland	2	2						
Introduced Upland Vegetation–Perennial Grassland and Forbland		1						
Quarries, Mines, Gravel Pits and Oil Wells								
Rocky Mountain Gambel Oak–Mixed Montane Shrubland		29	304					
Rocky Mountain Lower Montane–Foothill Shrubland		2						
Rocky Mountain Lower Montane Riparian Woodland and Shrubland				13				
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland								
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland								
Southern Rocky Mountain Ponderosa Pine Woodland			<1					

TABLE 3.6-1 (Cont.)

Land Cover Type	Acreage by Lease Tract Number 16	16A	17	18	19	19A	20	21
Colorado Plateau Mixed Bedrock Canyon and Tableland				62	12	14	37	4
Colorado Plateau Mixed Low Sagebrush Shrubland								
Colorado Plateau Piñon-Juniper Shrubland				284	2	16	62	2
Colorado Plateau Piñon-Juniper Woodland	1,726	563	454	761	534	674	361	449
Cultivated Cropland	1	14	2					
Disturbed/Successional–Recently Chained Piñon-Juniper								
Inter-Mountain Basins Big Sagebrush Shrubland	56	7	18	46	91	487	162	178
Inter-Mountain Basins Greasewood Flat					1			2
Inter-Mountain Basins Mat Saltbush Shrubland				<1		1	1	
Inter-Mountain Basins Mixed Salt Desert Scrub				21	24	<1	4	4
Inter-Mountain Basins Montane Sagebrush Steppe								
Inter-Mountain Basins Semidesert Grassland				1				6
Inter-Mountain Basins Semidesert Shrub Steppe				4			1	
Inter-Mountain Basins Shale Badland						2		
Introduced Riparian and Wetland Vegetation				<1				
Introduced Upland Vegetation–Annual Grassland				1			1	
Introduced Upland Vegetation–Perennial Grassland and Forbland								
Quarries, Mines, Gravel Pits and Oil Wells								6
Rocky Mountain Gambel Oak–Mixed Montane Shrubland								
Rocky Mountain Lower Montane–Foothill Shrubland	1							
Rocky Mountain Lower Montane Riparian Woodland and Shrubland								
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland	1							
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	4	1						
Southern Rocky Mountain Ponderosa Pine Woodland								

TABLE 3.6-1 (Cont.)

Land Cover Type	Acreage by Lease Tract Number						
	22	22A	23	24	25	26	27
Colorado Plateau Mixed Bedrock Canyon and Tableland		21	60		5	13	
Colorado Plateau Mixed Low Sagebrush Shrubland							
Colorado Plateau Piñon-Juniper Shrubland			1	5	3	20	
Colorado Plateau Piñon-Juniper Woodland	145	287	442	196	624	3,838	1,696
Cultivated Cropland			5				
Disturbed/Successional–Recently Chained Piñon-Juniper							
Inter-Mountain Basins Big Sagebrush Shrubland	74	94	55		2	51	65
Inter-Mountain Basins Greasewood Flat						1	
Inter-Mountain Basins Mat Saltbush Shrubland							
Inter-Mountain Basins Mixed Salt Desert Scrub		2	20		4		
Inter-Mountain Basins Montane Sagebrush Steppe							
Inter-Mountain Basins Semidesert Grassland		4	2				
Inter-Mountain Basins Semidesert Shrub Steppe					2		
Inter-Mountain Basins Shale Badland			5				
Introduced Riparian and Wetland Vegetation							
Introduced Upland Vegetation–Annual Grassland	1		2				
Introduced Upland Vegetation–Perennial Grassland and Forbland							
Quarries, Mines, Gravel Pits and Oil Wells	3		4				
Rocky Mountain Gambel Oak–Mixed Montane Shrubland						4	
Rocky Mountain Lower Montane–Foothill Shrubland							1
Rocky Mountain Lower Montane Riparian Woodland and Shrubland						22	<1
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland							
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland							
Southern Rocky Mountain Ponderosa Pine Woodland							

[a] Descriptions of land cover types are given in Table 3.6-2. Empty fields in the table indicate this land cover type is not found on a given lease tract.

Source: USGS (2004)

TABLE 3.6-2 Descriptions of Land Cover Types[a]

Colorado Plateau Mixed Bedrock Canyon and Tableland: Includes barren and sparsely vegetated (generally <10% plant cover) steep cliff faces, narrow canyons, and open tablelands. Composed of a very open coniferous tree canopy or scattered trees and shrubs. Herbaceous species are typically sparse.

Colorado Plateau Mixed Low Sagebrush Shrubland: Occurs in canyons, draws, hilltops, and dry flats. Consists of open shrubland and steppe habitats. Black sagebrush (*Artemisia nova*) or Bigelow sage (*A. bigelovii*) are the dominant species, with Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) co-dominant in some areas. Semiarid grasses are often present and may exceed 25% cover.

Colorado Plateau Piñon-Juniper Shrubland: Occurs on rocky mesatops and dry slopes, often upslope of piñon-juniper woodland. Stunted two-needle piñon (*Pinus edulis*) or Utah juniper (*Juniperus osteosperma*), or both, are the dominant species. Other shrubs may be present. Herbaceous species are sparse to moderately dense.

Colorado Plateau Piñon-Juniper Woodland: Occurs on foothills, ridges, and low-elevation mountain slopes. Two-needle piñon (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), or both, are the dominant species. Understory layers, if present, may be shrub- or grass-dominated.

Cultivated Cropland: Areas where pasture/hay or cultivated crops account for more than 20% of total vegetation cover.

Disturbed/Successional–Recently Chained Piñon-Juniper: Areas that have recently been chained to remove Piñon-Juniper (*Pinus edulis-Juniperus* sp.).

Inter-Mountain Basins Big Sagebrush Shrubland: Dominated by basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), or both. Other shrubs may be present. Perennial herbaceous plants are present but not abundant.

Inter-Mountain Basins Greasewood Flat: Dominated or co-dominated by greasewood (*Sarcobatus vermiculatus*) and generally occurring in areas with saline soils, a shallow water table, and intermittent flooding, although remaining dry for most growing seasons. This community type generally occurs near drainages or around playas. These areas may include, or may be co-dominated by, other shrubs, and may include a graminoid herbaceous layer.

Inter-Mountain Basins Mat Saltbush Shrubland: Occurs on gentle slopes and rolling plains. Mat saltbush (*Atriplex corrugata*) or Gardner's saltbush (*Atriplex gardneri*) are typically dominant in these dwarf-shrublands. Other dwarf-shrubs may be dominant or co-dominant. Low shrubs may be present and herbaceous species are usually sparse.

Inter-Mountain Basins Mixed Salt Desert Scrub: Generally consists of open shrublands which include at least one species of *Atriplex* along with other shrubs. Perennial grasses dominate a sparse to moderately dense herbaceous layer.

Inter-Mountain Basins Montane Sagebrush Steppe: Occurs on flats, ridges, level ridgetops, and mountain slopes. Mountain big sagebrush (*Artemisia tridentata vaseyana*) and related taxa such as big sagebrush (*Artemisia tridentata spiciformis*) are typically the dominant species. Perennial herbaceous species, especially grasses, are usually abundant, although shrublands are also present.

TABLE 3.6-2 (Cont.)

Inter-Mountain Basins Semidesert Grassland: Consists of perennial bunchgrasses as dominants or co-dominants. Scattered shrubs or dwarf shrubs may also be present.

Inter-Mountain Basins Semidesert Shrub Steppe: Generally consists of perennial grasses with an open shrub and dwarf shrub layer.

Inter-Mountain Basins Shale Badland: Typically occurs on rounded hills and plains. Consists of barren and sparsely vegetated areas (<10% plant cover) with high rate of erosion and deposition. Vegetation consists of sparse dwarf shrubs and herbaceous plants.

Introduced Riparian and Wetland Vegetation: Vegetation dominated (typically >60% canopy cover) by introduced species. These are spontaneous, self-perpetuating, and not (immediately) the result of planting, cultivation, or human maintenance. Land occupied by introduced vegetation is generally permanently altered (converted) unless restoration efforts are undertaken. Specifically, land cover is significantly altered/disturbed by introduced riparian and wetland vegetation.

Introduced Upland Vegetation–Annual Grassland: Dominated by non-native annual grass species.

Introduced Upland Vegetation–Perennial Grassland and Forbland: Dominated by non-native perennial grass and forb species.

Quarries, Mines, Gravel Pits and Oil Wells: Includes open-pit mines and quarries.

Rocky Mountain Gambel Oak–Mixed Montane Shrubland: Occurs on dry foothills and lower mountain slopes. Gambel oak (*Quercus gambelii*) may be the only dominant species or share dominance with other shrubs.

Rocky Mountain Lower Montane–Foothill Shrubland: Occurs on dry foothills, canyon slopes, and lower mountains. These areas are typically dominated by a variety of shrubs. Scattered trees or patches of grassland or steppe may occur.

Rocky Mountain Lower Montane Riparian Woodland and Shrubland: Occurs on stream banks, islands, and bars, in areas of annual or episodic flooding, and often occurs as a mosaic of tree-dominated communities with diverse shrubs.

Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland: Occurs on all aspects of mountain slopes, ridges, canyon slopes, and plateaus. Consists of a mix of trees, as well as shrubs and grasses on dry to mesic soils.

Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland: Occurs in cool, moist areas of ravine slopes, stream terraces, and north- or east-facing slopes. A dense layer of diverse deciduous shrubs is often present. A high diversity of herbaceous species, including grasses, sedges, and forbs are present.

Southern Rocky Mountain Ponderosa Pine Woodland: Occurs on dry slopes. Ponderosa pine (*Pinus ponderosa*) is the dominant species. Other tree species may be present. The understory is usually shrubby and grasses may be present.

[a] Land cover descriptions are from USGS (2005)

TABLE 3.6-3 Noxious Weeds Occurring on or in the Vicinity[a] of ULP Lease Tracts

Common Name	Scientific Name	List[b]	Tract[c]
Bull thistle	*Cirsium vulgare*	B	
Canada thistle	*Cirsium arvense*	B	9, 13
Cypress spurge	*Euphorbia cyparissias*	A	
Dalmatian toadflax	*Linaria dalmatica*	B	
Dame’s rocket	*Hesperis mattronalis*	B	
Diffuse knapweed	*Centaurea diffusa*	B	
Downy brome/cheatgrass	*Bromus tectorum*	C	5, 7, 10, 11, 12, 13, 16, 18, 19, 21, 22, 23, 25, 26, 27
Dyer’s woad	*Isatis tinctoria*	A	
Field bindweed	*Convolvulus arvensis*	C	19, 21, 27
Halogeton	*Halogeton glomeratus*	C	13, 13A, 15, 15A, 17, 18, 19, 19A, 23, 25
Hoary cress	*Cardaria draba*	B	
Houndstongue	*Cynoglossum officinale*	B	
Jointed goatgrass	*Aegilops cylindrica*	B	18
Leafy spurge	*Euphorbia esula*	B	
Musk thistle	*Carduus nutans*	B	7, 8, 9, 11, 19, 23
Oxeye daisy	*Chrysanthemum leucanthemum*	B	
Perennial pepperweed	*Lepidium latifolium*	B	
Purple loosestrife	*Lythrum salicaria*	A	
Redstem filaree	*Erodium cicutarium*	C	10, 11, 16, 18, 19, 21, 22, 25, 26, 27
Russian knapweed	*Acroptilon repens*	B	5, 6, 7, 8, 9, 10, 11, 11A, 13, 13A, 14, 15, 15A, 16, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25
Russian-olive	*Elaeagnus angustifolia*	B	
Salt cedar	*Tamarix ramosissima*	B	9, 13, 13A, 14, 15A, 17, 18, 19, 19A, 20, 22, 22A
Scentless chamomile	*Matricaria perforata*	B	
Scotch thistle	*Onopordium acanthium*	B	
Spotted knapweed	*Centaurea maculosa*	B	
Sulphur cinquefoil	*Potentilla recta*	B	
Yellow toadflax	*Linaria vulgaris*	B	

[a] Mapped within approximately 20 mi (32 km) of lease tracts (CDA 2010).

[b] The CDA classifies noxious weeds into one of three lists (CDA 2011): “List A species in Colorado that are designated by the Commissioner for eradication.” “List B weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, develops and implements state noxious weed management plans designed to stop the continued spread of these species.” “List C weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species.”

[c] Tract where species has been recorded within tract boundaries (S.M. Stoller Corporation 2012).

summary of the noxious weed species regulated in Colorado that are known to occur in the vicinity (within approximately 20 mi [32 km]) of the lease tracts (CDA 2010) or have been identified within the boundaries of the lease tracts (S.M. Stoller Corp. 2012).

3.6.1.1 Wetlands and Floodplains

Rocky Mountain Lower Montane Riparian Woodland and Shrubland occurs along segments of Calamity Creek in Lease Tracts 26 and 27 and along the Dolores River in Lease Tract 13 and the withdrawn area of the northwest section of Lease Tract 13A. A small area of Introduced Riparian and Wetland Vegetation occurs in the northwest corner of Lease Tract 18 along Atkinson Creek.

Wetland areas are typically inundated or have saturated soils for at least a portion of the growing season (Cowardin et al. 1979). Wetlands generally support plant communities that are adapted to saturated soil conditions; however, as described in Cowardin et al. (1979), streambeds, mudflats, gravel beaches, and rocky shores are wetland areas that may not be vegetated. Although surface flows provide the water source for some wetlands, such as many riverine marshes, other wetlands, such as springs and seeps, are supported by groundwater discharge. Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, or lakes and ponds. However, some wetlands, such as vernal pools, have seasonal or intermittent sources of water. Wetlands in the area of the lease tracts have been mapped by the National Wetlands Inventory (NWI) (USFWS 2012). Digital data are not available for this area of Colorado; however, wetlands are mapped and identified by type. Figure 3.6-6 shows an example of NWI mapping in the vicinity of Lease Tracts 13 and 14. Because of the lack of digital data, wetland acreages are not available. Because wetlands may change over time (e.g., boundaries may shift due to new impoundments or wetlands may be eliminated by development), wetlands on the lease tracts may not always correspond to NWI data. Some wetlands occurring in these areas may not be mapped because of the inherent limitations of high-altitude image interpretation. Riverine wetlands occur in many canyon areas within the tracts, including along the Dolores River and named creeks. Small palustrine wetlands occur in several tracts, typically as a result of a dike or impoundment, and may represent livestock watering ponds. Table 3.6-4 lists the NWI mapped wetlands for each tract; Table 3.6-5 gives the description of each wetland type. The lease tracts may include jurisdictional wetlands (those that are under the jurisdiction of Section 404 of the Clean Water Act).

As described in 10 CFR Part 1022, DOE shall determine whether a proposed action would occur within a base or critical floodplain. A base floodplain is the 100-year floodplain (i.e., a floodplain with a 1.0% chance of flooding in any given year). A critical action floodplain is a floodplain (500-year floodplain at a minimum) in which an action could occur for which even a slight chance of flooding would be too great, and it would not apply to the ULP. Portions of Lease Tracts 13, 13A, and 14 are located within the 100-year floodplain of the Dolores River (DOE 2007). Other perennial streams occurring within the lease tracts are Calamity Creek (Lease Tracts 26 and 27) and Atkinson Creek (Lease Tract 18). The floodplains along these streams are unmapped, although the entire area in which Lease Tracts 26 and 27 occur is mapped as a moderate flood hazard area (outside the 100-year flood but not the 500-year flood).

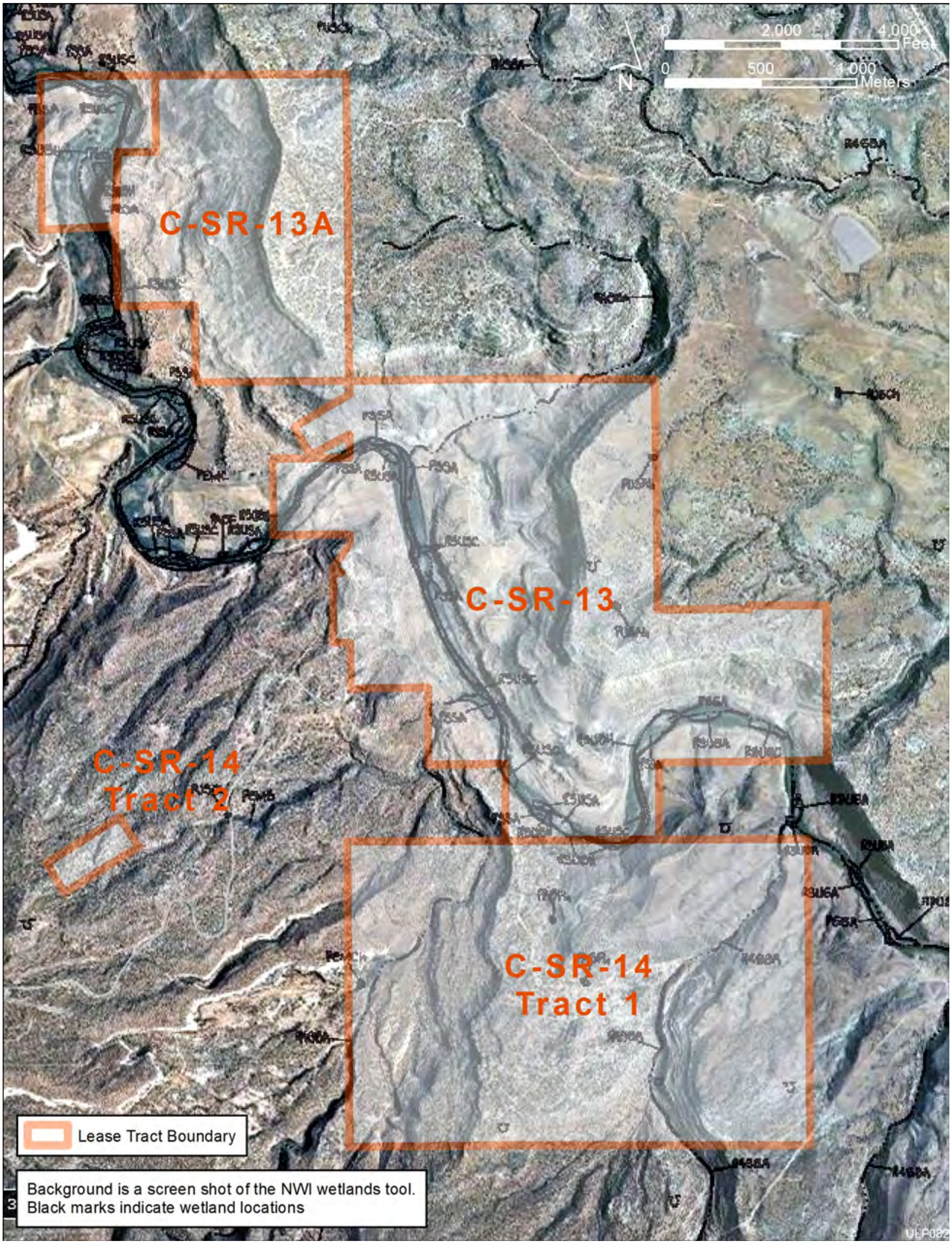


FIGURE 3.6-6 NWI Wetlands Mapped in the Vicinity of Lease Tracts 13 and 14 (USFWS 2012)

TABLE 3.6-4 Wetlands Mapped by the National Wetlands Inventory within ULP Lease Tracts

	Lease Tract Number							
Wetland Type[a]	5	5A	6	7	8	8A	9	10
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded								X
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded								
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded								
Palustrine, Emergent, Temporary Flooded							X	
Palustrine, Emergent, Temporarily Flooded, Diked/Impounded			X					
Palustrine, Scrub-Shrub, Temporary Flooded								
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated				X			X	
Palustrine, Unconsolidated Shore, Semipermanently Flooded, Excavated	X				X			
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded					X			
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								
Riverine, Intermittent, Streambed, Intermittently Flooded								
Riverine, Intermittent, Streambed, Seasonally Flooded								
Riverine, Intermittent, Streambed, Temporary Flooded							X	X Bishop Canyon
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded								

TABLE 3.6-4 (Cont.)

Wetland Type[a]	Lease Tract Number 11	11A	12	13	13A	14	15	15A
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded			X			X[2, b]		
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded						X		
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded								
Palustrine, Emergent, Temporary Flooded								
Palustrine, Emergent, Temporary Flooded, Diked/Impounded								
Palustrine, Scrub-Shrub, Temporary Flooded				X[7] Dolores River	X[4] Dolores River			
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated								
Palustrine, Unconsolidated Shore, Semipermanently Flooded, Diked/Impounded	X							
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded				X[2]				
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								
Riverine, Intermittent, Streambed, Intermittently Flooded	X Summit Canyon	X Summit Canyon						
Riverine, Intermittent, Streambed, Seasonally Flooded								
Riverine, Intermittent, Streambed, Temporary Flooded	X Summit Canyon	X Summit Canyon		X[2] Burro Canyon Bush Canyon		X[2] Morrison Canyon Bush Canyon	X	
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded				X[3] Dolores River	X[2]	X Dolores River		
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded				X[5] Dolores River	X[3] Dolores River			
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded				X[4] Dolores River				

TABLE 3.6-4 (Cont.)

	Lease Tract Number							
Wetland Type[a]	16	16A	17	18	19	19A	20	21
Palustrine, Aquatic Bed, Semipermanently Flooded Diked/Impounded				X	X	X[2]		
Palustrine, Emergent, Seasonally Flooded Diked/Impounded								
Palustrine, Emergent Semipermanently Flooded, Diked/Impounded	X							
Palustrine, Emergent, Temporary Flooded								
Palustrine, Emergent, Temporary Flooded, Diked/Impounded				X[2]		X		X
Palustrine, Scrub-Shrub, Temporary Flooded								
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated								
Palustrine, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded				X[2]		X		
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded				X			X	
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								X
Riverine, Intermittent, Streambed, Intermittently Flooded								
Riverine, Intermittent, Streambed, Seasonally Flooded				X Atkinson Creek				
Riverine, Intermittent, Streambed, Temporary Flooded	X	X						X
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded								

TABLE 3.6-4 (Cont.)

Wetland Type[a]	Lease Tract Number 22	22A	23	24	25	26	27
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/ Impounded	X	X	X	X	X	X^2	X^2
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded		X					X
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded							
Palustrine, Emergent, Temporary Flooded							
Palustrine, Emergent, Temporary Flooded, Diked/Impounded				X			X
Palustrine, Scrub-Shrub, Temporary Flooded							
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated							
Palustrine, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded			X				X
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded			X		X	X	
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated							
Riverine, Intermittent, Streambed, Intermittently Flooded							
Riverine, Intermittent, Streambed, Seasonally Flooded							
Riverine, Intermittent, Streambed, Temporary Flooded						X^2 Maverick Canyon Calamity Creek	
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded						X Calamity Creek	
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded							
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded							
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded							
Riverine, Upper Perennial Unconsolidated Shore, Seasonally Flooded							
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded							

[a] See Table 3.6-4 for descriptions of wetland types.

[b] Superscripts refer to the number of occurrences of that wetland type in the indicated lease tract.

1 **TABLE 3.6-5 Descriptions of Wetland Types**

Aquatic Bed (AB): Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

Diked/Impounded (D/I): Created or modified by a human-made barrier or dam that obstructs the inflow or outflow of water. The descriptors "diked" and "impounded" have been combined into a single modifier, since the observed effect on wetlands from either a dike or an impoundment is similar. They have been combined here because of image interpretation limitations.

Emergent (E): Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.

Excavated (Ex): Lies within a basin or channel that has been dug, gouged, blasted. or suctioned through artificial means by man.

Intermittent (I): Includes channels that contain flowing water only part of the year but may contain isolated pools when the flow stops.

Intermittently Flooded (IF): Limited to describing habitats in the arid western portions of the United States. Substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. These habitats are very climate-dependent. Weeks or months or even years may intervene between periods of inundation. Flooding or inundation may come from spring snowmelt or sporadic summer thunderstorms. The dominant plant communities under this regime may change as soil moisture conditions change. Some areas exhibiting this regime do not fall within the Cowardin et al. (1979) definition of wetland, because they do not have hydric soils or support hydrophytes. This water regime has been used extensively in vegetated and nonvegetated situations, including identifying some shallow depressions (playa lakes), intermittent streams, and dry washes in the arid west.

Palustrine (P): Includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens. Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics: (1) are less than 20 acres (8 ha); (2) do not have an active wave-formed or bedrock shoreline feature; (3) have, at low water, a depth of less than 6.6 ft (2 m) in the deepest part of the basin; and (4) have salinity due to ocean-derived salts that is less than 0.5 part per trillion.

Permanently Flooded (PF): Covered by water throughout the year in all years.

Riverine (R): Includes all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water, or that form a connecting link between the two bodies of standing water. Upland islands or palustrine wetlands may occur in the channel, but they are not part of the riverine system.

Seasonally Flooded (SF): Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated at the surface to a water table well below the ground surface.

Semipermanently Flooded (SPF): Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land's surface.

Streambed (S): Includes all wetlands contained within the Intermittent Subsystem of the Riverine System.

TABLE 3.6-5 (Cont.)

Scrub-Shrub (SS): Includes areas dominated by woody vegetation less than 6 m (20 ft) tall; the species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.

Temporary Flooded (TF): Surface water is present for brief periods during growing season, but the water table usually lies well below the soil surface for most of the growing season. Plants that grow both in uplands and wetlands may be characteristic of this water regime.

Unconsolidated Bottom (UB): Includes all wetlands and deepwater habitats with a cover of at least 25% consisting of particles smaller than stones (less than 6–7 cm or 2.4–2.8 in.) and a vegetative cover of less than 30%.

Upper Perennial (UP): This subsystem is characterized by a high gradient and a fast water velocity. Some water flows throughout the year. This substrate consists of rock, cobbles, or gravel, with occasional patches of sand. There is very little floodplain development.

Unconsolidated Shore (US): Includes all wetland habitats having two characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; and (2) less than 30% areal cover of vegetation. Landforms such as beaches, bars, and flats are included in this class.

3.6.2 Wildlife

As discussed in Section 3.6.1, the various ecoregions within the three-county study area within which the lease tracts are located include a diversity of land cover, plant communities, and plant species, which, in turn, provide a wide range of habitats supporting diverse assemblages of terrestrial wildlife species (Table 3.6-6). Many of these species may be expected to inhabit areas within or near the lease tracts, depending upon the plant communities and habitats present.

The BLM and other Federal agencies that administer public lands have active wildlife management programs. These programs are aimed largely at habitat protection and improvement. The general objectives of wildlife management are to (1) maintain, improve, or enhance wildlife species diversity while ensuring healthy ecosystems; (2) restore disturbed or altered habitat with the objective of obtaining desired native plant communities while providing for wildlife needs and soil stability; and (3) protect and maintain wildlife and associated wildlife habitat by addressing and mitigating impacts from authorized and unauthorized uses of BLM-administered lands. Federal agencies such as the BLM are primarily responsible for managing habitats, while state agencies (e.g., Colorado Parks and Wildlife,[15] a division of the Colorado Department of Natural Resources [CDNR]) are responsible for managing the big game, small game, and nongame wildlife species in cooperation with the BLM. The USFWS has responsibility for oversight of migratory bird species and most Federal threatened, endangered,

[15] Colorado Parks and Wildlife was created July 1, 2011, from the merger of Colorado State Parks and the Colorado Division of Wildlife (CDOW). Some of the references listed in Chapter 8 of the ULP PEIS that were prepared by CDOW still mention that within the citation.

TABLE 3.6-6 Number of Wildlife Species in the Three-County Study Area[a]

County	Amphibians	Reptiles	Birds	Mammals
Mesa	10	20	343	83
Montrose	10	20	260	82
San Miguel	9	19	224	81

[a] Excludes native species that have been extirpated and not subsequently reintroduced into the wild, and feral domestic species.

Sources: CPW (2011a); Colorado Field Ornithologists (2010a,b,c)

proposed, or candidate species. Management of threatened and endangered species is discussed in Section 3.6.4.

3.6.2.1 Amphibians and Reptiles

The three-county study area supports a number of amphibian and reptile species (Table 3.6-6). However, amphibian species are not expected to be found throughout most of the lease tracts because of the limited abundance of water bodies and wetlands capable of supporting breeding populations of amphibians. A number of lizard and snake species may inhabit the lease tracts. Turtles do not inhabit areas within the three-county study area (CPW 2011a). Table 3.6-7 lists a number of the amphibian and reptile species expected to inhabit areas within the lease tract boundaries. Threatened, endangered, and other special status amphibian and reptile species (e.g., BLM sensitive species) are addressed in Section 3.6.4.

3.6.2.2 Birds

Several hundred species of birds occur in the three-county study area (Table 3.6-6). The following discussion focuses on major groups of birds that occur within the three-county study area. These include birds that have key habitats within the study area, are important to humans (e.g., waterfowl and upland game species), and/or are representative of other species that share important habitats. Threatened, endangered, and other special status bird species are addressed in Section 3.6.4.

3.6.2.2.1 Waterfowl, Wading Birds, and Shorebirds. Waterfowl (ducks, geese, and swans), wading birds (herons and cranes), and shorebirds (plovers, sandpipers, and similar birds) are among the more abundant groups of birds in the three-county study area. Many of these species migrate extensive distances from breeding areas in Alaska and Canada to wintering

TABLE 3.6-7 Amphibian and Reptile Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
Amphibians		
New Mexico spadefoot (*Spea multiplicata*)	3,000–6,500	Desert grassland, shortgrass prairie, sagebrush, mixed grassland, piñon-juniper, pine-oak woodlands, and open pine forests. Breeding habitat includes ephemeral artificial impoundments (e.g., stock tanks and pools that form along roads or railroad grades), ephemeral pools and playas, and isolated pools in temporary streams.
Red-spotted toad (*Bufo punctatus*)	3,000–7,000	Usually associated with rocky canyons, occasionally along streams and in canyon bottoms without large rocks.
Tiger salamander (*Ambystoma tigrinum*)	3,000–12,000	Any habitat that has a body of water nearby for breeding (e.g., ponds, lakes, and impoundments ranging from a few meters in diameter to several hectares in area). Virtually any water source may be used for breeding.
Reptiles		
Collared lizard (*Crotaphytus collaris*)	3,000–8,000	Rocky canyons, slopes, and gullies; rocky ledges above cliffs; bedrock exposures; and areas with scattered large rocks and sparse vegetation.
Fence lizard (*Sceloporus undulatus*)	3,000–9,500	Rocky habitats including cliffs, talus, old lava flows and cones, canyons, hogbacks, and outcroppings. Adjacent vegetation includes piñon-juniper woodland, mountain shrubland, semidesert shrubland, and various grasses and forbs. May occur in riparian habitats, but not known to make significant use of aquatic habitat.
Gopher snake (*Pituophis catenifer*)	3,000–8,500	Multitude of habitats including plains grasslands, sandhills, riparian areas, marshes, pond and lake edges, rocky canyons, semidesert and mountain shrublands, piñon-juniper woodlands, ponderosa pine, and rural and suburban areas.
Night snake (*Hypsiglena torquata*)	3,000–8,000	Rocky slopes and canyons sparsely vegetated with piñon-juniper woodland and/or various shrubs and grasses.
Plateau striped whiptail (*Cnemidophorus velox*)	4,500–7,500	Mainly piñon-juniper woodland, but also a wide variety of other grassland, shrubland, and forest habitats.
Sagebrush lizard (*Sceloporus graciosus*)	4,500–8,500	Various habitats including piñon-juniper woodlands, semidesert shrublands, and shale hills with sparse grasses and low shrubs.
Short-horned lizard (*Phrynosoma hernandesi*)	3,000–11,000	Various habitats including short-grass prairie, sagebrush, semidesert shrubland, shale barrens, and piñon-juniper woodland.

TABLE 3.6-7 (Cont.)

Species	Elevation (ft)	Habitat
Reptiles (Cont.)		
Side-blotched lizard (*Uta stansburiana*)	4,500–6,000	Washes, arroyos, boulder-strewn ravines, rocky canyon slopes, bedrock exposures, rimrock outcroppings, rocky cliff bases, and shrubby areas in canyon bottoms where soils are soft and deep. Usually found where there is an abundance of bare ground.
Striped whipsnake (*Masticophis taeniatus*)	4,500–8,500	Semidesert shrublands, piñon-juniper woodlands and shrublands on mesa tops and rocky slopes, and intermittent stream courses and arroyos in the bottoms of canyons.
Tree lizard (*Urosaurus ornatus*)	4,500–8,000	Cliffs, canyon walls, steep bedrock exposures, talus slopes with large boulders, and other areas strewn with huge rocks. Vegetation present includes piñon pine, juniper, and various shrubs.
Western rattlesnake (*Crotalus viridis*)	3,000–9,500	Various habitats including plains grasslands, sandhills, semidesert shrubland, mountain shrubland, riparian zones, and piñon-juniper woodland.
Western whiptail (*Cnemidophorus tigris*)	4,500–6,000	Canyon bottoms to adjacent low mesa tops, preferring open spaced stands of shrubs such as greasewood, sagebrush, or piñon-pine and juniper of friable soils.

Source: CPW (2011a); USGS (2007)

grounds in Mexico and southward (Lincoln et al. 1998). Most are ground-level nesters, and many forage in flocks (sometimes relatively large) on the ground or water. Within the study area, migration routes for these birds are often associated with riparian corridors and wetland or lake stopover areas.

Common to abundant waterfowl and shorebird species reported from the three-county study area include Canada goose (*Branta canadensis*), green-winged teal (*Anas crecca*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), gadwall (*Anas strepera*), ring-necked duck (*Aythya collaris*), great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferous*), spotted sandpiper (*Actitis macularius*), and snow goose (*Chen caerulescens*) (CPW 2011a). Major waterfowl species harvested in the three counties include mallard and Canada goose. Other species commonly harvested include gadwall, American widgeon (*Anas americana*), teal (*Anas* spp.), northern pintail (*Anus acuta*), and northern shoveler (USFWS 2003). In Colorado, no hunting season for the sandhill crane (*Grus canadensis*) occurs west of the Continental Divide (CPW 2011b).

Habitat for most waterfowl, wading birds, and shorebirds in the three-county study area occurs within the larger permanent water bodies, such as the Dolores and San Miguel Rivers.

Waterfowl, wading birds, and shorebirds are limited within the lease tract boundaries because of a lack of their suitable habitats within the lease tracts.

3.6.2.2.2 Songbirds. Songbirds (also referred to as perching birds) of the order Passeriformes represent the most diverse category of birds, with the warblers and sparrows representing the two most diverse groups of passerines. The passerines exhibit a wide range of seasonal movements, with some species remaining as year-round residents in some areas and being migratory in others, and with still other species migrating hundreds of miles or more (Lincoln et al. 1998). Nesting occurs in vegetation from near ground level to the upper canopy of trees. Some songbirds, such as the thrushes and chickadees, are relatively solitary throughout the year, while others, such as swallows and blackbirds, may occur in small to large flocks at various times of the year. Foraging may occur in flight (e.g., swallows and swifts) or on vegetation or the ground (e.g., warblers, finches, and thrushes). Table 3.6-8 lists a number of the songbird species that are expected to inhabit areas within the lease tract boundaries and that are considered by CPW (2011a) to be fairly common to abundant within the three-county study area.

3.6.2.2.3 Birds of Prey. The birds of prey include the raptors (hawks, falcons, eagles, kites, and osprey), owls, and vultures. These species represent the top avian predators in many ecosystems. The raptors and owls vary considerably among species with regard to their seasonal occurrence. Some species are nonmigratory (year-round residents), some species are migratory in the northern portions of their ranges but not in the southern portions of their ranges, and still other species migrate throughout their ranges.

Raptors forage on a variety of prey, including small mammals, reptiles, other birds, fish, invertebrates, and, at times, carrion. They typically perch on trees, utility support structures, highway signs, and other high structures that provide a broad view of the surrounding topography, and they may soar for extended periods at relatively high altitudes. The raptors forage from either a perch or on the wing (depending on the species), and all forage during the day. The owls also perch on elevated structures and forage on a variety of prey, including mammals, birds, and insects. Forest-dwelling species typically forage by diving on a prey item from a perch, while open-country species hunt on the wing while flying low over the ground. While generally nocturnal, some owl species are also active during the day. The vultures, of which only the turkey vulture (*Cathartes aura*) occurs in the three-county study area, are large, soaring scavengers that feed on carrion.

Table 3.6-9 lists a number of the raptor species expected to occur within the lease tract boundaries. Threatened, endangered, and other special status raptor species are discussed in Section 3.6.4.

3.6.2.2.4 Upland Game Birds. Upland game birds that are native to the three-county study area include dusky grouse (*Dendragapus obscurus*), Gambel's quail (*Callipepla gambelii*), mourning dove (*Zenaida macroura*), white-winged dove (*Z. asiatica*), and wild turkey (*Meleagris gallopavo*). Introduced species include ring-necked pheasant (*Phasianus colchicus*)

TABLE 3.6-8 Songbird Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
American crow (*Corvus brachyrhynchos*)	3,000–10,000	Mostly riparian, agricultural, and urban areas, but also coniferous forests, shrublands, and cholla grasslands.
American robin (*Turdus migratorius*)	3,000–11,500	Summer: urban areas around farmhouses and windbreaks; riparian areas; coniferous and aspen forests; and krummholz. During migration: woods and bare or sparsely vegetated fields. Winter: urban, riparian, and agricultural areas; piñon-juniper woodlands; and ponderosa pine forests.
Ash-throated flycatcher (*Myiarchus cinerascens*)	3,000– 9,000	Piñon-juniper woodlands and open riparian forests.
Berwick's wren (*Thryomanes bewickii*)	3,000–7,000	Dry canyon and piñon-juniper woodlands and semidesert shrublands. Often inhabits tamarisk in summer, and mostly inhabits tamarisk in winter.
Black-billed magpie (*Pica pica*)	3,000–13,000	Most common in riparian forests, agricultural, and urban areas, but also regularly inhabits shrublands, piñon-juniper woodlands, and cholla grasslands.
Black-chinned hummingbird (*Archilochus alexandri*)	3,000–7,000	Piñon-juniper woodlands, lowland and foothill riparian forests, Gambel oak shrublands, and urban areas.
Black-headed grosbeak (*Pheucticus melanocephalus*)	3,000–11,500	Breeds primarily in ponderosa pine, aspen, and foothill riparian forests, piñon-juniper woodlands, and Gambel oak shrublands. Needs to be near water.
Black-throated gray warbler (*Dendroica nigrescens*)	3,000–7,500	Breeds in piñon-juniper woodlands, especially in taller and denser woodlands. Occasionally inhabits other coniferous forest types adjacent to piñon-juniper. During migration it primarily inhabits piñon-juniper woodlands, but occasionally shrublands and lowland riparian forests.
Blue-gray gnatcatcher (*Polioptila caerulea*)	5,000–7,000	Breeds in piñon-juniper woodlands, Gambel oak, mountain mahogany and riparian shrublands. During migration, it inhabits wooded or brushy areas. In winter it inhabits shrublands on dry, sunny slopes or along open streams.
Brewer's blackbird (*Euphagus cyanocephalus*)	3,000–12,000	Meadows, grasslands, and riparian, agricultural, and urban areas; occasionally sagebrush or other shrublands. During winter, it most often inhabits areas near open water (streams and irrigation canals) and farmyards with livestock.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Brown-headed cowbird (*Molothrus aster*)	3,000–12,000	Breeds mostly in open areas such as grasslands, shrublands, agricultural areas, mountain meadows, and adjacent open forests. During winter, it mostly frequents feedlots or farmyards.
Bushtit (*Psaltriparus minimus*)	5,000–8,500	Primarily piñon-juniper woodlands and in upland and riparian shrublands, also rabbitbrush in fall.
Canyon wren (*Catherpes mexicanus*)	5,000–8,500	Cliffs and on rocky slopes, river canyons, river bluffs, cliffs, and rock slides. Frequents canyons with streams at the bottom.
Chipping sparrow (*Spizella passerine*)	3,000–11,000	Breeds in ponderosa pine forests, riparian and piñon-juniper woodlands, and shrublands. Occasionally inhabits Douglas-fir, lodgepole pine, aspen, or spruce-fir forests, especially adjacent to meadows. During migration, it inhabits weedy fields, agricultural areas, grasslands, and urban areas.
Clark's nutcracker (*Nucifraga columbiana*)	5,500–12,000	Breeds in spruce-fir, Douglas-fir, and limber pine forests; also occurs inhabits aspen forests at all seasons. It wanders to alpine tundra in spring, summer, and fall, and to Gambel oak and mountain mahogany shrublands, riparian, and agricultural areas in fall and early winter. In years of large cone production, large numbers may inhabit ponderosa pine forests and piñon-juniper woodlands.
Cliff swallow (*Petrochelidon pyrrhonota*)	3,000–10,000	Breeds on cliffs and human-made structures such as buildings, bridges, culverts, and dams (mostly in or near open habitats). During migration, it frequents areas around lakes, marshes, and open agricultural areas.
Common nighthawk (*Chordeiles minor*)	3,000–10,000	Inhabits grasslands, sagebrush and semidesert shrublands, open riparian and ponderosa pine forests, piñon-juniper woodlands, agricultural areas, and urban areas. Also forages in other habitats.
Common raven (*Corvus corax*)	5,000–14,000	Breeds on cliffs, and wanders (mostly outside of the breeding season) to adjacent lowlands, mostly in grasslands and shrublands but also in riparian and agricultural areas. Also nests in tall trees and on power poles.
Dark-eyed junco (*Junco hyemalis*)	3,000–10,000	Variety of wooded habitats that have openings with dense herbaceous ground cover. Winters in coniferous and riparian forests and thickets, shrublands, and wooded urban areas.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Dusky flycatcher (*Empidonax oberholseri*)	5,500–11,000	Breeds in fairly open or brushy habitats, such as ponderosa pine forest, hillside shrublands (Gambel oak, mountain mahogany, serviceberry), shrubby openings in piñon-juniper woodlands, montane and foothill riparian forests, small willow thickets, and aspen forests. During migration, it inhabits all wooded or brushy habitats.
Green-tailed towhee (*Pipilo chlorurus*)	3,000–11,500	Breeds most commonly in dry, hillside shrublands (Gambel oak, mountain mahogany, serviceberry, sagebrush), and also in riparian shrublands and piñon-juniper woodlands. Migrates in wooded or brushy riparian and urban areas and shrublands.
Hermit thrush (*Catharus guttatus*)	3,000–11,500	Summer habitat primarily includes spruce-fir forests, but also all other coniferous forest types. In some areas, it is most common in lodgepole pine forests and may be fairly common in dense upper elevation piñon-juniper woodlands. Locally inhabits Gambel oak shrublands, especially those with scattered conifers. During migration, it inhabits wooded habitats.
Horned lark (*Eremophila alpestris*)	3,000–9,000	Breeds in grasslands, sagebrush and semidesert shrublands, and alpine tundra. During migration and in winter, it inhabits the same habitats (except tundra), and also in agricultural areas. It is especially common in stubble and fallow fields and also occurs around feedlots and farmyards in winter. Almost always occurs where plant density is low and there is exposed soil. Can be found in association with prairie dog colonies.
House finch (*Carpodacus mexicanus*)	3,000–10,000	Most common in urban areas and lower piñon-juniper woodlands, but also in agricultural areas, riparian forests, shrublands (sagebrush and rabbitbrush), and cholla grasslands.
Juniper titmouse (*Baeolophus griseus*)	2,250–8,000	Dry habitats of open woodlands. Most common where large mature junipers are present, especially piñon-juniper woodlands. Also forages in shrub and riparian habitats.
Lark sparrow (*Chondestes grammacus*)	3,000–9,000	Inhabits grasslands, shrublands, open riparian areas, and agricultural areas. Sometimes inhabits open piñon-juniper woodlands. Can be found in association with prairie dog colonies.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Lazuli bunting (*Passerina amoena*)	3,000–9,500	Breeds most commonly in Gambel oak shrublands, but also in other hillside shrublands (mountain mahogany, serviceberry, etc.), lowland and foothill riparian forests and shrublands, brushy meadows, sage shrublands, and piñon-juniper woodlands. In all habitats, it requires low shrubs. During migration, it inhabits wooded or brushy areas.
Mountain bluebird (*Sialia currucoides*)	3,000–13,500	In summer, it inhabits mountain grasslands and sage shrublands adjacent to open coniferous forests (especially ponderosa pine and piñon-juniper) and aspen forests. Alpine tundra adjacent to krummholz, and Gambel oak and mountain mahogany shrublands also provide excellent habitat. During migration, it inhabits grasslands, open shrublands, and agricultural areas. In winter, it commonly inhabits piñon-juniper woodlands, but also inhabits shrublands and agricultural areas.
Mountain chickadee (*Poecile gambeli*)	5,500–11,500	Inhabits coniferous and aspen forests. Also occurs in piñon-juniper woodlands. In winter, wandering birds also occur in shrublands, urban areas, and lowland riparian forests.
Northern flicker (*Colaptes auratus*)	3,000–11,500	Grassland, shrubland, forestland, riparian/wetland, and urban/cropland habitats.
Orange-crowned warbler (*Vermivora celata*)	3,000–9,000	During migration, it inhabits riparian and urban areas, but also most other forest and shrubland habitats. In summer, it frequents Gambel oak shrublands, foothill riparian and aspen forests, piñon-juniper woodlands, and montane riparian willow shrublands.
Pine siskin (*Carduelis pinus*)	3,000–11,500	Breeds primarily in coniferous forests (especially spruce-fir) and rarely in riparian areas, aspen forests, and shrublands. Also inhabits ponderosa, lodgepole, and piñon pine. In winter and during migration, it frequents coniferous forests, riparian areas, shrublands, agricultural, and urban areas.
Piñon jay (*Gymnorhinus cyanocephalus*)	5,000–7,000	Inhabits piñon-juniper woodlands. Wandering birds inhabit isolated aspen stands, and alpine tundra.
Plumbeous vireo (*Vireo plumbeus*)	3,000–8,000	Inhabits ponderosa pine forests and piñon-juniper woodlands, especially denser woodlands at the upper elevational range of piñon-juniper and aspen forests, foothill riparian forests, and Gambel oak shrublands with scattered tall trees. Occasionally breeds in lowland riparian forests adjacent to foothills.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Pygmy nuthatch (*Sitta pygmaea*)	5,500–10,000	Inhabits ponderosa pine forests, but may also nest in lodgepole pines and aspens. Wanders rarely to Douglas-fir and piñon-juniper woodlands, and even more rarely to spruce-fir forests and lowland riparian forests.
Rock wren (*Salpinctes obsoletus*)	3,000–12,000	Habitat includes open, rocky slopes and around cliffs. During migration, it inhabits grasslands, brushy slopes, riparian areas, and urban areas.
Ruby-crowned kinglet (*Pegulus calendula*)	3,000–11,500	Breeds in coniferous forests, primarily in spruce-fir, and is common in lodgepole pine forests in some areas. During migration, it frequents all wooded habitats. In winter, it inhabits piñon-juniper woodlands, ponderosa pine forests, planted conifers, urban areas, and lowland riparian forests.
Sage sparrow (*Amphispiza belli*)	3,000–7,000	Breeds in big sagebrush or mixed big sagebrush and greasewood habitats. During migration, it inhabits grasslands and shrublands.
Sage thrasher (*Oreoscoptes montanus*)	3,000–14,000	Breeds in sagebrush shrublands and occasionally in other shrublands or cholla grasslands. During migration and in winter, it inhabits open agricultural areas, pastures, grasslands, shrublands, open riparian areas, and piñon-juniper woodlands.
Say's phoebe (*Sayornis saya*)	3,000–9,500	Breeds in most open habitats such as grasslands and shrublands, often near buildings (especially if abandoned) and bridges. It generally does not breed in agricultural areas except those adjacent to uncultivated areas. During migration, it inhabits all open habitats, including cultivated and riparian areas. In winter, it is usually found around the open water of streams and sewage ponds. Can be found associated with prairie dog colonies.
Spotted towhee (*Pipilo maculatus*)	3,000–8,000	Prefers scrub oak, shrubby piñon-pine woodlands, and riparian thickets.
Vesper sparrow (*Pooecetes gramineus*)	3,000–13,000	Breeds in grasslands, open shrublands mixed with grasslands, and open piñon-juniper woodlands. During migration, it inhabits open riparian and agricultural areas.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Virginia's warbler (*Vermivora virginiae*)	3,000–10,000	Breeds in dry, dense hillside shrublands, especially Gambel oak. Habitat includes mountain mahogany and riparian thickets, ponderosa pine forests, and piñon-juniper woodlands, especially with shrubby understories. Occasionally inhabits aspen or Douglas-fir forests, especially those with an understory of shrubs. During migration, it frequents riparian and urban areas and shrublands.
Western bluebird (*Sialia mexicana*)	3,000–8,000	Breeds primarily in ponderosa pine forests (or mixed ponderosa pine/aspen) and less often in piñon-juniper woodlands and Gambel oak shrublands. During migration, it inhabits most open forest types and adjacent open areas. In winter, it frequents piñon-juniper woodlands, but also inhabits riparian areas and shrublands, generally where fruits are abundant.
Western kingbird (*Tyrannus verticalis*)	3,000–10,000	Breeds mostly in open riparian and agricultural areas, but also in piñon-juniper woodlands adjacent to fields and in urban areas. Inhabits grasslands or desert shrublands, mostly in the vicinity of streams, isolated trees, shelterbelts, and houses. Often associated with prairie dog colonies in areas of juniper and cholla or sagebrush.
Western meadowlark (*Sturnella neglecta*)	3,000–12,000	Most common in agricultural areas, especially in winter when it often frequents areas around farmyards. Also inhabits grasslands, croplands, weedy fields, and, less commonly, semidesert and sagebrush shrublands.
Western scrub-jay (*Aphelocoma californica*)	5,000–7,000	Scrub-oak and piñon-juniper woodlands, ponderosa pine forests, wooded creek bottoms, and brushy ravines.
Western tanager (*Piranga ludoviciana*)	3,000–10,500	Breeds most commonly in ponderosa pine and Douglas-fir forests. It also regularly inhabits Gambel oak shrublands, especially those with trees, and piñon-juniper woodlands and aspen forests. During migration, it inhabits lowland riparian forests and wooded urban areas.
Western wood-pewee (*Contopus sordidulus*)	3,000–10,000	Commonly breeds in aspen forests. Also inhabits ponderosa pine and foothill riparian forests. It is generally less common in lodgepole pine, Douglas-fir, lowland riparian forests, and piñon-juniper woodlands. During migration, it frequents wooded riparian and urban areas.
White-breasted nuthatch (*Sitta carolinensis*)	3,000–11,500	Most common in ponderosa pine forests and piñon-juniper woodlands. It also regularly inhabits foothill and lowland riparian forests, and can be found in urban areas, especially in fall and winter.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
White-throated swift (*Aeronautes saxatalis*)	5,500–10,000	Nests in crevices in cliffs, canyon walls, pinnacles, and large rocks, and in human-made structures that provide crevice-like openings.
Yellow-rumped warbler (*Dendroica coronate*)	3,000–11,000	Nests in forests and open woodlands. During migration and winter, it inhabits open forests, woodlands, savannas, roadsides, pastures, and scrublands.

Sources: CPW (2011a); USGS (2007)

and chukar (*Alectoris chukar*). All the upland game bird species are year-round residents. The Gunnison sage-grouse (*Centrocercus minimus*), no longer considered an upland game bird in Colorado, is addressed in Section 3.6.4.

Table 3.6-10 lists the upland game bird species expected to inhabit areas within the lease tract boundaries.

Figure 3.6-7 shows the activity areas for the wild turkey in the three-county study area (CPW 2011a). Only lease tracts 26 and 27 occur within the overall range and winter range of the wild turkey. Winter habitat includes dense mature conifer stands that provide thermal protection and roost sites (Sargent and Carter 1999). Trees that produce pine nuts, juniper berries, or acorns are also important for food sources in winter (UCDC 2012). Table 3.6-11 provides the acreage of the wild turkey activity areas within the three-county study area and within the combined boundary for the lease tracts.

3.6.2.2.5 Regulatory Framework for Protection of Birds. The Federal regulatory framework for protecting birds includes the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and E.O. 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." The ESA is discussed in Section 6.6.4, and the other regulations are discussed briefly here:

- The Migratory Bird Treaty Act implements a variety of treaties and conventions in the United States, Canada, Mexico, Japan, and Russia. This Act provides that it is unlawful to pursue, hunt, take, capture or kill, possess, offer to sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg, or product, manufactured or not, unless permitted by regulations, except as authorized under a valid permit. Most of the bird species reported from the three-county study area Region are classified as migratory under this Act.

1 **TABLE 3.6-9 Raptor Species Expected To Occur within the Lease Tract Boundaries**

Species	Elevation (ft)	Habitat
American kestrel (*Falco sparverius*)	3,000–10,000	Inhabits virtually all terrestrial habitats, especially during migration. Most often inhabits agricultural areas, grasslands, riparian forest edges, and urban areas.
Cooper's hawk (*Accipiter cooperi*)	3,000–10,000	Mostly breeds in ponderosa pine, Douglas-fir, lodgepole pine, and aspen forests. Some may also inhabit riparian and spruce-fir forests and piñon-juniper woodlands. Migrants and winter residents inhabit the same habitats plus lowland riparian forests and urban areas. Migrants also inhabit open areas such as shrublands, grasslands, and agricultural areas.
Golden eagle (*Aquila chrysaetos*)	3,000–14,000	Inhabits grasslands, shrublands, piñon-juniper woodlands, and ponderosa pine forests. Occasionally inhabits. Nests are located on cliffs and sometimes in trees in rugged areas. Breeding birds range widely over surrounding habitats.
Long-eared owl (*Asio otus*)	3,000–9,000	In lowlands, it primarily inhabits riparian forests and windbreaks, but also urban areas and tamarisk thickets. In mountains, it primarily inhabits dense Douglas-fir forests. It primarily inhabits areas where there are dense, tall shrubs and/or trees. Also recorded from foothill shrublands, piñon-juniper woodlands, aspen forests, and spruce-fir forests.
Northern harrier (*Circus cyaneus*)	3,000–9,500	Inhabits grasslands, shrublands, agricultural areas, and marshes; also observed on alpine tundra in the fall. Breeds mainly in wet habitats.
Northern pygmy-owl (*Glaucidium gnoma*)	5,000–10,000	Inhabits coniferous forests, piñon-juniper woodlands, aspen forests, and foothills and montane riparian forests. Prefers canyons with running water and ecotonal areas.
Northern saw-whet owl (*Aegolius acadicus*)	5,500–10,000	Prefers dense forests or woodlands associated with water. Mostly inhabits ponderosa pine, Douglas-fir forests, lodgepole pine, spruce-fir and montane riparian forests, and piñon-juniper woodlands.
Prairie falcon (*Falco mexicanus*)	3,000–14,000	Breeding birds nest on cliffs or bluffs in open areas, and range widely over surrounding grasslands, shrublands, and alpine tundra. Migrants and winter residents mostly inhabits grasslands, shrublands, and agricultural areas.
Red-tailed hawk (*Buteo jamaicensis*)	3,000–13,500	Inhabits open areas with scattered, elevated perch sites in a wide range of altitudes and habitats such as scrub desert, plains and montane grasslands, agricultural fields, pastures, urban parklands, and broken coniferous and deciduous woodlands.

TABLE 3.6-9 (Cont.)

Species	Elevation (ft)	Habitat
Sharp-shinned hawk (*Accipiter striatus*)	3,000–11,500	Breeds in ponderosa pine, Douglas-fir, aspen, lodgepole pine, and spruce-fir forests; some may also inhabit riparian forests or piñon-juniper woodlands. Migrants and winter residents inhabit most types of forests and in urban areas and are often observed over open areas, such as shrublands, grasslands, and agricultural areas.
Swainson's hawk (*Buteo swainsoni*)	3,000–10,000	Inhabits grasslands, agricultural areas, shrublands, and riparian forests. Nests in trees in or near open areas. Migrants are often observed in treeless areas.
Turkey vulture (*Cathartes aura*)	3,000–9,000	Migrants and foraging birds inhabit most open habitats such as grasslands, shrublands, and agricultural areas. Nests on cliffs. Nests are located on the ground under vegetation; fallen, hollow logs; broken tree stumps; or in caves.
Western screech-owl (*Otus kennicottii*)	3,000–9,000	Inhabits mature lowland and foothill riparian forests with shrubby undergrowth and rural woodlots; also inhabits aspen and coniferous forests and from piñon-juniper woodlands.

Sources: CPW (2011a); USGS (2007)

TABLE 3.6-10 Upland Game Bird Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
Chukar (*Alectoris chukar*)	4,500–6,000	Inhabits desert areas with rocky canyons, steep hillsides, scattered bushes, and blankets of cheatgrass.
Gambel's quail (*Callipepla gambelii*)	4,500–7,000	Inhabits semidesert sagebrush and rabbitbrush shrublands, and adjacent agricultural areas. Requires tall shrubs such as greasewood and tamarisk.
Mourning dove (*Zenaida macroura*)	3,000–11,500	Inhabits grasslands, shrublands, croplands, lowland and foothill riparian forests, ponderosa pine forests, and urban areas. Rarely inhabits aspen forests, coniferous woodlands, forests other than ponderosa pine, and alpine tundra. In winter it mostly inhabits lowland riparian forests adjacent to cropland.
Wild turkey (*Meleagris gallopavo*)	3,000–8,000	Primarily inhabits ponderosa pine forests with an understory of Gambel oak. Tall pines used during all seasons for roosting. Also inhabits foothill shrublands (mountain mahogany), piñon-juniper woodlands, foothill riparian forests, and agricultural areas.

Source: CPW (2011a)

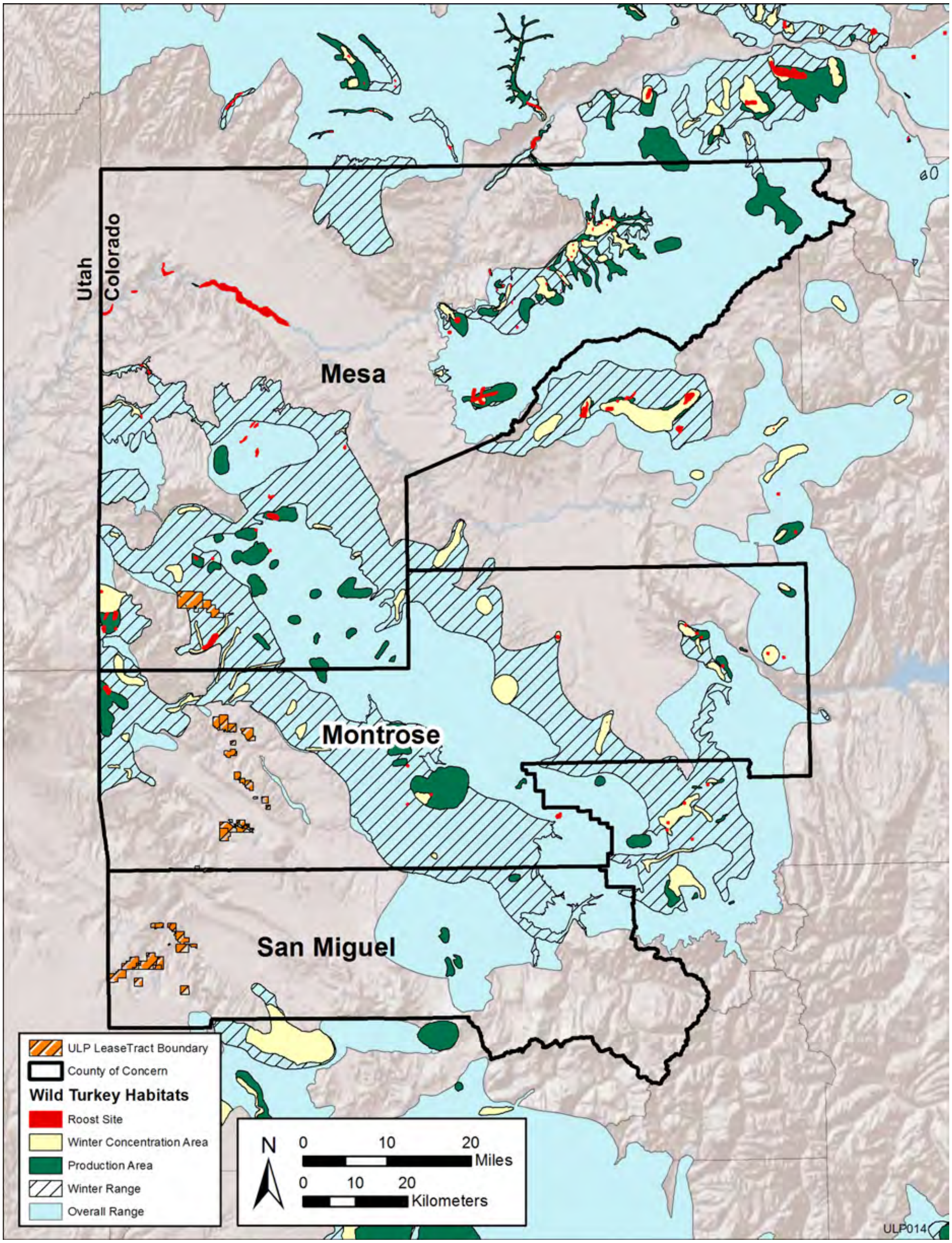


FIGURE 3.6-7 Wild Turkey Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-11 Acreages of Wild Turkey Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	2,202,563	5,000	26, 27
Production area	125,555	0	None
Roost sites	11,020	0	None
Winter range	928,954	5,000	26, 27
Winter concentration area	62,694	0	None

Source: CPW (2011a)

- The Bald and Golden Eagle Protection Act provides for the protection of bald and golden eagles by prohibiting the take, possession, sale, purchase or barter, offer to sell, transport, export, or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb;" and "disturb" means "to agitate or bother an eagle to a degree that causes, or is likely to cause, injury; decrease in its productivity, by substantially interfering with normal breeding, feeding or sheltering behavior; or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior." In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment.

- Under E.O. 13186, each Federal agency that is taking an action that has or is likely to have negative impacts on migratory bird populations must work with the USFWS to develop an agreement to conserve those birds. The protocols developed by this consultation are intended to guide future agency regulatory actions and policy decisions.

3.6.2.3 Mammals

More than 80 mammal species occur in the three-county study area (Table 3.6-6). The following discussion emphasizes big game and other mammal species that (1) have key habitats within or near the lease tracts, (2) are important to humans (e.g., big and small game and furbearer species), and/or (3) are representative of other species that share important habitats. Threatened, endangered, and other special status mammal species are addressed in Section 3.6.4.

3.6.2.3.1 Big Game. The big game species within the three-county study area include American black bear (*Ursus americanus*), cougar (*Puma concolor*), desert bighorn sheep (*Ovis canadensis nelsoni*), elk (*Cervis canadensis*), moose (*Alces americanus*) mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*). Because the moose is located only in the far eastern and northern most portions of the three-county study area, it is geographically separated from the lease tracts; therefore, the species will not be addressed further in the ULP PEIS. A number of the big game species migrate when seasonal changes reduce food availability, when movement within an area becomes difficult (e.g., due to snow pack), or when local conditions are not suitable for calving or fawning. Established migration corridors provide important transition habitats between seasonal ranges and provide food sources for the animals during migration (Feeney et al. 2004). Maintaining genetic interchange through landscape linkages among subpopulations is also essential for the long-term survival of species. Maintaining migration corridors and landscape linkages, especially when seasonal ranges or subpopulations are far removed from each other, can be difficult because of the various land ownership mixes that often need to be traversed (Sawyer et al. 2005). Although migration corridors for the desert bighorn sheep, elk, and mule deer are present within the three-county study area, the lease tracts do not occur within those corridors.

Table 3.6-12 provides a description of the various activity areas that have been mapped for the big game species in Colorado. Table 3.6-13 provides habitat information for the big game species expected to occur within the lease tract boundaries.

The following presents a generalized overview of the big game species that inhabit the lease tracts.

American Black Bear. The American black bear occurs mostly within forested or brushy mountain environments and woody riparian corridors (UDWR 2008). It is considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). The omnivorous American black bear will feed on forbs and grasses, fruits and acorns, insects, small vertebrates, and carrion depending on their seasonal availability (CPW 2011a). Breeding occurs in June or July, with young born in January or February (UDWR 2008). American black bears are generally nocturnal and have a period of winter dormancy (UDWR 2008). They are locally threatened by habitat loss and disturbance by humans (NatureServe 2011). The home range size of American black bears varies, depending on the area and the bear's gender, and has been reported to be from about 1,250 to nearly 32,200 acres (500 to 13,000 ha) (NatureServe 2011).

TABLE 3.6-12 Descriptions of Big Game Activity Areas in Colorado

Activity Area	Activity Area Description
Concentration area	That part of the overall range where densities are at least 200% greater than they are in the surrounding area during a season other than winter.
Fall concentration area	That part of the overall range occupied from August 15 until September 30 for the purpose of ingesting large quantities of mast and berries to establish fat reserves for the winter hibernation period. Applies to the American black bear.
Migration corridor	Specific mappable site through which large numbers of animals migrate and the loss of which would change migration routes.
Overall range	Area that encompasses all known seasonal activity areas for a population.
Production area	That part of the overall range occupied by females from May 15 to June 15 for calving. Applies to ungulates.
Resident population area	Area used year-round by a population (i.e., an individual could be found in any part of the area at any time of the year).
Severe winter range	That part of the winter range where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum during the 2 worst winters out of 10. Applies to ungulates.
Summer concentration area	That portion of the overall range where individuals congregate from mid-June through mid-August.
Summer range	That portion of the overall range where 90% of the individuals are located between spring green-up and the first heavy snowfall.
Water source	Water sources known to be utilized (by bighorn sheep) in dry, water scarce areas. Up to a 1- mi radius described around a point source, and up to a 1-mi band along a river or stream.
Winter concentration area	That part of the winter range where densities are at least 200% greater than in the surrounding winter range during an average of 5 winters out of 10.
Winter range	That part of the overall range where 90% of the individuals are located during an average of 5 winters out of 10 from the first heavy snowfall to spring green-up.

Source: CPW (2011a)

TABLE 3.6-13 Habitat Information for Big Game Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
American black bear (*Ursus americanus*)	4,500–11,500	Montane shrublands and forests, and subalpine forests at moderate elevations. Dens in mixed conifer forests, piñon-juniper woodlands, spruce-fir forests, ponderosa pine forests, and oak shrublands.
Cougar (*Puma concolor*)	3,000–12,500	Most common in rough, broken foothills and canyon country, often in association with montane forests, shrublands, and piñon-juniper woodlands.
Desert bighorn sheep (*Ovis canadensis nelsoni*)	2,500–5,500 (winter) 6,000–10,000 (summer) Mainly 4,500–9,000 in project area	Vertical cliffs and sandstone rims to rolling flat desert valley bottoms dissected by gulches. Piñon-juniper and desert shrubs in canyons and mesas, aspen and ponderosa pine in upper drainages, and grasslands intermixed with oak brush, sagebrush, and juniper woodlands at intermediate elevations.
Elk (*Cervis canadensis*)	6,000–13,000	Semi-open forests or forest edges adjacent to parks, meadows, and alpine tundra.
Mule deer (*Odocoileus hemionus*)	3,000–13,000	All ecosystems from grasslands to alpine tundra. Highest densities in shrublands on rough, broken terrain, which provide abundant browse and cover.
Pronghorn (*Antilocapra americana*)	3,000–9,500	Grasslands and semidesert shrublands on rolling topography that affords good visibility. Most abundant in shortgrass or midgrass prairies, and least common in xeric habitats.

Sources: BLM and CDOW (1989); CPW (2011a); Streubel (2000); USGS (2007)

All the lease tracts occur within the overall range for the American black bear. Table 3.6-14 provides the acreage of the American black bear activity areas within the three-county study area and within the combined boundary for the lease tracts.

Cougar. Cougars (also known as mountain lions or puma) inhabit most ecosystems in the three-county study area but are most common in the rough, broken terrain of foothills and canyons, often in association with montane forests, shrublands, and piñon-juniper woodlands (CPW 2011a). They mostly occur in remote and inaccessible areas (NatureServe 2011). They are considered apparently secure in Colorado (uncommon but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011). Their annual home range can be more than 560 mi^2 (1,450 km^2), while densities are usually not more than 10 adults per 100 mi^2

TABLE 3.6-14 Acreages of American Black Bear Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreages		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	4,377,502	25,909	All
Summer concentration area	645,821	0	None
Fall concentration area	759,012	0	None

Source: CPW (2011a)

(259 km^2) (NatureServe 2011). The cougar is generally found where its prey species (especially mule deer) are located. In addition to preying on deer, cougars prey upon most other mammals (which sometimes include domestic livestock) and some insects, birds, fishes, and berries (CPW 2011a). They are active year-round. Their peak periods of activity are within 2 hours of sunset and sunrise, although their activity peaks after sunset when they are near humans (NatureServe 2011; UDWR 2008). In some states, they are hunted on a limited and closely monitored basis (NatureServe 2011).

The overall range of the cougar covers the three-county study area, including all the lease tracts, and 122,000 acres (302,000 ha) of cougar peripheral range habitat occurs within Mesa County. Peripheral range is the part of the overall range where habitat is limited and populations are isolated. Population density may also be lower there than in the central part of the cougar’s range (CPW 2011a). None of the tract leases in Mesa County is located near cougar peripheral range habitat.

Desert Bighorn Sheep. The bighorn sheep is considered apparently secure in Colorado (uncommon, but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011).[16] The bighorn sheep is considered to be a year-long resident; it does not make seasonal migrations like elk and mule deer. Winter snow pack can limit the distribution and survival of bighorn sheep; therefore, during winter many of the larger herds in Colorado are associated with areas that receive warm, down slope, winter winds or low to mid-elevation cold desert habitats (George et al. 2009). Ewes move to reliable water courses or water sources during the lambing season, with lambing occurring on steep talus slopes within 1 mi to 2 mi (1.6 km to 3.2 km) of water. Bighorn sheep prefer open vegetation, such as low shrub, grassland, and other

[16] Within Colorado, there are two subspecies of bighorn sheep: the Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) and the desert bighorn sheep (*O. c. nelsoni*). The desert bighorn sheep, a BLM sensitive species (see Section 3.6.4), is the subspecies that inhabits areas within or near the lease tract boundaries.

treeless areas with steep talus and rubble slopes. Unsuitable habitats include open water, wetlands, dense forests, and other areas without grass understory (NatureServe 2011). Their annual home ranges can be up to 23 mi^2 (37 km^2) for males and 12 mi^2 to 17 mi^2 (19 to 27 km^2) for females (NatureServe 2011).

The diet of the bighorn sheep consists of shrubs, forbs, and grasses. In the early 1900s, bighorn sheep experienced significant declines due to disease, habitat degradation, and hunting. Threats to bighorn sheep include habitat changes resulting from fire suppression, interactions with feral and domestic animals, and human encroachment (NatureServe 2011). Bighorn sheep are very vulnerable to viral and bacterial diseases carried by livestock, particularly domestic sheep. Therefore, the BLM has adopted specific guidelines regarding domestic sheep grazing in or near bighorn sheep habitat. In appropriate locations, reintroduction efforts, coupled with water and vegetation improvements, have been conducted to restore bighorn sheep populations.

Thirty-six desert bighorn sheep were first introduced to Colorado from 1979 through 1981from translocations of individuals from Nevada and Arizona (BLM and CDOW 1989). The desert bighorn sheep occurs in the extreme western portion of the state within portions of Mesa, Montrose, San Miguel, and Dolores Counties. There are only four herds of desert bighorn sheep totaling about 325 individuals (in 2007). These herds occur in Game Management Units S56, S62, S63, and S64 (George et al. 2009). The population of desert bighorn sheep in Colorado falls short of the population objective of 1,200 individuals set by BLM and CDOW (1989). Respiratory disease, habitat quantity and quality, and cougar predation account for the failure to reach the population objective (George et al. 2009).

Figure 3.6-8 shows the activity areas for the desert bighorn sheep in the three-county study area (CPW 2011a). Within the study area, the desert bighorn sheep primarily inhabits areas along the Dolores, Gunnison, and lower Uncompahgre Rivers. Several of the lease tracts within the Uravan, Paradox, and Slick Rock Lease Tracts occur within the overall, winter, and summer ranges of the desert bighorn sheep; primarily of the 100 individuals of desert bighorn sheep in the two herds of Game Management Units S63 and S64 (George et al. 2009). Based on limited data collected for desert bighorn sheep with GPS collars, individuals have been recorded within lease tracts 9, 13A, 14, and 15 (CPW 2012b). Table 3.6-15 provides the acreage of the desert bighorn sheep activity areas within the three-county study area and within the combined boundary for the lease tracts.

Although there are no mapped migration corridors in the area of the lease tracts, data provided for desert bighorn sheep occurrence (CPW 2012b) demonstrate that Lease Tracts 13, 13A, and 14 provide a critical linkage point between the upper Dolores and middle Dolores desert bighorn sheep populations. Lease Tracts 15 and 15A are also important to the desert bighorn sheep, and Lease Tract 17 occurs in an area that seems to funnel desert bighorn sheep movements in the area. GPS collars on individual desert bighorn sheep in the Dolores River area have demonstrated that the area around Slick Rock is a significant movement corridor between the two desert bighorn sheep populations and may be where many of the sheep lamb and winter (CPW 2012b).

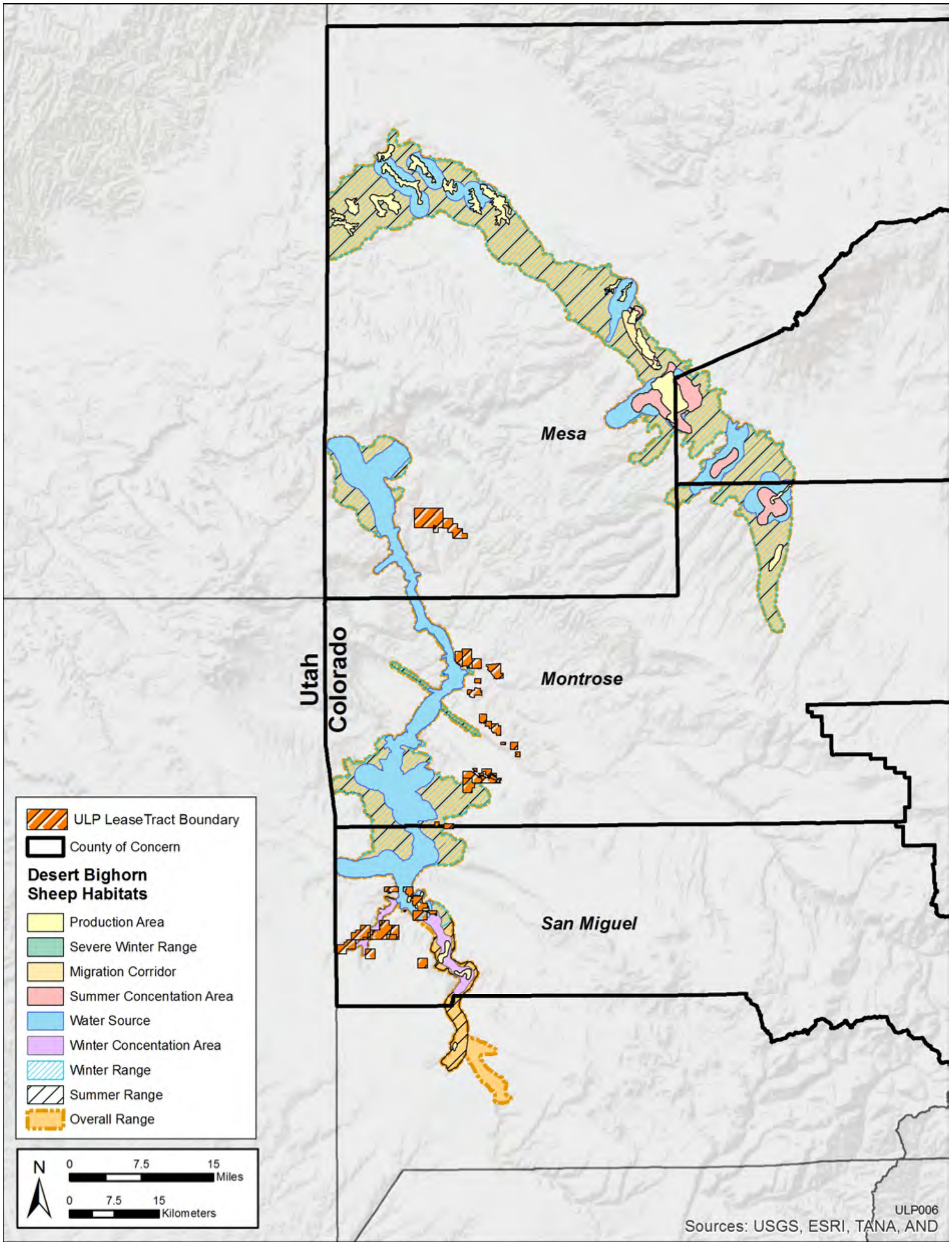


FIGURE 3.6-8 Desert Bighorn Sheep Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-15 Acreages of Desert Bighorn Sheep Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

Activity Area	Acreage: Three-County Study Area	Acreage: Lease Tract Boundaries	Lease Tracts
Overall range	380,836	4,263	8, 9, 10, 11, 11A, 13, 13A, 14, 15, 16, 17, 19
Migration corridor	4,087	0	None
Production area	26,819	709	13, 13A, 14
Winter range	371,100	3,695	8, 9, 10, 11, 11A, 13, 13A, 16, 17, 19, 19A, 20
Winter concentration area	28,008	2,621	10, 11, 11A, 13, 13A, 16, 19A, 20
Severe winter range	0	0	None
Summer range	373,472	3,276	8, 9, 10, 11, 11A, 13, 13A, 14, 15, 16, 17, 19, 19A, 20
Summer concentration area	14,819	0	None
Water source	148,697	2,420	13, 13A14, 15, 19, 19A, 20

Source: CPW (2011a)

Elk. The elk is considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). Elk generally migrate between their summer and winter ranges, although some herds remain within the same area year-round (UDWR 2005). Their summer range occurs at higher elevations. Aspen and conifer woodlands provide security and thermal cover, while upland meadows, sagebrush/mixed grass, and mountain shrub habitats are used for forage. Their winter range occurs at mid to lower elevations, where they forage in sagebrush/mixed grass, big sagebrush/rabbitbrush, and mountain shrub habitats. They are highly mobile within both their summer and winter ranges as they search for the best forage conditions. In winter, they congregate into large herds of 50 to more than 200 individuals. The crucial winter range is considered to be the part of the local elk range where about 90% of the local population is located during an average of 5 winters out of 10 from the first heavy snowfall to spring. Elk calving generally occurs in aspen-sagebrush parkland vegetation and habitat zones during late spring and early summer. Calving areas are located mostly where cover, forage, and water are nearby. Migratory herds may move up to 60 mi (97 km) annually, while nonmigratory herds have a home range of 0.7 mi^2 to 2.0 mi^2 (1.8 km^2 to 5.3 km^2) (NatureServe 2011). Elk are susceptible to chronic wasting disease.

Figure 3.6-9 shows the activity areas for the elk in the three-county study area, and Figure 3.6-10 shows the various winter activity areas for the elk within the lease tracts (CPW 2011a). All the lease tracts occur within the overall range of the elk, and more than 70% of the lease tracts occur within the winter range and severe winter range habitats. Table 3.6-16 provides the acreage of the elk activity areas within the three-county study area and within the combined boundary for the lease tracts.

Mule Deer. Mule deer occur within most ecosystems in the three-county study area but attain their highest densities in shrublands characterized by rough, broken terrain with abundant browse and cover. The deer are considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). The size of their home range can vary from 74 to 590 acres (180 to 1,500 ha) or more, depending on the availability of food, water, and cover (NatureServe 2011). Some populations of mule deer are resident (particularly those that inhabit plains), but those in mountainous areas generally migrate between their summer and winter ranges (NatureServe 2011). In arid regions, they may migrate in response to rainfall patterns (NatureServe 2011). In mountainous regions, they may migrate more than 62 mi (100 km) between high summer and lower winter ranges (NatureServe 2011). Their summer range is at higher elevations that contain aspen and conifers and mountain browse vegetation. Fawning occurs during the spring while the mule deer are migrating to their summer range. This normally occurs in aspen-mountain browse intermixed vegetation.

Mule deer have a high fidelity to specific winter ranges, where they congregate within a small area at a high density. Their winter range is at lower elevations within sagebrush and piñon-juniper vegetation. Winter forage is primarily sagebrush, but Colorado birchleaf mountain-mahogany (*Cercocarpus montanus*), fourwing saltbush (*Atriplex canescens*), and antelope bitterbrush (*Purshia tridentata*) are also important. Piñon-juniper provides emergency forage during severe winters. Overall, mule deer habitat is characterized by areas of thick brush or trees (used for cover) interspersed with small openings (for forage and feeding areas); mule deer do best in habitats that are in the early stage of succession (UDWR 2003). Prolonged drought and other factors can limit mule deer populations. Several years of drought can limit forage production, which can substantially adversely affect the animals' condition and fawn production and survival. Severe drought conditions were responsible for declines in the population of mule deer in the 1980s and early 1990s. In arid regions, they are seldom found more than 1.0 to 1.5 mi (1.6 to 2.4 km) from water. Mule deer are also susceptible to chronic wasting disease. When the disease is present, up to 3% of a herd's population can be affected. Some deer herds in Colorado have experienced significant outbreaks of chronic wasting disease.

Figure 3.6-11 shows the activity areas for the mule deer in the three-county study area, and Figure 3.6-12 shows the various winter activity areas for the mule deer within the lease tracts (CPW 2011a). All the lease tracts occur within the overall range of the mule deer, and more than 70% of the lease tracts occur within mule deer winter range and severe winter range habitats. Table 3.6-17 provides the acreage of the mule deer activity areas within the three-county study area and within the combined boundary for the lease tracts.

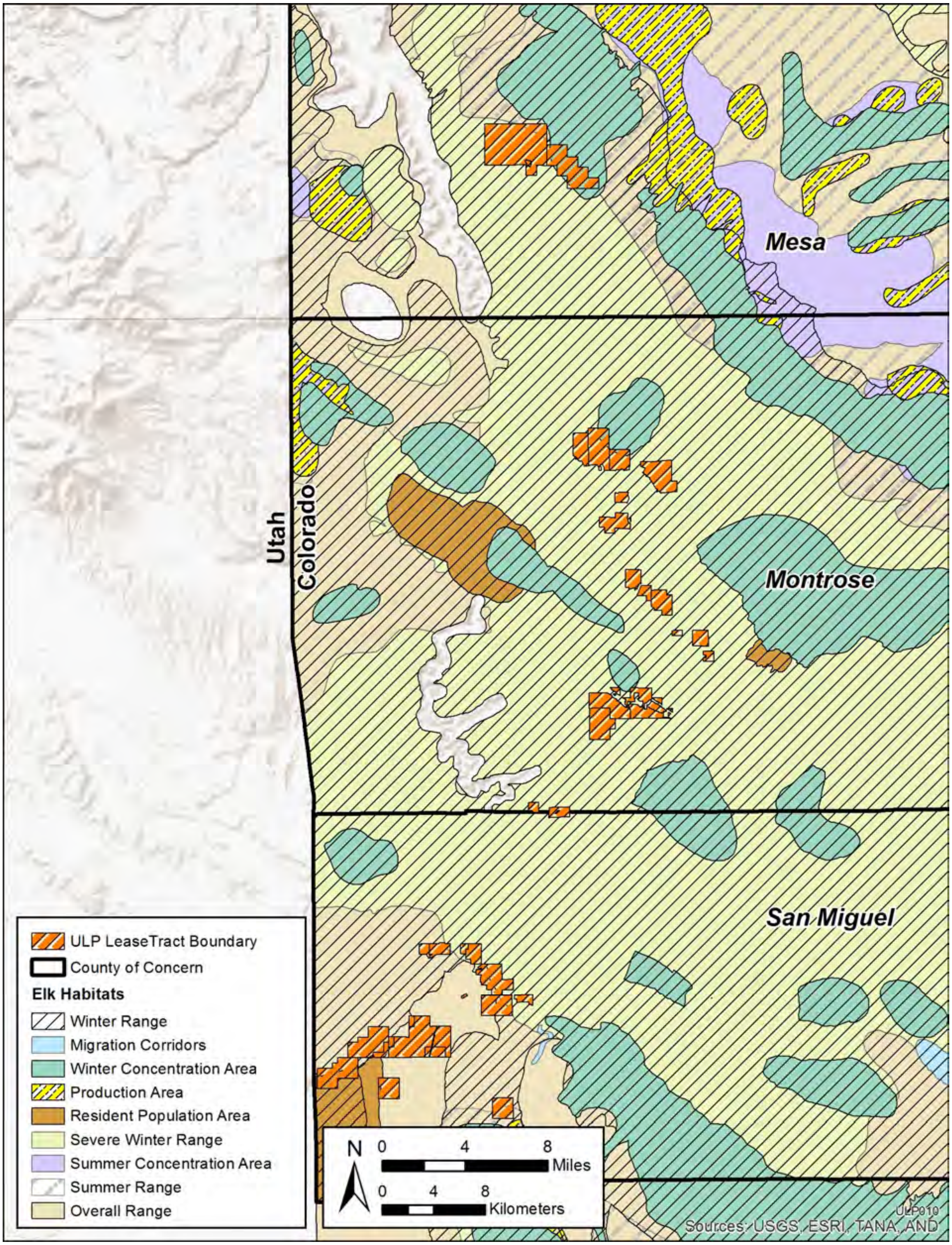
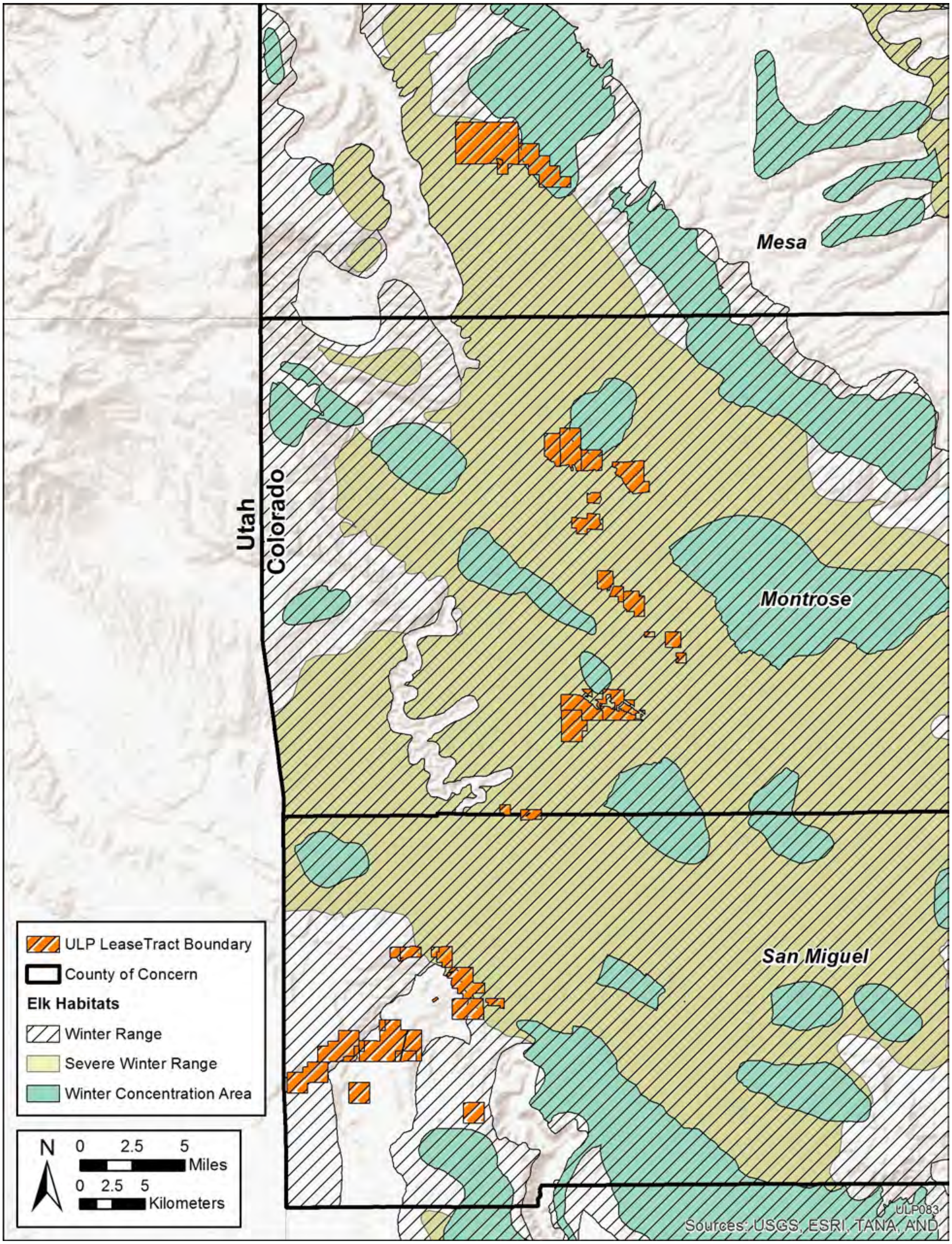


FIGURE 3.6-9 Elk Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)



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2 **FIGURE 3.6-10 Elk Winter Activity Areas within the Lease Tracts (CPW 2011a)**

TABLE 3.6-16 Acreages of Elk Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	3,859,070	25,909	All
Migration corridor	99,611	0	None
Production area	287,244	0	None
Winter range	2,515,281	16,371	5, 5A, 6, 7, 8, 8A, 9, 13, 13A, 14, 15, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Winter concentration area	533,978	1,994	7, 8A, 19A, 20, 26, 27
Severe winter range	1,155,714	16,846	5, 5A, 6, 7, 8, 8A, 9, 13, 13A, 14, 15, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Summer range	1,531,501	1,060	12, 19A, 20, 26, 27
Summer concentration area	432,072	0	None
Resident population area	133,097	758	10, 11, 11A, 19A, 20

Source: CPW (2011a)

Pronghorn. Pronghorns inhabit nonforested areas such as desert, grassland, and sagebrush habitats. They are considered apparently secure in Colorado (uncommon but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011). Herd size can commonly exceed 100 individuals, especially during winter. Pronghorns consume a variety of forbs, shrubs, and grasses, with shrubs being most important in winter. Some pronghorns are year-long residents and do not have seasonal ranges. Fawning occurs throughout the species range. However, some seasonal movement within their range occurs in response to factors such as extreme winter conditions and water or forage availability. Other pronghorns are migratory. Most herds range within an area 5 mi (8 km) or more in diameter, although the separation between summer and winter ranges has been reported to be as much as 99 mi (159 km) or more (NatureServe 2011). Pronghorn populations have been adversely affected in some areas by historic range degradation and habitat loss and by periodic drought conditions.

Figure 3.6-13 shows the activity areas for the pronghorn in the three-county study area (CPW 2011a). Only lease tract 13 occurs within pronghorn activity areas. Table 3.6-18 provides

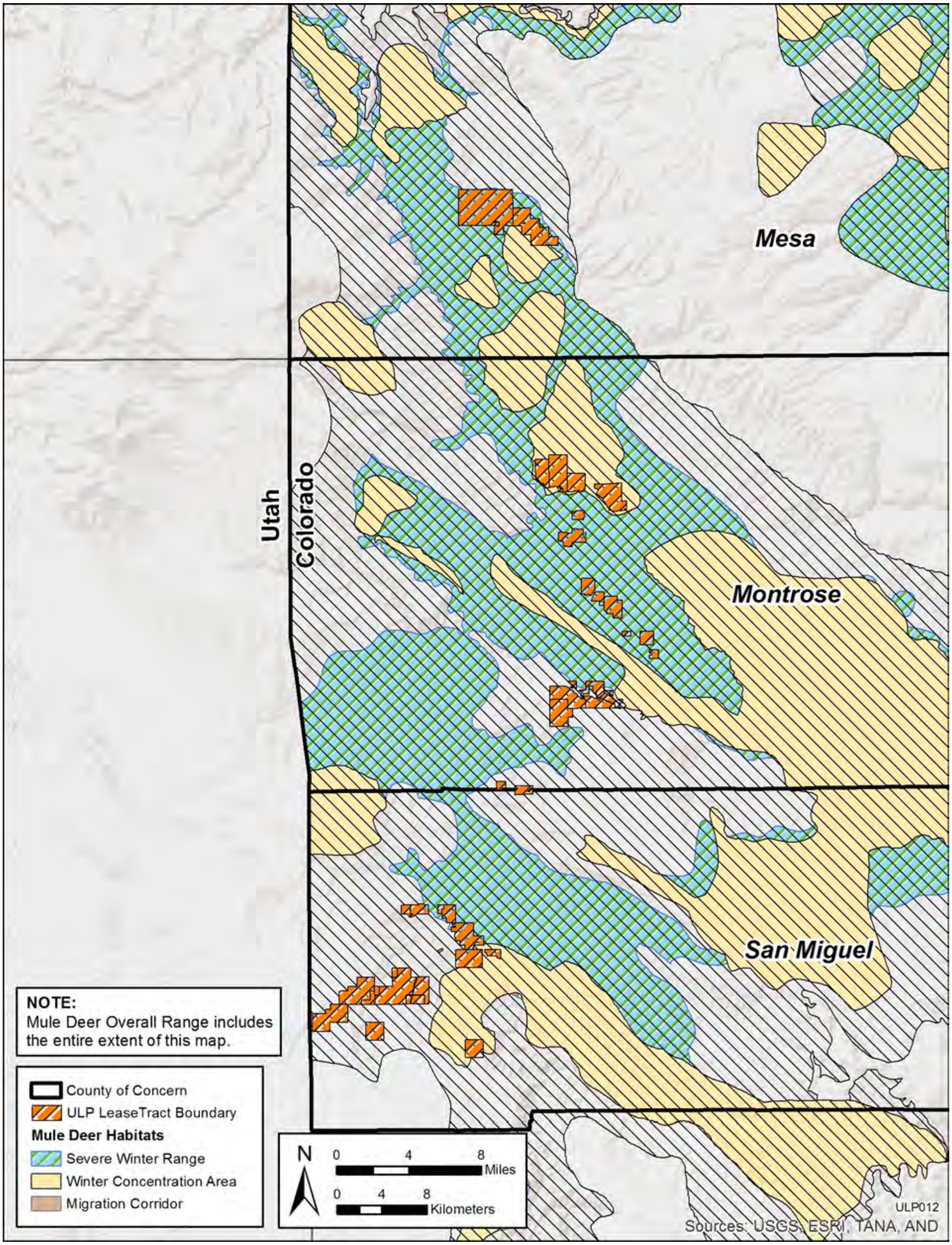

FIGURE 3.6-11 Mule Deer Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

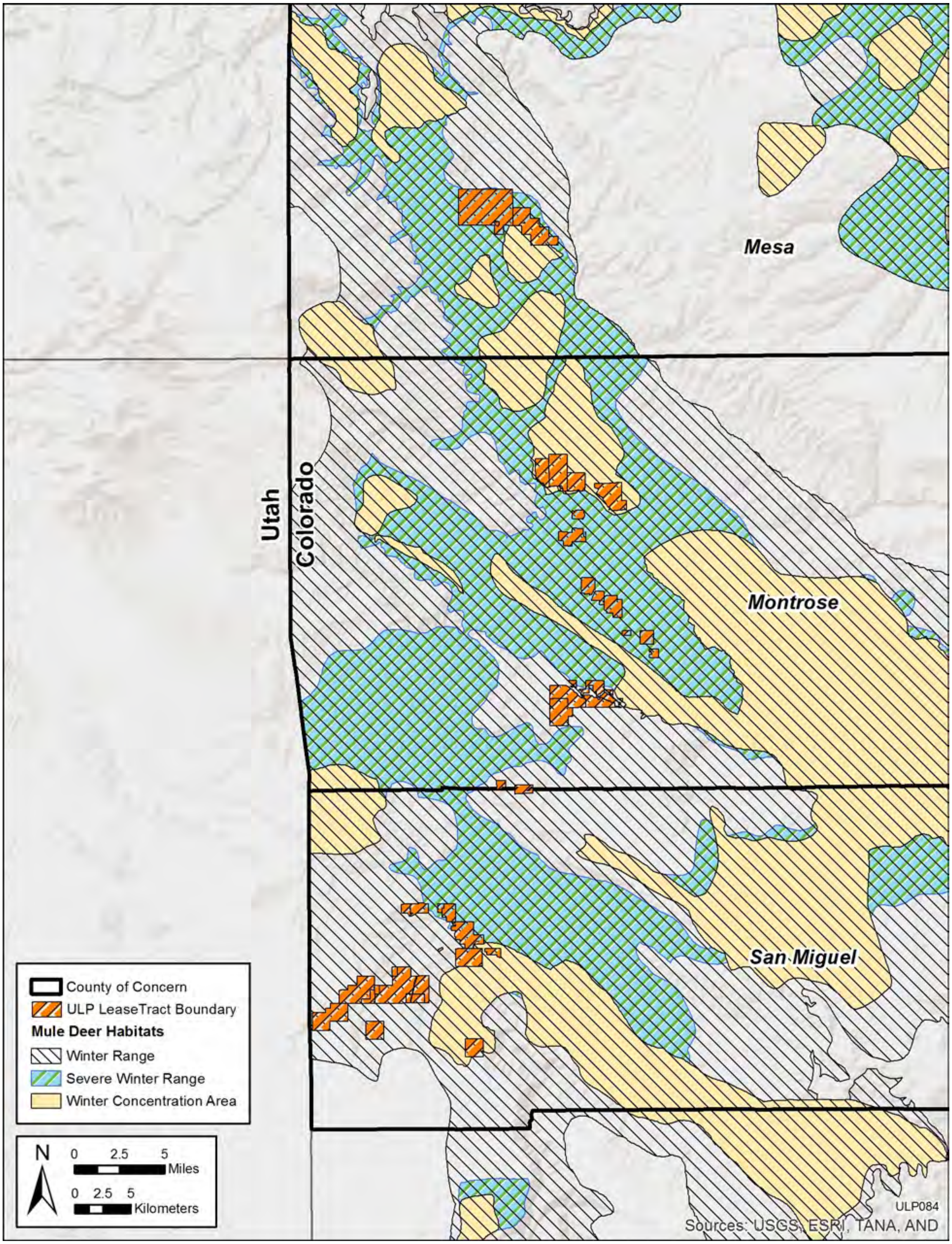

FIGURE 3.6-12 Mule Deer Winter Activity Areas within the Lease Tracts (CPW 2011a)

TABLE 3.6-17 Acreages of Mule Deer Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	4,389,942	25,909	All
Migration corridor	57,159	0	None
Winter range	2,583,851	25,909	All
Winter concentration area	690,210	5,817	5A, 12, 13, 14, 18, 19, 19A, 20, 26, 27
Severe winter range	1,186,029	14,524	5A, 7, 8A, 12, 13, 13A, 14, 15, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Summer range	2,267,402	<1	27
Concentration area	155,470	0	None
Resident population area	487,478	656	10, 12

Source: CPW (2011a)

the acreage of the pronghorn activity areas within the three-county study area and within the combined boundary for the lease tracts.

3.6.2.3.2 Other Mammals. Other mammals that occur in the three-county study area include small game, furbearers, and nongame species. Small game species that occur within the three-county study area include black-tailed jackrabbit (*Lepus californicus*), white-tailed jackrabbit (*Lepus townsendii*), desert cottontail (*Sylvilagus audubonii*), mountain cottontail (*S. nuttallii*), squirrels (*Sciurus* spp.), snowshoe hare (*L. americanus*), and yellow-bellied marmot (*Marmota flaviventris*). Furbearers include American badger (*Taxidea taxus*), American marten (*Martes americana*), American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), common muskrat (*Ondatra zibethicus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*). Nongame species include bats, shrews, mice, voles, chipmunks, and many other rodent species. Bats are of particular concern because their populations have declined in many parts of North America and because a number of bat species roost or hibernate in mines.

Nineteen species of bats occur in Colorado (Colorado Bat Working Group 2010a). Mining is one of the issue categories that affect bat populations in Colorado (Ellison et al. 2003).

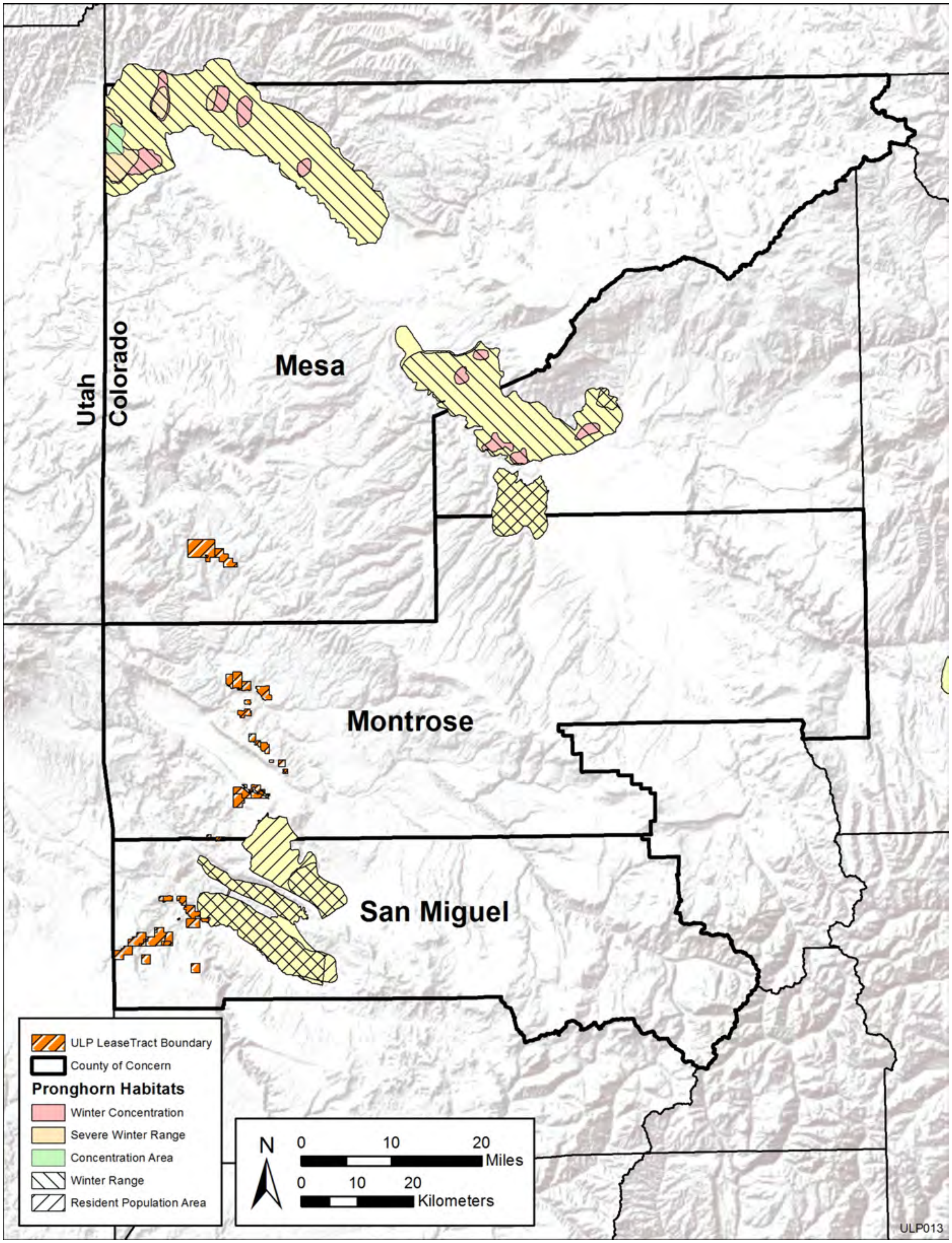

FIGURE 3.6-13 Pronghorn Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-18 Acreages of Pronghorn Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tract
Overall range	290,431	30	13
Winter range	257,064	30	13
Winter concentration area	30,152	0	None
Severe winter range	15,469	0	None
Concentration area	3,551	0	None
Resident population area	93,020	30	13

Source: CPW (2011a)

As recreational caving and deforestation diminishes natural bat habitat, abandoned mines have increased in importance as roosting habitat. About 30% of the 23,000 abandoned mines in Colorado show signs of providing bat roosting habitat (Ellison et al. 2003). Abandoned mines surveyed in Lease Tracts 13, 13A, 14, 15, 16, 23, 26, and 27 have been observed to provide summer and/or winter roosting habitat for twelve bat species (Woodward 2012a,b; Table 3.6-19). The spotted bat (*Euderma maculatum*), fringed myotis (*Myotis thysanodes*), long-eared myotis (*M. evotis*), long-legged myotis (*M. volans*), western small-footed myotis (*M. ciliolabrum*), California myotis (*M. californicus*), and Yuma myotis (*M. yumanensis*) have been observed in abandoned uranium mines in Colorado (DOE 1995). Some of the DOE-reclaimed mine sites have bat gate closures to protect these bat habitats.

Table 3.6-20 provides habitat information for the small game, furbearer, and nongame mammal species expected to occur within the lease tract boundaries. Information on threatened, endangered, and other special status mammal species is provided in Section 3.6.4.

3.6.3 Aquatic Biota

The three-county study area contains a variety of freshwater aquatic habitats, which, in turn, support a wide diversity of aquatic biota. Aquatic habitats range in size and permanency from ephemeral ponds and streams to the Dolores and San Miguel Rivers. Sport fish in the three-county study area include trout (family Salmonidae), catfish (family Ictaluridae), sunfish and black basses (family Centrarchidae), suckers (family Catostomidae), perch and walleye (family

TABLE 3.6-19 Bat Species Reported from Abandoned Mines within the ULP Lease Tracts

Species	Lease Tract
Big brown bat (*Eptesicus fuscus*)	13A, 15, 16, 23, 26, 27
Big free-tailed bat (*Nyctinomops macrotis*)	13
California myotis (*Myotis californicus*)	13A, 14, 15, 16, 23, 26, 27
Fringed myotis (*Myotis thysanodes*)	14, 23, 26, 27
Little brown bat (*Myotis lucifugus*)	13
Long-eared myotis (*Myotis evotis*)	14, 26, 27
Long-legged myotis (*Myotis volans*)	13A, 14, 15, 23, 26, 27
Spotted bat (*Euderma maculatum*)	27
Townsend's big-eared bat (*Corynorhinus townsendii*)	13, 13A, 14, 15, 16, 23, 26, 27
Western pipistrelle (*Pipistrellus hesperus*)	13
Western small-footed myotis (*Myotis ciliolabrum*)	13A, 14, 15, 16, 23, 26, 27

Source: Woodward (2012a)

Percidae), and pike (family Esocidae). In addition to fish, aquatic habitats also support a large variety of aquatic invertebrates, including crustaceans and insects.

Valdez et al. (1992) identified 11 orders of macroinvertebrates in the Dolores and San Miguel Rivers. Diptera (true flies), Ephemeroptera (mayflies), and Trichoptera (Caddisflies) made up more than 85% of the macroinvertebrates in the Dolores River and more than 70% of the macroinvertebrates in the San Miguel River. The crayfish *Orconectes virilis* was abundant in the Dolores River. Valdez et al. (1992) reported that macroinvertebrate diversity was very low in the Dolores and San Miguel Rivers in the 1970s and 1980s. Biotic Condition Index values for the Dolores and San Miguel Rivers for 1991 rated the rivers as excellent and fair to poor, respectively (Valdez et al. 1992).

Historically, only 12 species of fish were native to the Upper Colorado River Basin, including 5 minnow species, 4 sucker species, 2 salmonids, and the mottled sculpin (*Cottus bairdii*, family Cottidae). Four of these native species (humpback chub [*Gila cypha*], bonytail [*Gila elegans*], Colorado pikeminnow [*Ptychocheilus lucius*], and razorback sucker [*Xyrauchen texanus*]) are now Federally listed as endangered, and critical habitat for these species has been designated within the Upper Colorado River Basin (see Section 3.6.4). The roundtail chub (*Gila robusta*), bluehead sucker (*Catastomus discobolus*), and flannelmouth sucker (*Catastomus latipinnis*) (which occur in both the Dolores and San Miguel Rivers) are BLM-sensitive species, and the roundtail chub is also a Colorado species of special concern. See Section 3.6.4 for additional information on these species. In addition to native fish species, more than 25 non-native fish species are now present in the basin, often as a result of intentional introductions (e.g., for establishment of sport fisheries) (Muth et al. 2000; McAda 2003). Most of the trout species found within the Upper Colorado River Basin are introduced non-natives (e.g., rainbow trout [*Oncorhynchus mykiss*], brown trout [*Salmo trutta*], and some strains of cutthroat trout [*Oncorhynchus clarkii*]). However, the mountain whitefish (*Prosopium*

TABLE 3.6-20 Small Game, Furbearer, and Nongame Mammal Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
Small Game and Furbearers		
American badger (*Taxidea taxus*)	4,500–14,500	Grasslands, meadows in subalpine and montane forests, alpine tundra, and semidesert shrublands.
Black-tailed jackrabbit (*Lepus californicus*)	3,000–7,000	Grasslands and semidesert shrublands.
Bobcat (*Lynx rufus*)	3,000–14,500	Most common in the rocky, broken terrain of foothills and canyonlands. Preferred habitats are piñon-juniper woodlands and montane forests, although it inhabits all terrestrial ecosystems.
Coyote (*Canis latrans*)	3,000–14,500	All terrestrial habitats, but least abundant in dense coniferous forests.
Desert cottontail (*Sylvilagus audubonii*)	3,000–7,000	Variety of habitats, including montane shrublands, riparian lands, semidesert shrublands, piñon-juniper woodlands, and various woodland-edge habitats. It will inhabit areas with minimal vegetation provided that adequate cover is present in the form of burrows, scattered trees and shrubs, or crevices and spaces under rocks.
Gray fox (*Urocyon cinereoargenteus*)	5,500–13,000	Usually rough, broken terrain in semidesert shrublands, montane shrublands, piñon-juniper and riparian woodlands, orchards, and weedy margins of croplands.
Long-tailed weasel (*Mustela frenata*)	3,000–14,500	All habitat types. Distribution is probably more dependent on availability of prey species than on vegetation or topography.
Mountain cottontail (*Sylvilagus nuttallii*)	6,000–11,500	Montane shrublands and semidesert shrublands and the edges of piñon-juniper woodlands and montane and subalpine forests. Also inhabits open parklands with sufficient shrub, rock, or tree cover.
Red fox (*Vulpes vulpes*)	3,000–14,500	Most common in open woodlands, pasturelands, and riparian and agricultural lands. Prefers areas with a mixture of these vegetation types. Also inhabits the margins of urbanized areas and is common in open spaces and other undeveloped areas adjacent to cities. In the mountains, it inhabits montane and subalpine meadows as well as in alpine and forest edges, usually near water.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Small Game and Furbearers (Cont.)		
Ringtail (*Bassariscus astutus*)	3,000–9,500	Arid and semiarid habitats. Typically associated with rocky canyon country and foothills areas of piñon-juniper woodlands, montane shrublands, and mixed conifer-oakbrush.
Striped skunk (*Mephitis mephitis*)	3,000–10,000	Wide range of grassland, shrubland, forestland, wetland, and riparian habitats.
Western spotted skunk (*Spilogale gracilis*)	4,000–8,000	Common in shrub habitats in broken country. Also inhabits montane forest and shrublands, semidesert shrublands, and piñon-juniper woodlands. Frequents rocky habitats.
White-tailed jackrabbit (*Lepus townsendii*)	4,000–14,500	Mostly semidesert shrublands, but also many grassland, shrubland, and forestland habitats.
Nongame (Small) Mammals		
Big brown bat (*Eptesicus fuscus*)	3,000–10,000	Variety of shrublands, forestlands, wetlands, and riparian areas. Roosts in dwellings and other structures, hollow trees, rock crevices, caves, under bridges, and in practically any other location that offers concealment and cover from the elements.
Botta's pocket gopher (*Thomomys bottae*)	4,000–8,500	Various vegetation types, including agricultural land, grasslands, roadsides, open parklands, piñon-juniper woodlands, open montane forest, montane shrublands, and semidesert shrublands.
Brazilian free-tailed bat (*Tadarida brasiliensis*)	3,000–9,500	Piñon-juniper woodlands, arid grasslands, and semidesert shrublands. Typically roosts in caves, mines, rock fissures, or buildings.
Brush mouse (*Peromyscus boylii*)	4,000–8,500	Montane shrublands, piñon-juniper woodlands, riparian cottonwood stands, willow thickets, and brushy salt-cedar (tamarisk) bottoms. Usually inhabits areas of rough, broken terrain with boulders and heavy brush.
Bushy-tailed woodrat (*Neotoma cinerea*)	4,500–14,000	Montane and subalpine forests, ponderosa pine forests, aspen communities, and alpine talus. Common around old mining camps and diggings at higher elevations. Also inhabits lower-elevation canyon country in semidesert shrublands, and in piñon-juniper woodlands, typically in rimrock, rock outcrops, and similar geologic features.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
California myotis (*Myotis californicus*)	4,500–7,500	Most common in semidesert shrublands and piñon-juniper woodlands. Night roosts include abandoned structures, mines, caves, and cracks and crevices in cliff faces. Day roosts are similar but also include hollow trees and spaces under bark.
Canyon mouse (*Peromyscus crinitus*)	4,500–8,000	Inhabits talus and outwash rubble, or eroded, exposed sandstone. Habitat includes piñon-juniper woodlands and montane and semidesert shrublands.
Common porcupine (*Erethizon dorsatum*)	3,000–14,500	Associated with conifers in montane and subalpine forests and piñon-juniper woodlands. Also occupies cottonwood-willow forests in river bottoms, aspen groves, and semidesert shrublands.
Deer mouse (*Peromyscus maniculatus*)	3,000–14,000	Most native terrestrial habitats with cover except well-developed wetlands. Cover types include burrows of other animals, cracks and crevices in rocks, surface debris and litter, and human structures.
Golden-mantled ground squirrel (*Spermophilus lateralis*)	5,200–12,500	Open woodlands, shrublands, mountain meadows, and forest-edge habitat.
Hoary bat (*Lasiurus cinereus*)	3,000–10,000	Variety of riparian/wetland, shrubland, and forestland habitats.
Hopi chipmunk (*Tamias rufus*)	4,500–8,000	Canyon and slickrock piñon-juniper country. Highest densities found in areas with an abundance of broken rock or rubble at the base of cliff faces or in rock formations with deep fissures and crevices suitable for den sites.
Least chipmunk (*Tamias minimus*)	5,500–12,000	Low-elevation semidesert shrublands, montane shrublands and woodlands, forest edges, and alpine tundra.
Little brown myotis (*Myotis lucifugus*)	5,000–11,000	Roosts are under bark and rocks, in wood piles, buildings, and other structures, and less frequently in caves and mines.
Long-eared myotis (*Myotis evotis*)	4,000–9,000	Most common in ponderosa pine woodlands, also found in piñon-juniper woodlands and subalpine forests. Day roosts found in tree cavities, under loose bark, and in buildings. These sites, as well as caves and mines, are used for night roosts.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
Long-legged myotis (*Myotis volans*)	4,000–12,500	Relatively common in ponderosa pine forests and piñon-juniper woodlands. Roosts in a variety of sites including trees, buildings, crevices in rock faces, and even fissures in the ground in severely eroded areas.
Mexican woodrat (*Neotoma mexicana*)	4,000–8,500	Rocky slopes and cliffs in montane shrublands, piñon-juniper woodlands, and montane forests. Usually dens and nests beneath ledges or in fissures of cliffs. Also uses abandoned or seasonally occupied buildings or mine tunnels.
Northern grasshopper mouse (*Onychomys leucogaster*)	4,500–8,000	Semiarid grasslands, sand hills, and open semidesert shrublands. Highest densities found on overgrazed rangelands, which typically have high populations of insects and numerous blowouts (patches of windblown soil) that are loose enough for burrowing and for dust bathing.
Northern pocket gopher (*Thomomys talpoides*)	5,000–14,500	Variety of habitats including agricultural and pasture lands, semidesert shrublands, and grasslands at lower elevations and upward into alpine tundra.
Ord's kangaroo rat (*Dipodomys ordii*)	3,000–8,000	Variety of habitats from semidesert shrublands and piñon-juniper woodlands to shortgrass or mixed prairie and silvery wormwood. Also dry, grazed, riparian areas if vegetation is sparse. Most common on sandy soils that allow for easy digging and construction of burrow systems.
Pallid bat (*Antrozous pallidus*)	3,000–7,000	Semidesert and montane shrublands, piñon-juniper woodlands, and riparian woodland in the foothills and canyon country. Day roosts are crevices and fissures in cliff faces, sallow caves and grottos, and buildings.
Piñon mouse (*Peromyscus truei*)	4,500–8,000	Piñon-juniper woodlands and occasionally sagebrush stands and rocky canyon country.
Rock squirrel (*Spermophilus variegatus*)	3,000–8,300	Mostly in piñon-juniper woodlands and montane shrublands in rocky hillsides, rimrock, and canyons. It requires boulders, talus, or dense tangles of vegetation under which it burrows.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
Silver-haired bat (*Lasionycteris noctivagans*)	4,500–9,500	Prefers forest edges. Forages over open areas or over streams and ponds. Generally uses tree cavities or crevices under loose bark for summer roosts but also uses buildings, caves, and woodpiles during migration or hibernation.
Western pipistrelle (*Pipistrellus hesperus*)	3,000–6,000	Canyon and desert country. Roosts under loose rocks, in crevices or caves, and occasionally in buildings. Also uses the burrows of animals in open desert scrub communities.
Western small-footed myotis (*Myotis ciliolabrum*)	4,000–8,500	In summer, it roosts in rock crevices, caves, dwellings, burrows, among rocks, under bark, and beneath rocks scattered on the ground. Generally found in the broken terrain of canyons and foothills, commonly in places with a cover of trees or shrubs.
White-tailed antelope squirrel (*Ammospermophilus leucurus*)	4,500–7,000	Semidesert shrublands, piñon-juniper woodlands, montane shrublands, and occasionally lowland riparian areas. Occupies burrows dug by other species such as kangaroo rats or small ground squirrels, but can also dig its own burrow under bushes, clumps of grasses, or at the base of trees, often in sandy soils near rock outcrops.
White-throated woodrat (*Neotoma albigula*)	3,000–7,000	Shrublands and piñon-juniper and juniper woodlands.
Yuma myotis (*Myotis yumanensis*)	3,000–6,000	Associated with riparian lands, although some of these areas may be relatively dry and shrubby. Day roosts are rock crevices, buildings, caves, and mines. Night roosts include buildings, under ledges, or similar shelters.

Sources: CPW (2011a); USGS (2007)

williamsoni) and Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) are native to the basin. Although the Colorado River cutthroat trout was once common within the upper Green River and upper Colorado River watersheds, it now occurs only in isolated subdrainages in Colorado, Utah, and Wyoming and is a species of concern in those states (Hirsch et al. 2006, see Section 3.6.4).

In 1990 and 1991, Valdez et al. (1992) collected 19 species of fish in the 180-mi (290-km) reach of the Dolores River between its confluence with the Colorado River and Bradfield Bridge (about 14 mi [22 km] downstream of McPhee Reservoir). Native fish collected included the Colorado pikeminnow, roundtail chub, flannelmouth sucker, bluehead sucker, speckled dace (*Rhinichthys osculus*), and mottled sculpin. The red shiner (*Cyprinella lutrensis*), sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), common carp (*Cyprinus carpio*), and channel catfish (*Ictalurus punctatus*) were the most abundant non-native species. The other non-native species collected included the white sucker (*Catostomus commersonii*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), plains killifish *Fundulus zebrinus*), black bullhead (*Ameiurus melas*), channel catfish, brown trout, and rainbow trout (Valdez et al. 1992). Native species made up only 19% of the numbers of fish collected; however, this percentage is relatively higher here than it is in other upper Colorado River basins, indicating that predation and competition by non-native species was not a limiting factor for native fish species in the river system. Fish composition was similar to that found in a survey conducted in 1981, indicating that the fish community was somewhat stable over that 10-year period (Valdez et al. 1992).

Four Colorado pikeminnows were collected within 1.2 mi (2 km) of the confluence with the Colorado River. The species was reported in the lower 60 mi (100 km) of the Dolores River in the 1950s and 1960s. Although no Colorado pikeminnows were collected in the Dolores River in 1971 and 1981, there were unconfirmed reports of seven individuals collected in the lower 6 mi (10 km) of the San Miguel River in 1973 (Valdez et al. 1992). See Section 3.6.4 for additional information on the Colorado pikeminnow and other special status fish species.

Altered base flow releases from McPhee Dam (constructed in 1984 and located 200 mi [320 km] upstream of the Dolores River confluence with the Colorado River) accounted for reduced native fish habitat in the lower 170 mi (270 km) of the river, which resulted from decreased fish holding areas, dewatered nursery backwaters, impeded movement, and enhanced sedimentation (Valdez et al. 1992).

The Colorado Department of Wildlife (now Colorado Parks and Wildlife) collected fish from the Dolores River in Big Gypsum Valley near the Montrose/San Miguel County border (Anderson and Stewart 2003). This site is less than 1.5 mi (2.4 km) west of Lease Tract 17. A total of 13 fish species were collected in 2000, 2001, 2004, and 2005. These included four native species—flannelmouth sucker, bluehead sucker, roundtail chub, and speckled dace—and nine nonnative species—channel catfish, black bullhead, common carp, green sunfish, pumpkinseed (*Lepomis gibbosus*), red shiner, sand shiner, fathead minnow, and brown trout (Anderson and Stewart 2003). Increasing drought and sedimentation problems over the course of the study resulted in an increased number of black bullheads and a decreased number of flannelmouth suckers. Low-velocity pools that dominated the study area were favorable to bullhead and not favorable to native species. The absence of quality riffle habitats accounted for low numbers of bluehead suckers observed in the later years of the study (Anderson and Stewart 2003). Degraded or more silted riffle habitats observed after 2002 may have decreased invertebrate production and, as a result, caused the decreases observed for roundtail chub and channel catfish. The roundtail chub, flannelmouth sucker, and bluehead sucker appear to mature at a younger age and smaller size in the Dolores River than is typical in other larger rivers (Anderson and Stewart 2003). Several of the species may also occur in the tributary streams to the Dolores and San Miguel Rivers where flows are sufficient to provide habitat.

3.6.4 Threatened, Endangered, and Sensitive Species

A total of 52 species of plants and animals that are listed as threatened, endangered, or sensitive by state and Federal agencies may occur on or in the vicinity of the ULP lease tracts (Table 3.6-21). The known or potential distribution and habitat requirements for these species were determined from the USFWS Information, Planning, and Conservation System (IPaC) (USFWS 2011a), USFWS Critical Habitat Portal (USFWS 2011b), NatureServe Explorer (NatureServe 2011), Colorado Natural Heritage Program (CNHP) Rare Plant Guide List (CNHP 2011a), CNHP Element Occurrence Records (CNHP 2011b), CPW (2011a), and the Southwest Regional Gap Analysis Project (SWReGAP) (USGS 2007). The following types of species are considered in this assessment:

- Species that are listed as threatened or endangered under the ESA, or that are proposed or candidates for listing under the ESA;

- Species that are listed by the BLM as sensitive;

- Species that are listed by the U.S. Forest Service (USFS) as sensitive;

- Species that are listed as threatened or endangered by the State of Colorado.

3.6.4.1 Species Listed under the Endangered Species Act

Of the 10 ESA-listed, proposed, and candidate species that may occur in the vicinity of the ULP lease tracts, 7 are ESA-listed as threatened or endangered and 3 are candidates for listing (Table 3.6-21). The following definitions are applicable to the species listing categories under the ESA:

- *Endangered:* Any species that is in danger of extinction throughout all or a significant portion of its range.

- *Threatened:* Any species that is likely to become endangered within the foreseeable future throughout all or a significant part of its range.

- *Proposed for listing:* Species that has been formally proposed for listing by the USFWS by a notice in the *Federal Register*.[17]

[17] Within 1 year of a proposal for listing, the USFWS or National Marine Fisheries Service (NMFS) must take one of three possible courses of action: (1) finalize the listing rule (as proposed or revised); (2) withdraw the proposal if the biological information on hand does not support the listing; or (3) extend the proposal for up to an additional 6 months because, at the end of 1 year, there is substantial disagreement within the scientific community concerning the biological appropriateness of the listing. After the extension, the USFWS or NMFS must make a decision on whether to list the species on the basis of the best scientific information available.

TABLE 3.6-21 Threatened, Endangered, and Sensitive Species That May Occur in the Vicinity of the ULP Lease Tracts

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants			
Canyonlands biscuitroot	*Aletes latilobus*	BLM-S	In Colorado, known only from Mesa County. Inhabits piñon-juniper and desert shrub communities on sandy soils derived from the Entrada Formation. Elevation range is 5,000–7,000 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.
Dolores River skeletonplant	*Lygodesmia doloresensis*	BLM-S	Juniper-desert shrub or juniper-grassland communities on alluvial soils derived from sandstone outcrops associated with the undivided lower portion of the Cutler Group. Elevation range is 4,400–4,700 ft. Known occurrences of habitat for this species on Lease Tract 13; quad-level occurrences for this species also intersect Lease Tract 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Eastwood's monkeyflower	*Mimulus eastwoodiae*	BLM-S	Shallow caves and seeps on steep canyon walls. Elevation range is 4,700–5,800 ft. Known to occur in western Mesa, Montrose, and San Miguel Counties. Quad-level occurrences intersect Lease Tracts 11, 13, 13A, 14(1), 14(2), 15, 15A, 16, 16A, 18, 19, 19A, 20, 24, and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Fisher milkvetch	*Astragalus piscator*	BLM-S	In Colorado, known only from Mesa County on sandy, sometimes gypsiferous, soils of valley benches and gullied foothills. Elevation range is 4,300–5,600 ft. Quad-level occurrences intersect Lease Tract 26 in Mesa County. Suitable habitat could occur on or near lease tracts in Mesa County.
Grand Junction milkvetch	*Astragalus linifolius*	BLM-S	Grows on the Chinle and Morrison Formations, with piñon-juniper and sagebrush. Elevation range is 4,800–6,200 ft. Known to occur in Mesa and Montrose Counties. Quad-level occurrences intersect Lease Tracts 19, 19A, 20, 21, 22, 23(1), 23(2) 23(3), 24, 26, and 27. Suitable habitat could occur on or near lease tracts in Mesa and Montrose Counties.
Grand Junction suncup	*Camissonia eastwoodiae*	BLM-S	Occurs in adobe hills in the lower valleys of western Colorado. Inhabits saltbush, shadscale, blackbrush, and juniper communities at 3,900–5,900 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants (Cont.)			
Gypsum Valley cateye	*Cryptantha gypsophila*	BLM-S	Endemic to western Colorado. Inhabits gypsum outcrops. Quad-level occurrences intersect Lease Tracts 12, 13, 14(1), and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Helleborine	*Epipactis gigantea*	BLM-S; FS-S	Inhabits seeps on sandstone cliffs and hillsides; also occurs along springs. Elevation range is 4,800–8,000 ft. Quad-level occurrences intersect Lease Tracts 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Horseshoe milkvetch	*Astragalus equisolensis*	BLM-S	In Colorado, known only from Mesa County. Occurs in shrubland communities. Quad-level occurrences intersect Lease Tract 26. Suitable habitat could occur on or near lease tracts in Mesa County.
Kachina daisy	*Erigeron kachinensis*	BLM-S	Endemic to the Colorado Plateau in western Colorado and eastern Utah. Inhabits saline soils in alcoves and seeps in canyon walls. Elevation range is 4,800–5,600 ft. Quad-level occurrences intersect Lease Tracts 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Montrose County.
Naturita milkvetch	*Astragalus naturitensis*	BLM-S	Inhabits sandstone mesas, ledges, crevices, and slopes in piñon-juniper woodlands. Elevation range is 5,000–7,000 ft. Known occurrences and habitat for this species are on Lease Tract 13, near Paradox Valley, and near Uravan. Quad-level occurrences also intersect Lease Tracts 6, 7, 8, 8A, 9, 12, 13, 13A, 14(1), 14(2), 15, 15A, 17(1), 17(2), 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Osterhout's cryptantha	*Cryptantha osterhoutii*	BLM-S	Known from Mesa County, Colorado, as well as eastern Utah. Inhabits dry, barren sites, on sandstone substrates. Elevation range is 4,500–6,100 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants (Cont.)			
Paradox breadroot	*Pediomelum aromaticum*	BLM-S	Known from adobe hills in Mesa and Montrose Counties, Colorado. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Paradox lupine	*Lupinus crassus*	BLM-S	Endemic to western Montrose County, Colorado. Inhabits piñon-juniper woodlands or clay barrens along draws and washes with sparse vegetation. Elevation range is 5,000–8,000 ft. Occurs near Paradox Valley lease tracts and near Uravan. Quad-level occurrences also intersect Lease Tracts 18, 21, 22, 22A, 23(1), 23(2), 23(3), 24, and 25. Suitable habitat could occur on or near lease tracts in Montrose County.
San Rafael milkvetch	*Astragalus rafaelensis*	BLM-S	Inhabits hillsides, washes, and talus under cliffs on clay, silty, or sandy substrates. Elevation range is 4,400–6,500 ft. Known to occur near Uravan lease tracts. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, 24, 26, and 27. Suitable habitat could occur on or near lease tracts in Mesa and Montrose Counties.
Sandstone milkvetch	*Astragalus sesquiflorus*	BLM-S	Occurs on sandstone rock ledges, fissures of domed siltrock, talus, and sometimes in sandy washes. Elevation range is 5,000–5,500 ft. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, and 24. Suitable habitat could occur on or near lease tracts in Montrose County.
Wetherill's milkvetch	*Astragalus wetherillii*	FS-S	Occurs on steep slopes, canyon benches, and talus under cliffs. Elevation range is 5,250–7,400 ft. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, and 7. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Invertebrates			
Great Basin silverspot butterfly	*Speyeria nokomis nokomis*	BLM-S	Inhabits streamside meadows, open seepage areas, and other riparian areas with an abundance of violets. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Fish			
Bluehead sucker	*Catostomus discobolus*	BLM-S; FS-S	Found in a variety of aquatic habitats from headwater streams to large rivers. The bluehead sucker requires water moving at a moderate to fast velocity, preferably over rock substrates. This species does not occur on any of the lease tracts; however, it could occur in the Dolores and San Miguel Rivers, which are downstream of lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River flows through portions of Lease Tracts 13A, 13, and 14. It is most common in the Dolores River downstream of the confluence with the San Miguel River.
Bonytail chub	*Gila elegans*	ESA-E; CO-E	Found historically throughout the Colorado River drainage; currently known only from the Green River in Utah and Lakes Havasu and Mohave. Inhabits large river systems in eddies and pools. The bonytail chub does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Colorado pikeminnow	*Ptychocheilus lucius*	ESA-E; CO-T	Restricted to large rivers of the Colorado River basin. The Colorado pikeminnow does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Flannelmouth sucker	*Catostomus latipinnis*	BLM-S; FS-S	Inhabits moderate to large rivers, is seldom in small creeks, and is absent from impoundments. Prefers pools and deep runs. Spawns in riffles, usually over a substrate of coarse gravel. In Colorado, the flannelmouth is found only in large rivers on the western slope. This species does not occur on any of the lease tracts; however, it could occur in the Dolores and San Miguel Rivers, which are downstream of lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River flows through portions of Lease Tracts 13A, 13, and 14.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Fish (Cont.)			
Humpback chub	*Gila cypha*	ESA-E; CO-T	Historically ranged throughout the Colorado River system. Current distribution in Colorado is limited to the Yampa, Gunnison, Green, and Colorado Rivers in the western portion of the state. Inhabits slow eddies and pools over rock, sand, or gravel substrates. The humpback chub does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Razorback sucker	*Xyrauchen texanus*	ESA-E; CO-E	Historically ranged throughout the Colorado River system. Current distribution in Colorado is limited to the lower mainstem Colorado, Gunnison, lower Yampa, and Green Rivers. The razorback sucker does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Roundtail chub	*Gila robusta*	BLM-S; FS-S	Found in the Colorado River mainstem and larger tributaries. Prefers slow-moving waters adjacent to areas of faster water. The roundtail chub does not occur on any of the lease tracts; however, it could inhabit downstream areas, including the Dolores River, which flows through Lease Tracts 13A, 13, and 14. It is the most abundant native fish species in the downstream reaches of the Dolores River.
Amphibians			
Boreal toad	*Bufo boreas*	CO-E	Generally associated with montane riparian habitats at elevations from 8,500–11,500 ft. Habitats include marshes, meadows, streams, beaver ponds, and lakes. Not known to occur on or near any of the lease tracts and suitable habitat is not likely to occur on the lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat may occur in the vicinity of the Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (19, 26, and 27).
Canyon treefrog	*Hyla arenicolor*	BLM-S	Occurs along intermittent streams in deep, rocky, canyons. Elevation typically ranges from 4,500–6,300 ft. Quad-level occurrences for this species intersect Lease Tracts 6, 7, 8, 8A, 9, 11, 13, 13A, 14(1), 14(2), 15, 15A, 16, 16A, and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Amphibians (Cont.)			
Great Basin spadefoot	*Spea intermontana*	BLM-S	Inhabits piñon-juniper woodlands, sagebrush communities, and semidesert shrublands at elevations generally below 7,000 ft. Not known to occur in any lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat could occur within 1 mile to the west of Lease Tracts 11 and 11A.
Northern leopard frog	*Rana pipiens*	BLM-S; FS-S	Inhabits wet meadows, marshes, ponds, lakes, and reservoirs, as well as streams and irrigation ditches. Elevation range is 3,000–11,000 ft. Not known to occur in any lease tracts, and suitable habitat does not occur on the lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat could occur in the vicinity of Uravan lease tracts (18, 19, 19A, 24, and 25) and lease tracts in the Slick Rock area (13, 13A, 14, 15, and 15A).
Reptiles			
Longnose leopard lizard	*Gambelina wislizenii*	BLM-S	Inhabits flat or gently sloping shrublands in sparse vegetation. Quad-level occurrences intersect Lease Tract 26. According to the SWReGAP habitat model, potentially suitable habitat could occur on or near Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (18, 19, 19A, 20, 24, 26, and 27).
Midget-faded rattlesnake	*Crotalus oreganus concolor*	BLM-S	Quad-level occurrences for this species intersect Lease Tracts 26 and 27. According to the SWReGAP habitat model, potentially suitable habitat for this species occurs on or near all lease tracts.
Birds			
Bald eagle	*Haliaeetus leucocephalus*	BLM-S; FS-S	Preferred habitat includes reservoirs and large rivers. In winter, bald eagles may occur locally in semidesert and grassland habitats, especially near prairie dog towns. May forage in arid shrubland environments. Bald eagles winter in riparian habitat along the Dolores River and in Dry Creek Basin. A winter nocturnal roost area is located in the Slick Rock area. Eagles probably forage for carrion in deer and elk winter concentration areas such as Atkinson Mesa (Lease Tracts 18, 19, 19A and 20), The Slick Rock area (Lease Tracts 13, 13A, and 14), Paradox Valley (Lease Tracts 21, 22A, and 23A), Monogram Mesa (Lease Tracts 5, 6, 7, 7A, 8, and 9), and Calamity Mesa (Lease Tracts 26, 26A, 27, and 27A).

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TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Birds (Cont.)			
Brewer's sparrow	*Spizella breweri*	BLM-S	A summer resident on mesas and foothills of western Colorado; occurs primarily in sagebrush shrublands but also occurs in mountain mahogany communities. Not known to occur in any lease tracts; however, according to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Burrowing owl	*Athene cunicularia*	BLM-S; CO-T	A year-round resident in western Colorado in grasslands near prairie dog towns. This species may occur in association with prairie dog towns on or near the Gateway lease tracts (26 and 27). According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Ferruginous hawk	*Buteo regalis*	BLM-S; FS-S	A winter resident in western Colorado in grasslands and semidesert shrublands. Occasionally found in piñon-juniper woodlands. Winter residents concentrate around prairie dog towns. This species may use portions of the lease tracts during winter migration. According to the SWReGAP habitat model, potentially suitable winter habitat could occur on or near all lease tracts.
Gunnison sage-grouse	*Centrocercus minimus*	ESA-P; BLM-S; FS-S	Inhabits sagebrush shrublands, but will sometimes occur in meadows, grasslands, and thickets adjacent to sagebrush communities. A portion of the proposed occupied critical habitat for this species is within 1 mi (1.6 km) south of Lease Tracts 6, 8, and 9. Potential proposed critical habitat intersects several lease tracts in the Slick Rock area (Lease Tracts 10, 11, 11A, 12, 15A, 16, and 16A).
Mexican spotted owl	*Strix occidentalis lucida*	ESA-T; CO-T	Inhabits large steep canyons with dense old-growth mixed coniferous forest. Quad-level occurrences for this species intersect Lease Tract 12. However, suitable habitat for this species does not occur on any of the lease tracts. According to the SWReGAP habitat model for the spotted owl (*S. occidentalis*), potentially suitable migratory habitat may occur on all lease tracts.
Northern goshawk	*Accipiter gentilis*	BLM-S; FS-S	A rare migrant and winter resident in western Colorado, the northern goshawk inhabits various forest types including coniferous, piñon-juniper, and riparian habitats. May also forage in shrubland areas. According to the SWReGAP habitat suitability model, potentially suitable year-round habitat may occur on or near all lease tracts. Although the lease tracts may provide foraging habitat, it is unlikely that the lease tracts provide any nesting habitat for this species.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Birds (Cont.)			
Peregrine falcon	*Falco peregrinus*	BLM-S; FS-S	A summer breeding resident in western Colorado, this species occurs near cliffs and bluffs that overlook grasslands and shrublands. Breeding birds nest on cliff faces. Quad-level occurrences for this species intersect Lease Tracts 12, 22, 22A, 24, 25, and 26. Nesting is known to occur close to Paradox Valley lease tracts. According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Sage sparrow	*Amphispiza belli*	FS-S	Local and irregular summer resident on mesas of western Colorado. Breeds in sagebrush shrublands. Quad-level occurrences for this species intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, 24, and 25. According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; CO-E	An uncommon summer resident in western Colorado. Breeds in montane riparian thickets dominated by willow. Not known to occur in any of the lease tracts; however, potentially suitable breeding habitat could occur along the Dolores and San Miguel Rivers, which are downstream from lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River also flows through portions of Lease Tracts 13A, 13, and 14.
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	ESA-C; BLM-S; FS-S	An uncommon summer breeding resident in western Colorado. Inhabits riparian woodlands, particularly those consisting of cottonwood and willow. Not known to occur on any of the lease tracts. According to the SWReGAP habitat model, potentially suitable breeding habitat may occur along the Dolores River in southern Mesa County and northern Montrose County, downstream from the Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (18, 19, 19A, 20, 24, 25, 26, and 27). Potentially suitable habitat may occur on or near other lease tracts along the Dolores and San Miguel Rivers.
White-faced ibis	*Plegadis chihi*	BLM-S; FS-S	A rare fall migrant in western Colorado, this species inhabits wet meadows, marshlands, and reservoir shorelines. This species is not known to occur on any of the lease tracts. According to the SWReGAP habitat model, however, potentially suitable migratory habitat could occur on or near some Slick Rock area lease tracts (13, 13A, 14, 15, and 15A).

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TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Mammals			
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; FS-S	Forages primarily on moths in a variety of habitats, including montane forests and shrublands. Roosts in crevices on cliff faces or in buildings. Known to occur at Lease Tracts 8 and 13. According to the SWReGAP habitat model, potentially suitable year-round habitat intersects all lease tracts.
Black-footed ferret	*Mustela nigripes*	ESA-E; ESA-XN; CO-E	Believed to be extirpated from the state of Colorado since the 1950s. Experimental populations were reintroduced to the northwestern portion of Colorado beginning in 2001. Historically, it inhabited prairies and semiarid shrublands, where it preyed on prairie dogs. According to the SWReGAP habitat model, potentially suitable habitat does not occur near any lease tracts; however, this species could occur on or near some lease tracts that support prairie dog towns.
Fringed myotis	*Myotis thysanodes*	BLM-S	A snag-dependent bat species that occurs in a wide variety of forest types including ponderosa pine, oak, and piñon-juniper. Also forages in grasslands and shrublands. Roosts in snags and rock crevices. Known to occur at Lease Tracts 14, 23, 26, and 27. According to the SWReGAP habitat model, potentially suitable year-round habitat intersects all lease tracts.
Gunnison's prairie dog	*Cynomys gunnisoni*	ESA-C; BLM-S; FS-S	In Colorado, this species is restricted to the southwestern and south-central portion of the state. Inhabits grasslands and semiarid shrublands. 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.
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM-S; FS-S	Inhabits visually open, steep, rocky terrain in mountainous habitats of the southwestern United States. Rarely uses valleys and lowlands, except as travel corridors between mountain ranges. Known to occur in Lease Tracts 9, 13, 13A, 14, and 15. According to the SWReGAP habitat suitability model, however, potentially suitable habitat for this species could occur on or near all lease tracts. Winter concentration areas occur on or near lease tracts in the Slick Rock area (10, 11, 11A, 12, 13, 13A, 14, 15, 15A, 16, and 16A).

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Mammals (Cont.)			
Northern river otter	*Lutra canadensis*	CO-T	Occupies riparian and riverine habitats where permanent water is available. Feeds primarily on fish and crustaceans. Known to occur in the Dolores River, which flows through portions of Lease Tracts 13A, 13, and 14.
Spotted bat	*Euderma maculatum*	BLM-S; FS-S	Occurs near forests and shrubland habitats. Uses caves and rock crevices for day roosting and winter hibernation. Known to occur at Lease Tract 27. According to the SWReGAP habitat model, potentially suitable year-round habitat could occur on or near all lease tracts.
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; FS-S	Inhabits semiarid shrublands, piñon-juniper woodlands, and montane forests below elevations of 10,000 ft. Roosts in caves, mines, rock crevices, under bridges, or within buildings. Quad-level occurrences for this species intersect Lease Tracts 10, 11, 12, 16, 16A, 19, 19A, 20, 24, 26, and 27. Known to occur at Lease Tracts 8, 12, 13, 13A, 14, 15, 16, 23, 26, and 27. According to the SWReGAP habitat model, potentially suitable year-round habitat for this species could occur on or near all lease tracts.
White-tailed prairie dog	*Cynomys leucurus*	BLM-S; FS-S	In Colorado, this species is known from the northwestern and west-central portion of the state. Inhabits open shrublands, semidesert grasslands, and mountain valleys. Not known to occur near any of the lease tracts. According to the SWReGAP habitat model, however, potentially suitable year-round habitat could occur on or near the Gateway and Uravan lease tracts (18, 19, 19A, 24, 25, 26, and 27).

[a] BLM-S = listed as sensitive by the BLM; CO-E = listed as endangered by the state of Colorado; CO-T = listed as threatened by the state of Colorado; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population under the ESA; FS-S = listed as sensitive by the USFS.

[b] The potential to occur on or near ULP lease tracts is based on the known or potential distribution and availability of suitable habitat in the vicinity of the ULP lease tracts. Sources that were considered included USFWS (2011a,b), CNHP (2011a,b), CPW (2011a), CPW (2012a), and USGS (2007). If potential for occurrence exists, a site-specific survey will be conducted prior to any ground-disturbing activity.

[c] The availability of potentially suitable habitat was determined by using SWReGAP habitat suitability models (USGS 2007). Quad-level occurrences were obtained from CNHP (2011b). Habitat and natural history information was obtained from NatureServe (2011), CNHP (2011a), and CPW (2011a).

1

- *Candidate:* Species for which the USFWS has sufficient information on its biological status and threats that it could propose the species as threatened or endangered under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing actions.

- *Critical habitat:* Critical habitat for a listed species consists of

  – Specific areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the ESA, on which are found those physical or biological features (constituent elements) (a) that are essential to the conservation of the species and (b) that may require special management considerations or protection; and
  – Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the ESA, upon a determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Designated critical habitats are described in 50 CFR Parts 17 and 226.

These 10 ESA-listed, proposed, and candidate species are listed in Table 3.6-22 and are further discussed below. For these species, programmatic consultation with the USFWS was required to comply with Section 7 of the ESA. The final consultation documents (Biological Assessment [BA] and Biological Opinion [BO]) are provided in Appendix E. Additional information on the status, ecology, and natural history of these species is also provided in the BA in Appendix E. Additional lease-specific consultation with the USFWS may be required prior to the approval of project development and subsequent ground-disturbing activities.

There are no plants or invertebrates listed under the ESA that could occur in the vicinity of the ULP lease tracts. The Federally threatened Colorado hookless cactus (*Sclerocactus glaucus*) may occur in Mesa and Montrose Counties; however, this species and its habitat do not occur near any of the ULP lease tracts (Holsinger 2012). The uncompagre fritillary butterfly (*Boloria acrocnema*) is a Federally endangered butterfly that is known to occur in alpine (above 12,000 ft [3,658 m]) habitats in San Miguel County. However, none of these habitats occur in the vicinity of any of the ULP lease tracts.

3.6.4.1.1 Fish. There are four ESA-listed species of fish that may have suitable habitat occurring on or near the ULP lease tracts: the bonytail chub; Colorado pikeminnow; humpback chub; and razorback sucker. Collectively, these fish species are referred to as the Colorado River endangered fishes. 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. The last recorded observation of any of these species in the Dolores River was in 1991 when four Colorado pikeminnow were captured in the lower portion of the river (Valdez et al. 1992). Suitable habitat and populations may occur in the Colorado River downstream from the Dolores River, which is downgradient from several lease

1 **TABLE 3.6-22 Species Listed, Proposed for Listing, or Candidates for Listing under the ESA That May Occur in the Vicinity of the**
2 **ULP Lease Tracts**

Common Name	Scientific Name	ESA Status	Potential ULP County Occurrence	Designated Critical Habitat (Y/N)	ULP Counties in Which Critical Habitat Occurs	Recovery Plan (Y/N)
Fish						
Bonytail chub	*Gila elegans*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Humpback chub	*Gila cypha*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Razorback sucker	*Xyrauchen texanus*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Birds						
Gunnison sage-grouse	*Centrocercus minimus*	Proposed Endangered	Mesa, Montrose, San Miguel	N[a]	NA	N
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Montrose, San Miguel	Y	NA	Y
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Mesa, Montrose, San Miguel	Y	NA	Y
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Candidate	Mesa, Montrose, San Miguel	N	NA	N
Mammals[b]						
Black-footed ferret	*Mustela nigripes*	Endangered	Mesa, Montrose, San Miguel	N	NA	Y
Gunnison's prairie dog	*Cynomys gunnisoni*	Candidate	Montrose, San Miguel	N	NA	N

[a] Critical habitat for the Gunnison sage-grouse has been proposed (USFWS 2013a,b).

[b] The Canada lynx is a Federally threatened species, and the North American wolverine is a candidate for listing under the ESA. Both of these species have the potential to occur in the project counties. However, suitable habitat for these species is not likely to occur in the vicinity of the ULP lease tracts.

Source: USFWS (2011a)

tracts and flows through Lease Tracts 13, 13A, and 14 (Table 3.6-21). The confluence of the Colorado River and the Dolores River is in northeastern Utah, approximately 35 river miles (56 km) downstream from the nearest ULP lease tract (26). The confluence between the Colorado River and the Dolores River is approximately 56 river miles (90 km) downstream from the confluence of the Dolores and San Miguel Rivers (Figure 3.6-14). Designated critical habitat for the Colorado River endangered fishes also occurs in the Colorado River in Mesa County, downstream from the Dolores River (Table 3.6-22). The location of the ULP lease tracts relative to designated critical habitat for the Colorado River endangered fishes is shown in Figure 3.6-14.

The bonytail chub was listed as an endangered species under the ESA on April 23, 1980. Critical habitat for this species was designated within 310 mi (500 km) of the Colorado River basin on March 21, 1994. Designated critical habitat spans five states and includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin of the Colorado River. Currently, there are no self-sustaining populations of bonytail chub in the wild; only a small number of adults exist in the wild in the Green River and upper Colorado River. Hatchery-reared adults have been released into these rivers, but results indicate a low survival rate and no reproduction or recruitment (USFWS 2002a).

The Colorado pikeminnow was listed as an endangered species under the ESA on March 11, 1967. Critical habitat for this species was designated within 1,100 mi (1,850 km) of the Colorado River basin on March 21, 1994. Designated critical habitat spans three states and includes portions of the Colorado, Green, Yampa, White, and San Juan Rivers in the Upper Basin of the Colorado River. Currently, three wild reproducing populations of Colorado pikeminnow occur in the Green River, San Juan River, and upper Colorado River subbasins (USFWS 2002b).

The humpback chub was listed as an endangered species under the ESA on March 11, 1967. Critical habitat for this species was designated within 380 mi (610 km) of the Colorado River basin on September 19, 1990. Designated critical habitat spans three states and includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin of the Colorado River. The humpback chub is presently restricted to remote white water canyons. It is known to occur in the upper Colorado River (USFWS 1990).

The razorback sucker was listed as an endangered species under the ESA on October 23, 1991. Critical habitat for this species was designated within 1,700 mi (2,800 km) of the Colorado River basin on March 21, 1994. The critical habitat spans six states and includes portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White, and Yampa Rivers in the Upper Basin of the Colorado River. Currently, the razorback sucker inhabits only about 25% of its historic range in the upper Colorado River basin (USFWS 2002c). In the upper basin of the Colorado River, the species is found in small numbers in the Green River, upper Colorado River, and San Juan River.

3.6.4.1.2 Birds. There are four ESA-listed or candidate species of birds that could occur on the ULP lease tracts or may have suitable habitat occurring on or near the ULP lease tracts:

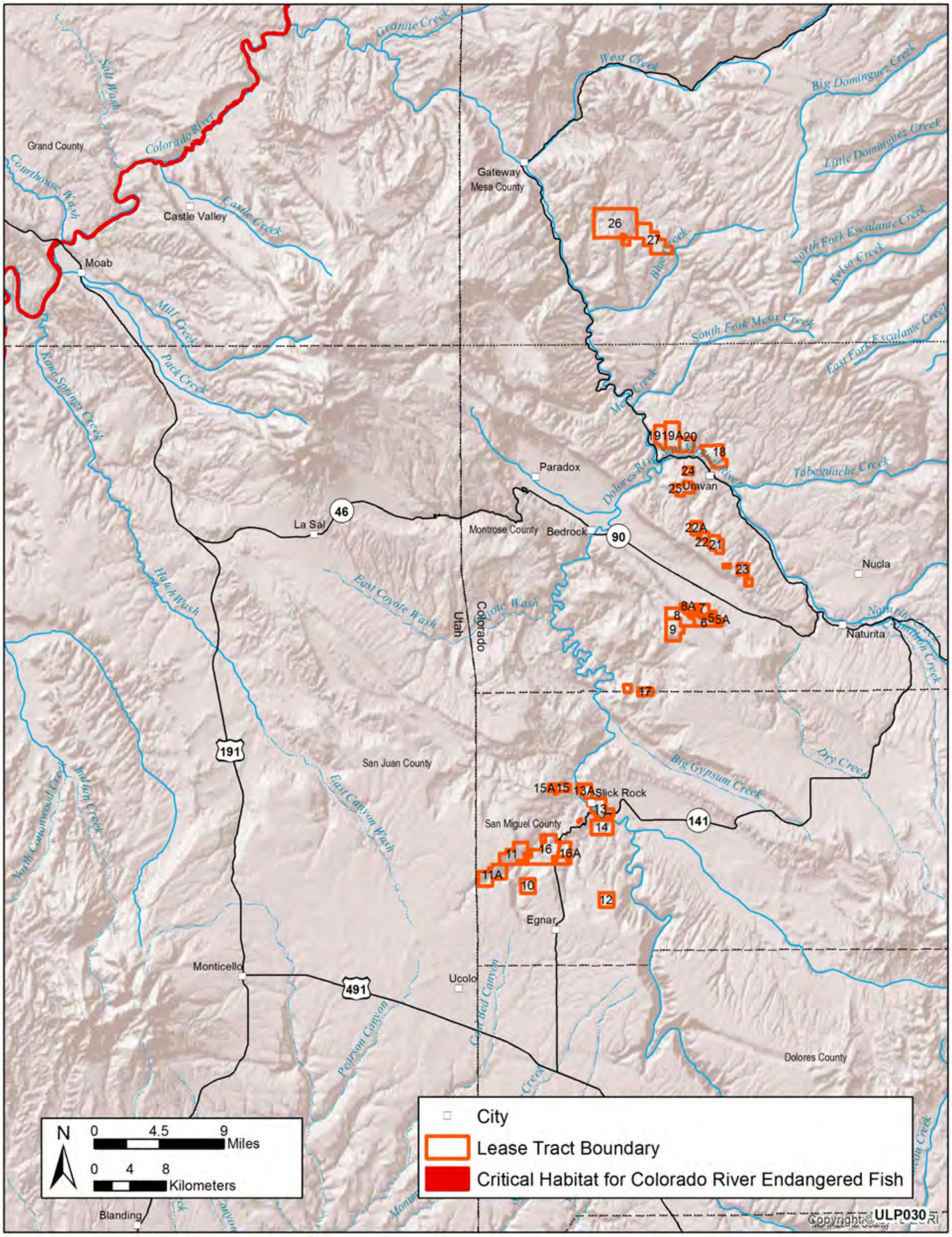


FIGURE 3.6-14 Locations of Designated Critical Habitat for the Colorado River Endangered Fishes in the Vicinity of the ULP Lease Tracts (USFWS 2011b)

the Gunnison sage-grouse; Mexican spotted owl; southwestern willow flycatcher; and western yellow-billed cuckoo (Table 3.6-22). These species are discussed individually here.

The Gunnison sage-grouse is a species proposed for listing as endangered under the ESA (USFWS 2013a). This species occurs in sagebrush-dominated habitats in southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. This species is known to occur in Mesa, Montrose, and San Miguel Counties. Critical habitat for this species has been proposed in portions of western Colorado and eastern Utah (USFWS 2013b; Figure 3.6-15). The proposed critical habitat has been categorized as occupied, potential, or vacant/unknown critical habitat[18]. 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) (Table 3.6-21; Figure 3.6-15).

The Mexican spotted owl was listed as a threatened species under the ESA on March 16, 1993. Critical habitat for this species was designated by the USFWS on June 6, 1995 (revised on February 1, 2001, and August 31, 2004). However, critical habitat for this species does not occur in the vicinity of any of the lease tracts. The Mexican spotted owl is known to occur in Montrose and San Miguel Counties, where it is considered to be a rare transient. However, recent surveys by the BLM and USFWS in these counties have not detected this species. The Mexican spotted owl inhabits steep canyons with dense old-growth coniferous forests. It is not known to occur on any of the lease tracts, but, according to the CNHP (2011b), quad-level occurrences for this species intersect Lease Tract 12 in southern San Miguel County. Suitable old growth forests and canyonlands do not occur on any of the lease tracts. According to the SWReGAP habitat suitability model, potentially suitable nonbreeding migratory habitat intersects and occurs in the vicinity of all lease tracts (Table 3.6-21; Figure 3.6-16).

The southwestern willow flycatcher was listed as an endangered species under the ESA on March 29, 1995. Critical habitat for this species was designated by the USFWS on July 22, 1997 (revised on October 19, 2005). However, critical habitat for this species does not occur in the vicinity of any of the lease tracts. The southwestern willow flycatcher is known to occur in San Miguel County, where it is an uncommon summer breeding resident. It nests in thickets, scrubby and brushy areas, open second growth, and riparian woodlands. 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 may 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 downslope from and in the

[18] From USFWS 2013b, occupied proposed critical habitat refers to the geographic area occupied by the species at the time of the proposed listing. Potential proposed critical habitat is defined as “unoccupied habitats that could be suitable for occupation of sage grouse if practical restoration were applied.” The vacant/unknown potential critical habitat category is defined as “suitable habitat for sage grouse that is separated (not contiguous) from occupied habitats that either (1) has not been adequately inventoried, or (2) has not had documentation of grouse presence in the past 10 years.”

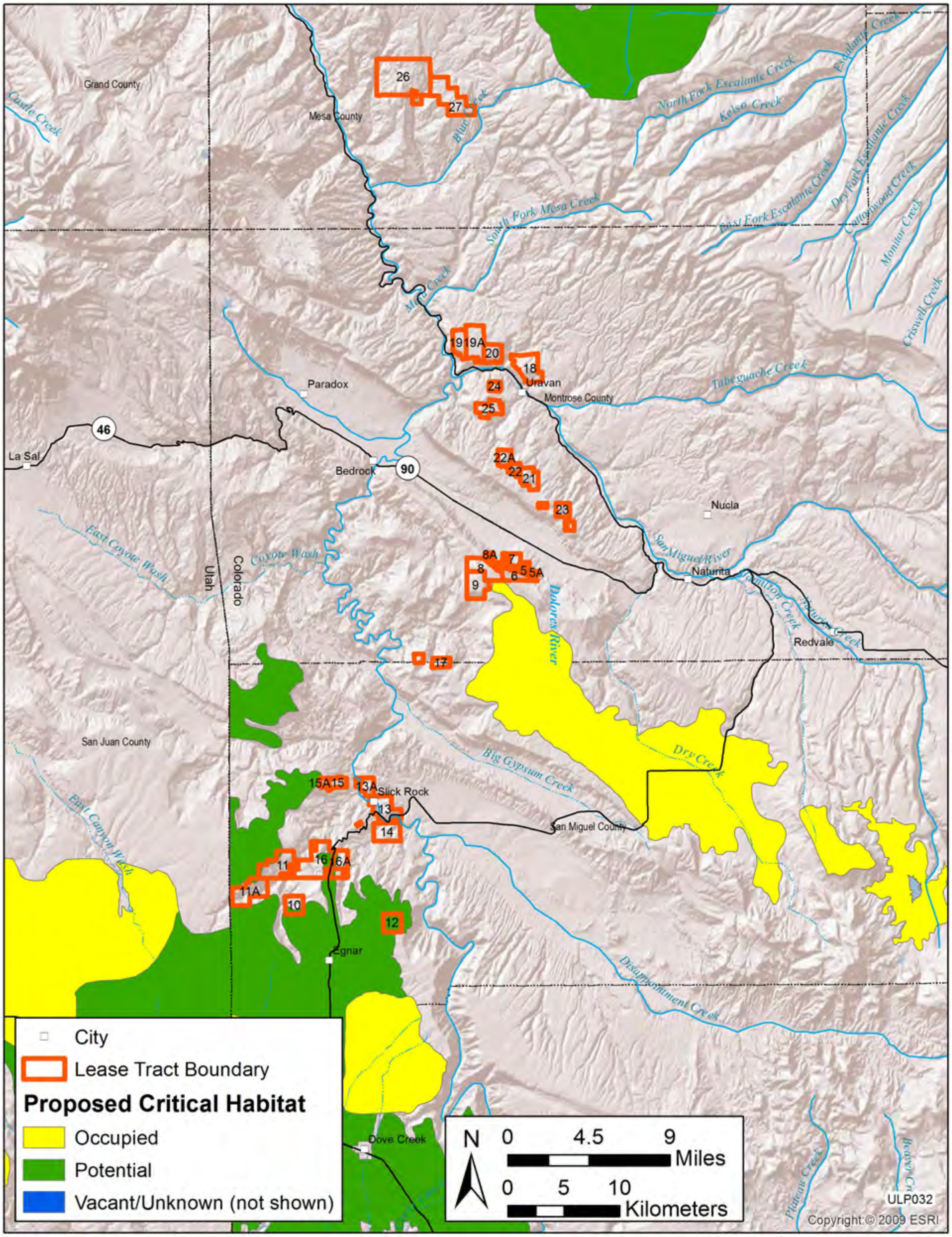
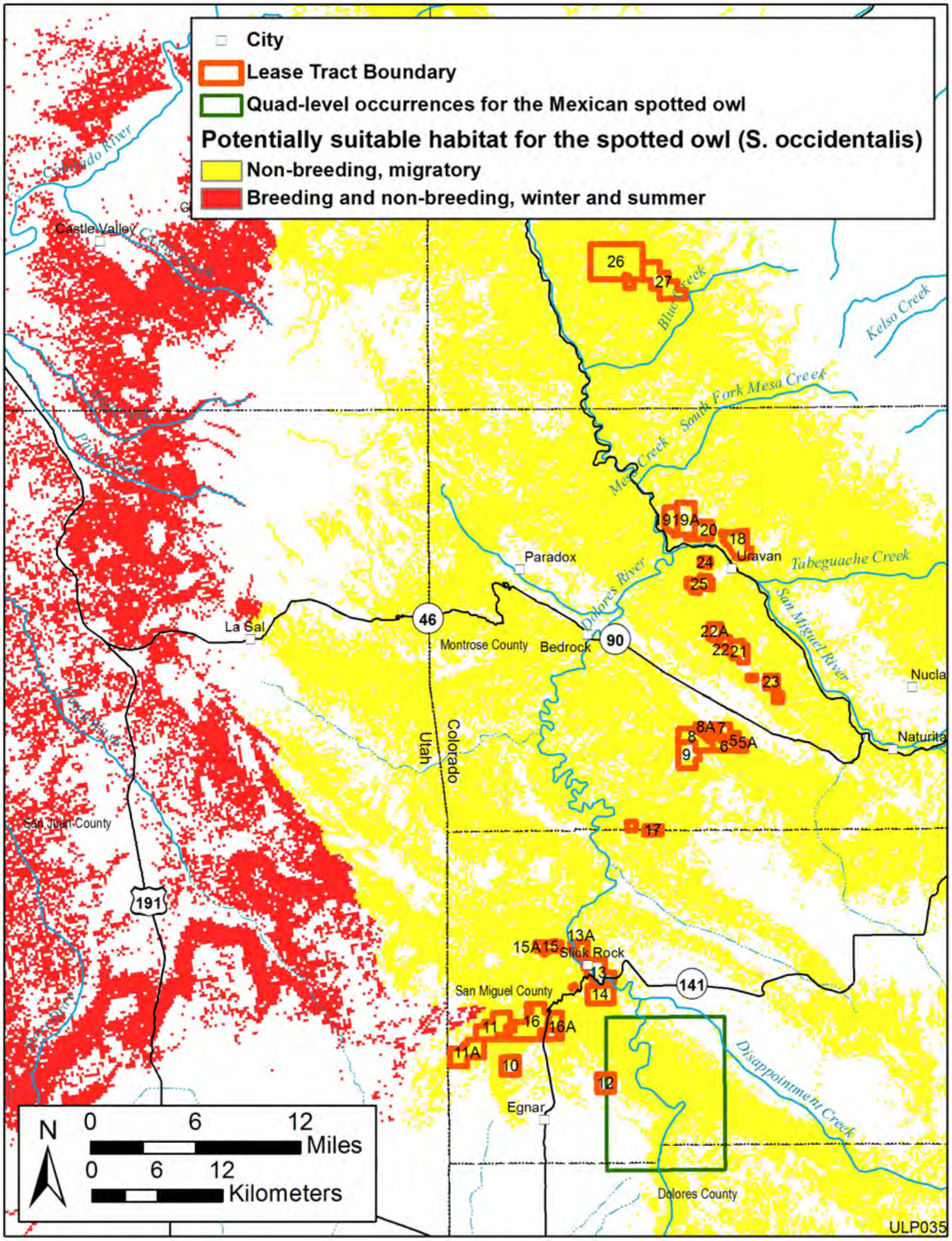


FIGURE 3.6-15 Distribution of Proposed Critical Habitat for the Gunnison Sage-Grouse in the Vicinity of the ULP Lease Tracts (USFWS 2013b)

1 

2 **FIGURE 3.6-16 Recorded Occurrences and Distribution of Potentially Suitable Habitat for the**
3 **Mexican Spotted Owl in the Vicinity of the ULP Lease Tracts (CNHP 2011b; USGS 2007)**

vicinity of all lease tracts; they also intersect lease tracts in the Slick Rock area (13, 13A, and 14) along the Dolores River (Table 3.6-21; Figure 3.6-17).

The western yellow-billed cuckoo is considered by the USFWS as a "distinct population segment" (DPS) (subspecies *occidentalis*) of the yellow-billed cuckoo. This species became a candidate for listing under the ESA on October 30, 2001. It inhabits deciduous riparian woodlands, particularly cottonwood and willow. The western yellow-billed cuckoo is known to occur in Mesa and Montrose Counties, where it is 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 may 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 do occur downslope from and in the vicinity of Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (Table 3.6-21; Figure 3.6-18).

3.6.4.1.3 Mammals. There are two ESA-listed or candidate species of mammals that could occur on the ULP lease tracts or may have suitable habitat occurring on or near the ULP lease tracts: the black-footed ferret and the Gunnison's prairie dog (Table 3.6-21). Suitable habitat for the Canada lynx may occur in the three project counties. However, given the strict habitat requirements for this species (high-elevation coniferous forests), suitable habitat for this species is not expected to occur near any of the ULP lease tracts (Figure 3.6-18).

The black-footed ferret was listed as an endangered species under the ESA on March 11, 1967. It is the only ferret species native to North America. Black-footed ferrets historically occurred in western Colorado, but it is believed it has been extirpated from the state since the 1950s. Experimental, nonessential populations have been established in the northwestern portion of Colorado as well as elsewhere throughout its historic range. This species inhabits prairies and semiarid shrublands where it preys upon prairie dogs. Black-footed ferrets are not known to occur in the vicinity of any of the lease tracts, and the SWReGAP model for the species indicates that no suitable habitat for the species occurs in the vicinity of the lease tracts. However, the species may occur on or near some of the lease tracts that support prairie dog towns (Table 3.6-21). The lease tracts have not been surveyed for prairie dog towns that might meet criteria for ferret habitat. Critical habitat for this species has not been designated.

The Gunnison's prairie dog became a candidate for listing under the ESA on February 5, 2008. It inhabits mountain valleys, plateaus, and open brush habitats at elevations between 6,000 and 12,000 ft (1,800 and 3,700 m). This species is known to occur in Montrose and Mesa Counties as a year-round resident and to occur in at least one ULP lease tract. According to information provided by CPW, the overall range for the Gunnison's prairie dog intersects several Paradox and Uravan lease tracts (Table 3.6-21; Figure 3.6-19).

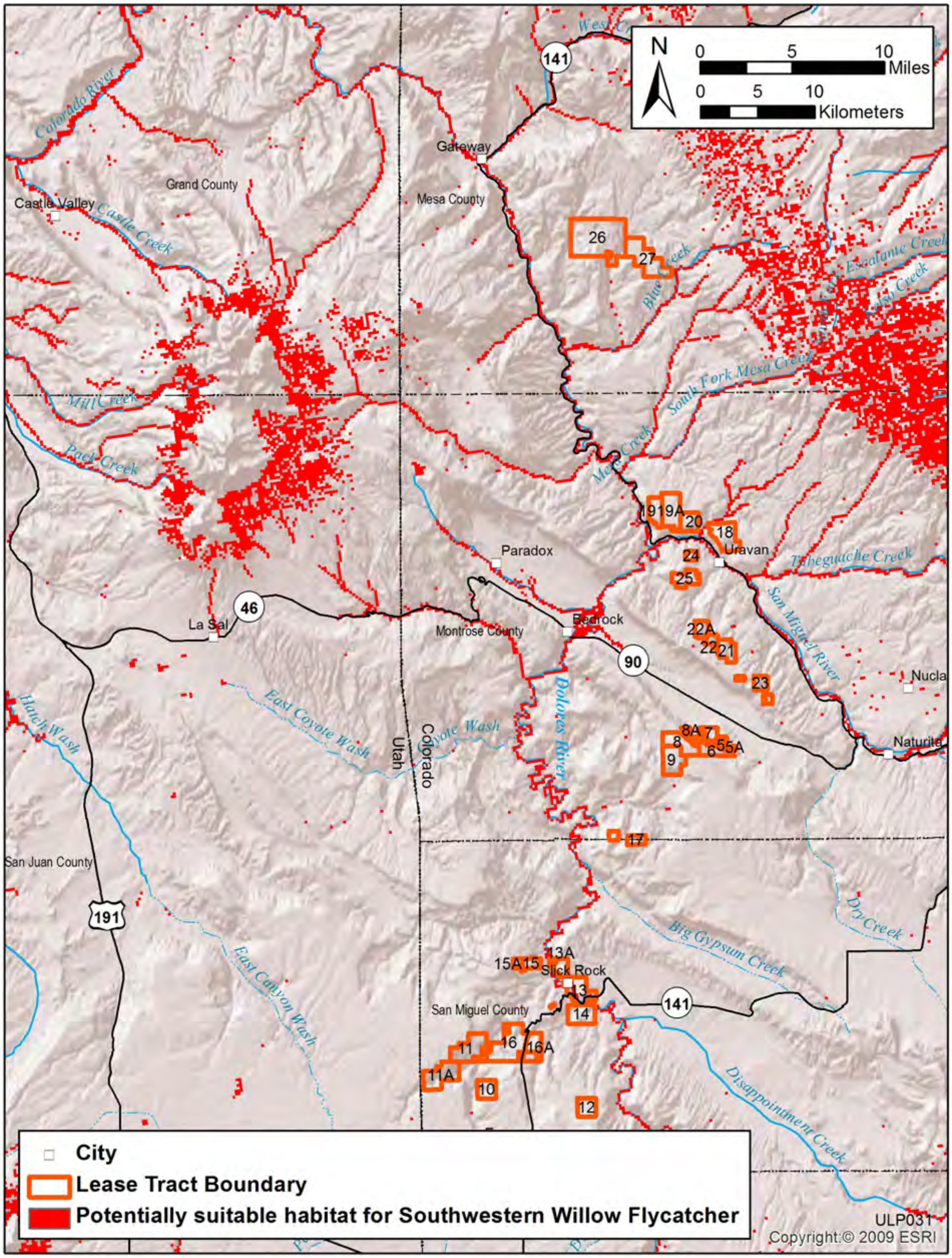


FIGURE 3.6-17 Distribution of Potentially Suitable Habitat for the Southwestern Willow Flycatcher in the Vicinity of the ULP Lease Tracts (USGS 2007)

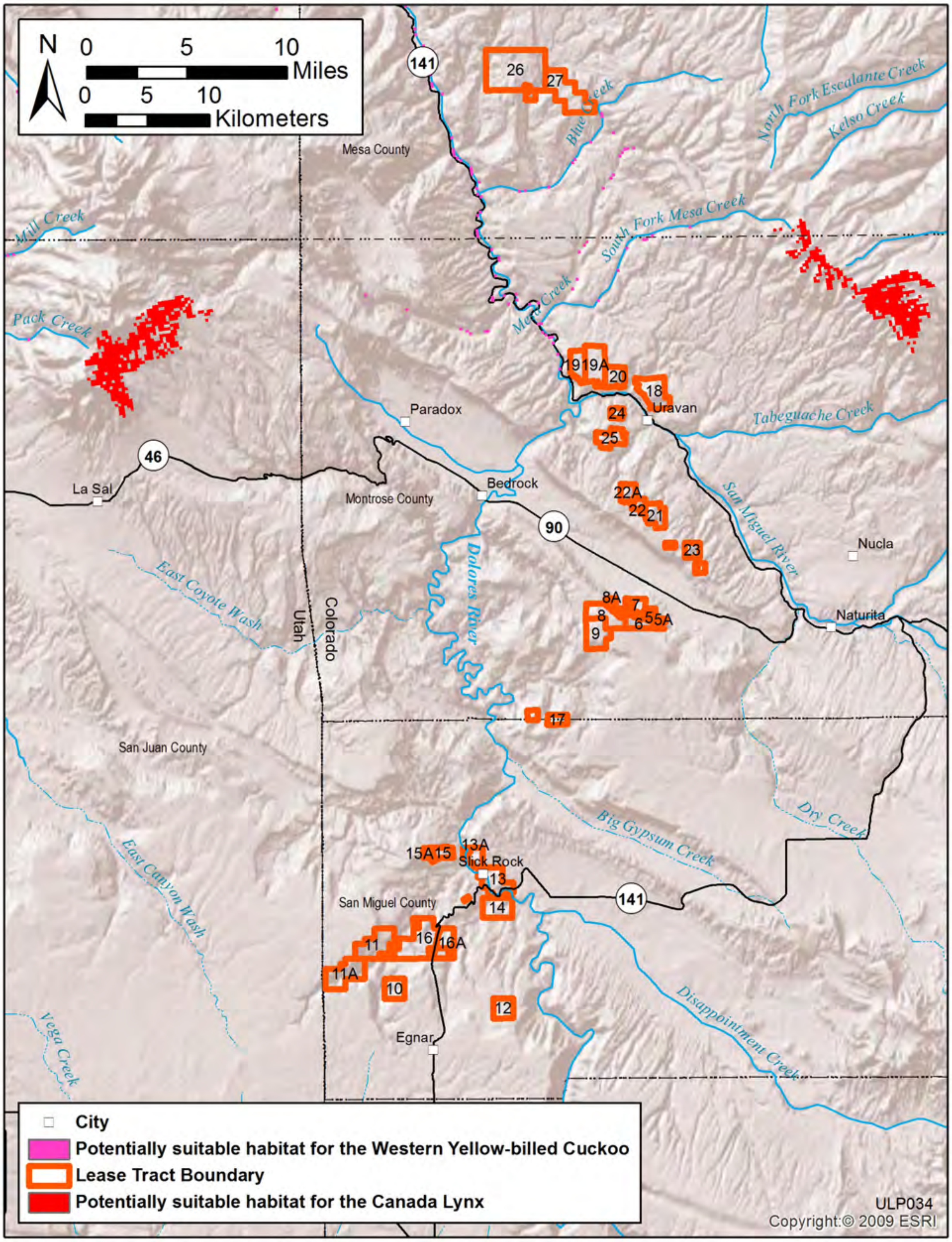


FIGURE 3.6-18 Distribution of Potentially Suitable Habitat for the Western Yellow-Billed Cuckoo and Canada Lynx in the Vicinity of the ULP Lease Tracts (USGS 2007)

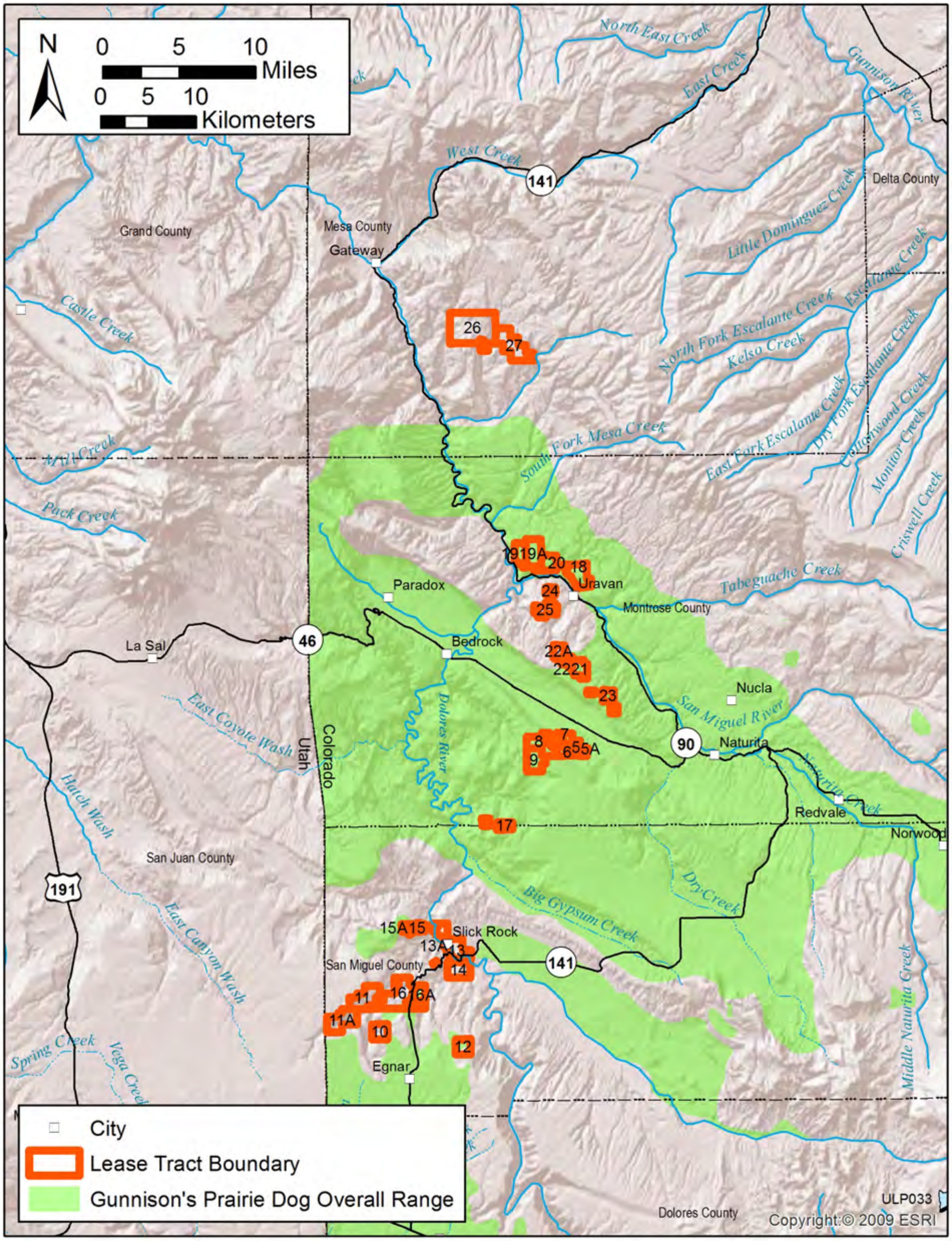


FIGURE 3.6-19 Distribution of Potentially Suitable Habitat for the Gunnison's Prairie Dog in the Vicinity of the ULP Lease Tracts (USGS 2007)

3.6.4.2 Sensitive and State-Listed Species

In addition to species listed under the ESA, several sensitive species may occur in the vicinity of the ULP lease tracts. For this assessment, these species include those that are designated as sensitive by the BLM and USFS, as well as those listed as threatened or endangered by the State of Colorado.

The BLM has established a policy, as specified in BLM Manual 6840, *Special Status Species Management* (BLM 2008a), that is designed "to provide policy and guidance for the conservation of BLM special status species and the ecosystems upon which they depend on BLM-administered lands." BLM special status species are identified in that manual as "(1) species listed or proposed for listing under the ESA, and (2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA, which are designated as Bureau sensitive by the State Director(s). All Federal candidate species, proposed species, and delisted species in the 5 years following delisting will be conserved as Bureau sensitive species." In addition, each BLM state director maintains a list of sensitive species, and impacts on these species would have to be considered in project-specific assessments developed before any activity that would affect them or their critical habitat could be approved.

The USFS has identified species considered sensitive under USFS Manual 2670 (USFS 2005). Many of these species are also listed as sensitive by the BLM.

The State of Colorado has also identified species that are threatened or endangered with extinction from the state under the Colorado Revised Statute 33-2-101. Many state-listed species are also listed as BLM sensitive species or USFS sensitive species, and some are also listed under the ESA. In cooperation with the USFWS, states are required to monitor, for no less than 5 years, the status of all species that have recovered to a point at which they are no longer listed as threatened or endangered (e.g., bald eagle).

By definition, all the species listed in Table 3.6-21 are considered to be sensitive species, including the 10 species listed or candidates for listing under the ESA (Section 3.6.4.1). Of the sensitive species that may occur on or near the ULP lease tracts, 41 are designated as sensitive by the BLM, 20 are designated as sensitive by the USFS, and 10 are listed as threatened or endangered by the State of Colorado. A summary of sensitive species by taxonomic group is provided in Table 3.6-23. Many of these species are protected under one or more regulatory statute (e.g., Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act), and some are listed under the ESA. A discussion of these species by listing status is provided below.

3.6.4.2.1 BLM Sensitive Species. A total of 41 species are designated as sensitive by the Colorado BLM state office that have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these BLM-designated sensitive species, there are 16 plants, 1 invertebrate, 3 fish, 3 amphibians, 2 reptiles, 9 birds, and

TABLE 3.6-23 Number of Sensitive Species That May Occur on or near ULP Lease Tracts

Taxonomic Group	Number of Sensitive Species[a]
Plants	17
Insects	1
Fish	7
Amphibians	4
Reptiles	2
Birds	12
Mammals	8

[a] Sensitive species are those that have been designated as sensitive by the BLM or USFS, as well as those species listed as threatened or endangered by the State of Colorado under *Colorado Revised Statutes* 33-2-101. Note: Sensitive species may also be listed under the ESA.

7 mammals. Some of the BLM-designated sensitive species are previously listed or considered for listing under the ESA.

Most of the BLM-designated sensitive plant species have the potential to inhabit desert shrublands or piñon-juniper forests in one or more of the ULP counties (Mesa, Montrose, or San Miguel). Shrublands and piñon-juniper forests either dominate or have the potential to occur on every ULP lease tract. These BLM-designated sensitive plant species also occur at elevation ranges that generally coincide with the elevation ranges for one or more of the ULP lease tracts.

The single BLM-designated sensitive invertebrate species –the Great Basin silverspot butterfly (*Speyeria nokomis nokomis*)—inhabits streamside meadows and other riparian areas in western Colorado. It is not known to occur in the vicinity of the ULP lease tracts, but suitable habitat could occur on each of the lease tracts in each of the ULP counties.

The three BLM-designated sensitive fish species (bluehead sucker, flannelmouth sucker, and roundtail chub) could occur in the project area in the Dolores and San Miguel Rivers. The Dolores River intersects Lease Tracts 13A, 13, and 14. Suitable habitat may also occur downgradient and in the vicinity of several other lease tracts. All three species are experiencing variable or declining population trends in the Dolores River. Two of these species (bluehead sucker and roundtail chub) may be extirpated from upstream reaches near McPhee Reservoir (Bestgen et al. 2011).

The three BLM-designated sensitive amphibian species are generally associated with montane riparian areas that occur in one or more of the project counties. These species also occur at elevation ranges that generally coincide with the elevation ranges for one or more of the ULP lease tracts. According to the SWReGAP habitat suitability models, suitable habitat for these species could occur on or in the vicinity of several lease tracts.

The two BLM-designated sensitive reptile species are generally associated with montane shrublands and slopes. Quad-level occurrences for both of these species intersect at least one ULP lease tract. According to the SWReGAP habitat suitability models, suitable habitat for these species could occur on or in the vicinity of several lease tracts.

Several BLM-designated sensitive bird species could occur in the ULP project area. These species occur as summer breeding residents, winter residents (including transients and migrants), or year-round residents. According to records provided by the CNHP and SWReGAP habitat suitability models, these species are either known to occur or may have suitable habitat in one or more of the ULP lease tracts. The summer breeding residents include species such as Brewer's sparrow (*Spizella breweri*) and peregrine falcon (*Falco peregrinus*). Nesting habitat for these species may occur on or in the vicinity of several lease tracts (Table 3.6-21). Winter residents include species such as the bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk (*Buteo regalis*), and northern goshawk (*Accipiter gentilis*). Some of these species are known to occur in the vicinity of several lease tracts. According to the SWReGAP habitat suitability models, potentially suitable winter foraging habitat for these species may occur on or in the vicinity of several lease tracts. Year-round permanent residents in the ULP project area include species such as the burrowing owl (*Athene cunicularia*). This species inhabits grasslands and shrublands, preying upon prairie dogs and inhabiting their burrows. Occurrences and potentially suitable habitat for this species are known from the vicinity of several lease tracts.

Most of the BLM-designated sensitive mammal species are bat species. There are four bat species that are BLM-designated sensitive that could occur on or in the vicinity of the ULP lease tracts. Some of these bat species have been documented to occur in the vicinity of the ULP lease tracts (e.g., fringed myotis [*Myotis thysanodes*]). Bat species in the project area may forage in riparian areas, shrublands, and piñon-juniper woodlands. One or more of these habitat types could occur on each of the ULP lease tracts. Bats in the region roost in rock crevices, caves, mines, and trees. These potential roost sites also occur on or in the vicinity of each of the ULP lease tracts. According to records provided by Colorado Parks and Wildlife, various species of bats (including sensitive species) have been documented to roost in the mines on Lease Tracts 8, 12, 13, 13A, 14, 15, 16, 23, 26, and 27 (CPW 2012a). For all these bat species, SWReGAP habitat suitability models indicate the presence of potentially suitable habitat in the vicinity of one or more lease tracts (Table 3.6-21).

Other BLM-designated sensitive mammal species that could occur in the project area include desert bighorn sheep (*Ovis canadensis nelsoni*) and white-tailed prairie dog (*Cynomys leucurus*). According to SWReGAP habitat suitability models, potentially suitable habitat for each of these species may occur on or in the vicinity of several lease tracts. According to information provided by CPW (2012b), desert bighorn sheep are known to occur in 5 lease tracts

(Lease Tracts 9, 13, 13A, 14, and 15); they may also occur in winter concentration areas near 11 lease tracts (Lease Tracts 10, 11, 11A, 12, 13, 13A, 14, 15, 15A, 16, and 16A).

3.6.4.2.2 USFS Service Sensitive Species. A total of 20 species designated as sensitive by the USFS that have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these sensitive species, there are two plants, three fish, one amphibian, eight birds, and six mammals. Most of the USFS sensitive species are previously listed or considered for listing under the ESA or are BLM-designated sensitive species. The only UFSF-designated sensitive species that are not previously discussed include Wetherill's milkvetch (*Astragalus wetherillii*) and sage sparrow (*Amphisppiza belli*). The Wetherill's milkvetch inhabits slopes and cliffs and is known to occur in the vicinity of lease tracts 5, 5A, 6, and 7. The sage sparrow is a summer breeding resident that nests in sagebrush shrublands. Potentially suitable habitat for this species could occur on or near all lease tracts.

3.6.4.2.3 State-Listed Species. A total of 10 species listed as threatened or endangered by the State of Colorado have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these species, there are four fish, one amphibian, three birds, and two mammals. Most of these species are previously listed or considered for listing under the ESA, or are BLM- or USFS-designated sensitive species. The only state-listed species not previously discussed are the boreal toad (*Bufo boreas*) and northern river otter (*Lutra canadensis*). The boreal toad typically inhabits montane riparian and aquatic habitats at elevations between 8,500 and 11,500 ft (2,570 and 3,500 m). Although suitable habitat for this species is not likely to occur on any of the lease tracts, potentially suitable habitat may occur in the vicinity of lease tracts 19, 26, and 27. The northern river otter inhabits riverine systems where permanent water is present. It is known to occur in the Dolores River, which flows through Lease Tracts 13, 13A, and 14.

3.7 LAND USE

The ULP lease tracts are located on public land administered by the BLM. The BLM manages its lands within a framework of numerous laws, the most comprehensive of which is the FLPMA. The FLPMA established the "multiple use" management framework for public lands so that "public lands and their various resource values … are utilized in the combination that will best meet the present and future needs of the American people" (from Section 103(a) of FLPMA). The FLPMA ensures that no predominant or single use overrides the multiple-use concept of any of the lands managed by the BLM. BLM-administered lands (and resources) are used for domestic livestock grazing; fish and wildlife development and utilization; mineral exploration, development and production; ROWs; outdoor recreation; and timber production.

Beginning in 1948, lands within the Uravan Mineral Belt in southwestern Colorado (including the subject 31 lease tracts) were withdrawn from mineral entry under Public Land

Order 459 (and others) to reserve them for the exploration and development of uranium and vanadium resources. These lands are currently managed under the ULP. Under the ULP, DOE maintains jurisdiction and authority over all mining-related activities on the lease tracts (exploration, development, mining, and transportation); the BLM maintains jurisdiction over all other surface uses. During the term of the land withdrawal, the lands cannot be appropriated, sold, or exchanged, and new mining claims cannot be filed. However, the lands remain open to mineral leasing (e.g., oil and gas) and the mineral material laws. They also remain open to ROW authorizations (for pipelines, transmission lines, and roads).

3.7.1 Specially Designated Areas and Lands with Wilderness Characteristics

Most of the lands surrounding the lease tracts are administered by the BLM (Figure 3.7-1). Some of these lands are components of the BLM's National Landscape Conservation System (NLCS), which includes more than 886 Federally recognized areas and about 27 million acres (11 million ha) of specially designated areas, mainly in the western United States. The purpose of the NLCS is to "conserve, protect, and restore nationally significant landscapes with outstanding cultural, ecological, and scientific values for the benefit of current and future generations" (BLM 2011g). Specially designated areas are those areas designated by an E.O., by an Act of Congress, or by the BLM through its land use planning process, as being deemed to possess unique or important resource values. Examples include ACECs, SRMAs, and WSAs. Table 3.7-1 lists the types of specially designated areas and their acreages (or mileage) within 25 mi (40 km) of the lease tracts; lands managed by the USFS are also listed.

The BLM also has inventories of Lands with Wilderness Characteristics (LWCs) within 25 mi (40 km) of the ULP lease tracts. These lands are defined by BLM as (1) being of sufficient size (generally more than 5,000 acres [2,000 ha] of roadless, contiguous BLM lands, excluding State or private lands), (2) being natural, (3) having outstanding opportunities for solitude or primitive and unconfined recreation, and (4) having supplemental values, such as ecological, geological, or other features of scientific, educational, scenic, or historical value (BLM 2012d,e). Table 3.7-2 lists and describes the LWCs near the ULP lease tracts; Figure 3.7-2 shows their locations.

Several river segments within the region have been determined by BLM to be eligible for inclusion in the National Wild and Scenic Rivers (WSR) System (Figure 3.7-3). WSR designation preserves and protects the free-flowing condition, water quality, and outstanding remarkable values (ORVs) of selected rivers or river segments and provides legal protections from development. Table 3.7-3 lists the river segments eligible for WSR designation within 25 mi (40 km) of the lease tracts based on BLM's WSR eligibility reports for the Uncompahgre, Grand Junction, and Tres Rios Field Office or Planning Area (BLM 2010e, 2009d; USFS and BLM 2013). These include several segments and tributaries of the San Miguel and Dolores Rivers.

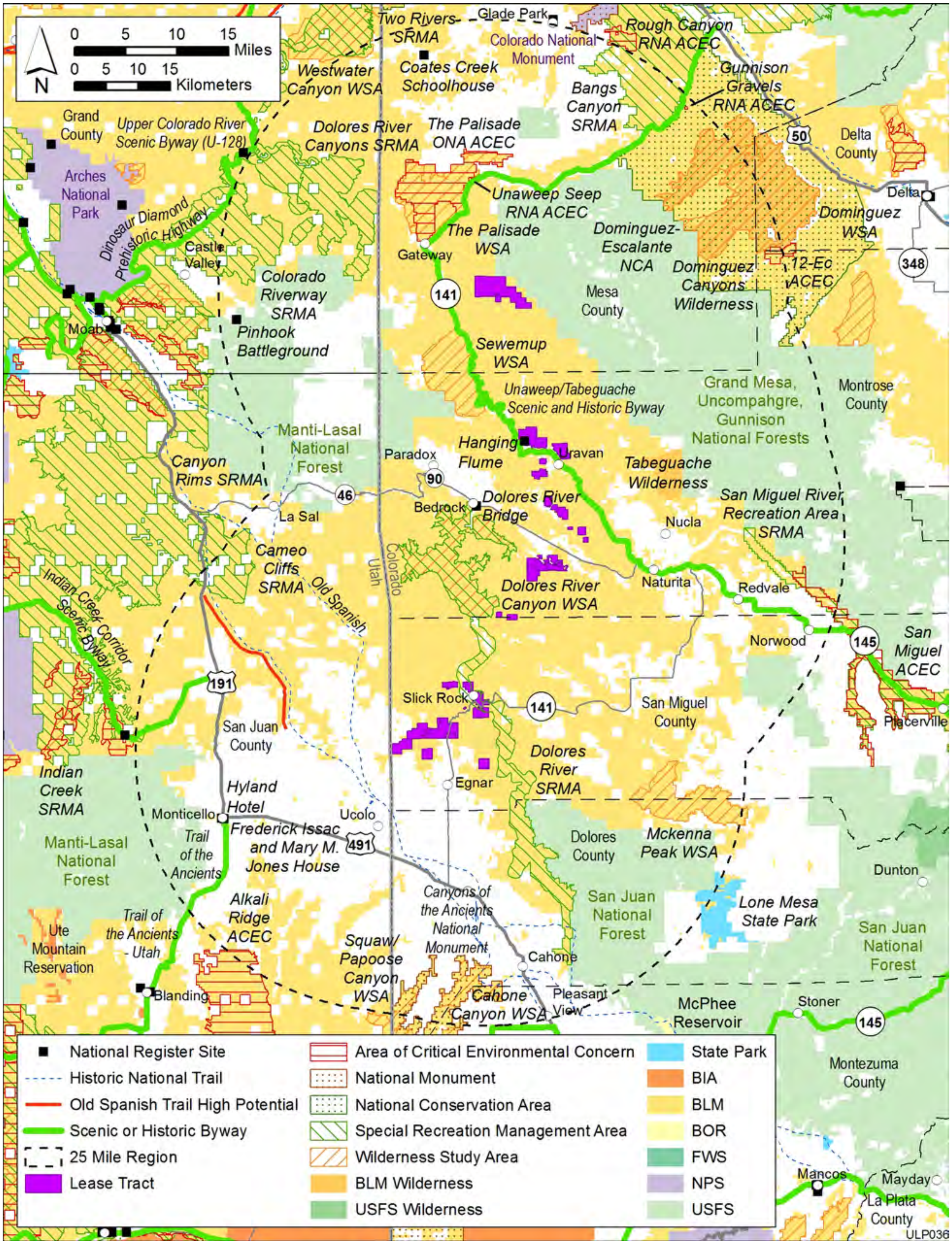


FIGURE 3.7-1 Specially Designated Areas on Public Lands near the ULP Lease Tracts

TABLE 3.7-1 Specially Designated Areas on Public Lands within 25 mi (40 km) of the ULP Lease Tracts

Name	Acreage
Areas of Critical Environmental Concern	
12-Ec	1,441
Alkali Ridge	1,713
Gunnison Gravels RNA[a]	40
Rough Canyon RNA	79
San Miguel	2,959
The Palisade ONA[a]	23,648
Unaweep Seep RNA	78
BLM Wilderness Areas	
Dominguez Canyons Wilderness Area	37,530
Tabeguache Wilderness	8,1860
Colorado State Park	
Lone Mesa State Park	1,689
National Monument	
Canyons of the Ancients	15,944
National Park Service Land	
Colorado National Monument	14
National Register of Historic Places *Sites*	
Coates Creek Schoolhouse	1
Dolores River Bridge	1
Frederick Isaac and Mary M. Jones House	1
Hanging Flume	4
Hyland Hotel	1
Pinhook Battleground	8
Special Recreation Management Areas	
Bangs Canyon	23,579
Cameo Cliffs	9,941
Canyon Rims	274
Colorado Riverway	30,056
San Miguel River	TBP
Dolores River	65,270
Dolores River Canyon	31,670
Indian Creek	566
Two Rivers	3,788

Name	Acreage
U.S. Forest Service Lands	
Grand Mesa, Uncompahgre, and Gunnison National Forests	411,767
Manti-Lasal National Forest	176,752
San Juan National Forest	121,532
Wilderness Study Areas	
Cahone Canyon	9,153
Dolores River Canyon	29,166
Dominguez	39,903
McKenna Peak	19,337
Sewemup	19,637
Squaw/Papoose Canyon	2,460
The Palisade	26,656
Westwater Canyon	1,398

Name	Mileage
National Historic Trails	
High Potential Old Spanish Trail	17
Old Spanish Trail	173
Scenic Byways	
Dinosaur Diamond Prehistoric Highway (Colorado)	0.3
Dinosaur Diamond Prehistory Highway (Utah)	0.3
Indian Creek Corridor Scenic Byway	11
Trail of the Ancients (Colorado)	11
Trail of the Ancients (Utah)	
Unaweep/Tabeguache Scenic and Historic Byway	108
Upper Colorado River Scenic Byway (U-128)[b]	0.3

[a] RNA = Research Natural Area; ONA = Outstanding Natural Area.

[b] U = Utah.

TABLE 3.7-2 Lands with Wilderness Characteristics within 25 mi (40 km) of the ULP Lease Tracts

Name	Planning Area	Acreage	Description
Dolores River Canyon WSA Addition	Uncompahgre	3,750	Adjacent to the Dolores River Canyon WSA, with no recreation facilities. The unit does not possess outstanding opportunities for solitude; no supplemental values noted.
Roc Creek	Uncompahgre	7,650	Near but not contiguous with Sewemup Mesa WSA. Accessible only by foot or on horse; no recreational facilities.
Shavano Creek	Uncompahgre	6,090	Immediately north of the Tabeguache Area (separated by Montrose County Road V24 and therefore not adjacent).
CO-030-290-h	Tres Rios	3,115	Centered around the Coyote Wash drainage, west of the Dolores River WSA and east of the Utah/Colorado state line. Supplemental value noted for Mexican spotted owl habitat (endangered species).
CO-030-301-a	Tres Rios	10,150	Bounded on the west by private lands and spur roads near the canyon rim, Snaggletooth Road along the Dolores River on the east, and a county road on the south. Largely undeveloped, isolated canyon country. Supplemental value noted for very scenic river corridor.
CO-030-301-b	Tres Rios	19,510	Bounded on the north by Snaggletooth Road, on the west by Snaggletooth Road along the Dolores River, and on the east by roads and road spurs near the canyon rim. Largely undeveloped, isolated canyon country. Supplemental value noted for very scenic river corridor.
CO-030-286-b	Tres Rios	2,635	Bounded by wilderness inventory roads and the McKenna Peak WSA to the south and east. Supplemental value noted for wild horse herd.
CO-030-286-d	Tres Rios	2,390	Adjacent to McKenna Peak WSA. Supplemental value noted for Spring Creek wild horse herd.
CO-030-286-f	Tres Rios	1,578	Adjacent to McKenna Peak WSA. No supplemental values noted.
Bang’s Canyon (1)	Grand Junction	20,434	Located in Mesa County about 6 mi (10 km) south of Grand Junction. Supplemental value noted for critically sensitive cultural resources and ecology.

TABLE 3.7-2 (Cont.)

Name	Planning Area	Acreage	Description
Lumsden Canyon (18)	Grand Junction	10,072	Located in southern Mesa County, just west of the town of Gateway and Highway 141; encompasses a system of canyons which rise above the Dolores River. Unit offers geologic, scenic, and ecological supplemental values.
Maverick Canyon (20)	Grand Junction	20,401	Located in Mesa County, about 25 mi (40 km) southwest of Grand Junction. Bounded on the north by private lands and on the west by private lands and the Dolores River; east side of the unit follows the rims of various canyons. Supplemental value noted for the Juanita Arch, a natural bridge and the only one of its kind in Colorado.
Unaweep (30)	Grand Junction	7,154	Located in Mesa County, about 25 mi (40 km) southwest of Grand Junction and just northeast of Gateway. No supplemental values noted.
West Creek (31)	Grand Junction	111	Adjacent to existing Palisade WSA and the Palisade Outstanding Natural Area about 35 mi (56 km) southwest of Grand Junction. Supplemental value noted for unique hydrologic features and a rare species of butterfly.

Sources: BLM (2011o, 2012f,g)

3.7.2 Agriculture

According to the 2007 agriculture census (USDA 2009a), about 845,000 acres (3,400 ha) in Colorado counties within 25 mi (40 km) of the ULP lease tracts (Mesa, Montrose, and San Miguel) are classified as farmland[19] (Table 3.7-4). Most farmland in these counties (about 58%) is permanent pasture and rangeland, with the remainder classified as cropland (29%), woodland (8.3%), and land in farmsteads, buildings, and livestock facilities (4.6%). About 67% of cropland in these counties is irrigated. While there are far fewer farms in San Miguel County than in Mesa and Montrose Counties, the average farm size in San Miguel County is four to five times larger.

About 1.6 million acres (0.65 million ha) in Utah counties within 25 mi (40 km) of the ULP lease tracts (Grand and San Juan) are classified as farmland, with most of the farmland (about 97%) occurring in San Juan County (Table 3.7-4). Most of the farmland in these counties (about 87%) is permanent pasture and rangeland, with the remainder classified as cropland

[19] A farm is defined by the U.S. Department of Agriculture (USDA 2009a) as any place from which agricultural products worth $1,000 or more were produced or sold during the census year.

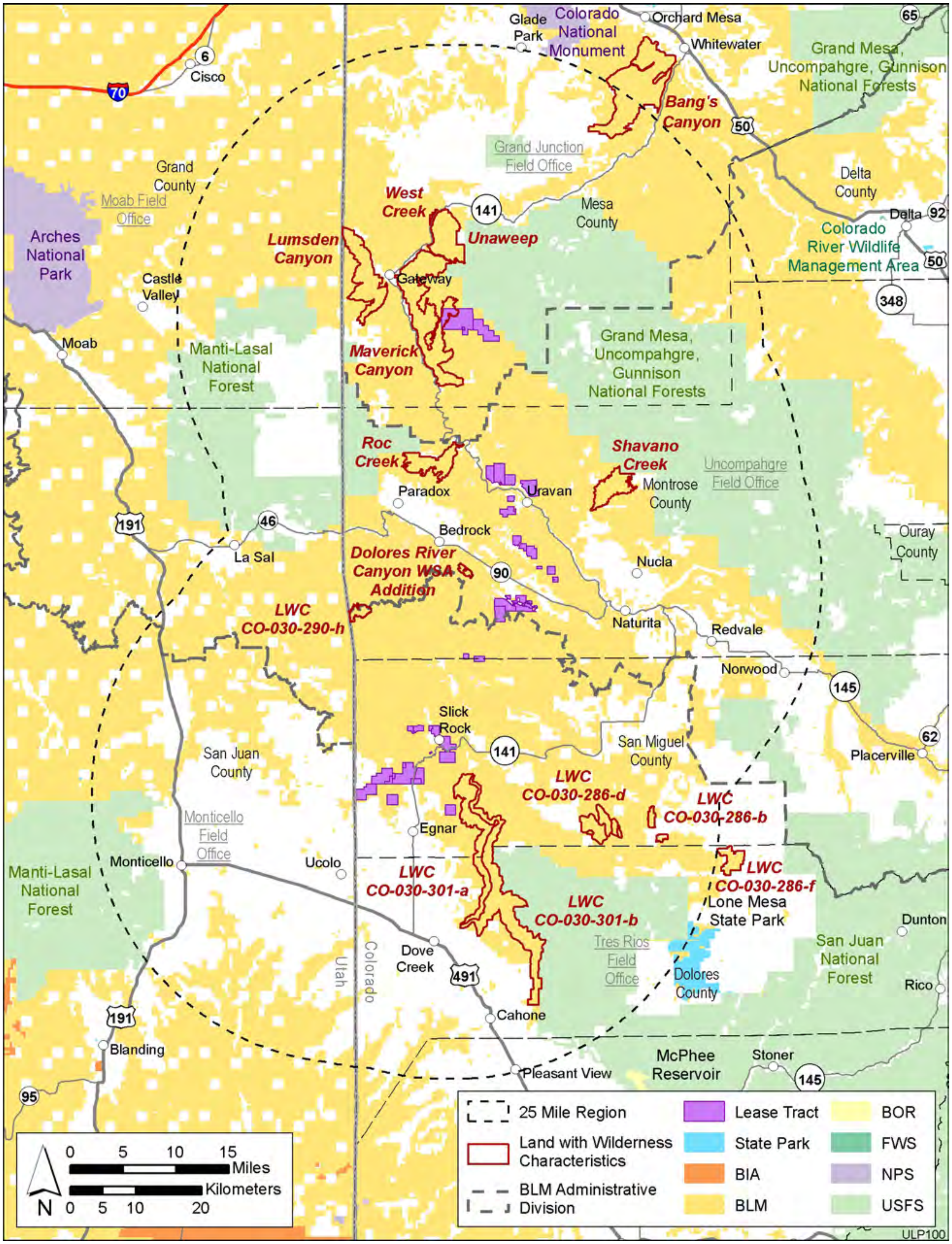


FIGURE 3.7-2 Land with Wilderness Characteristics near the ULP Lease Tracts

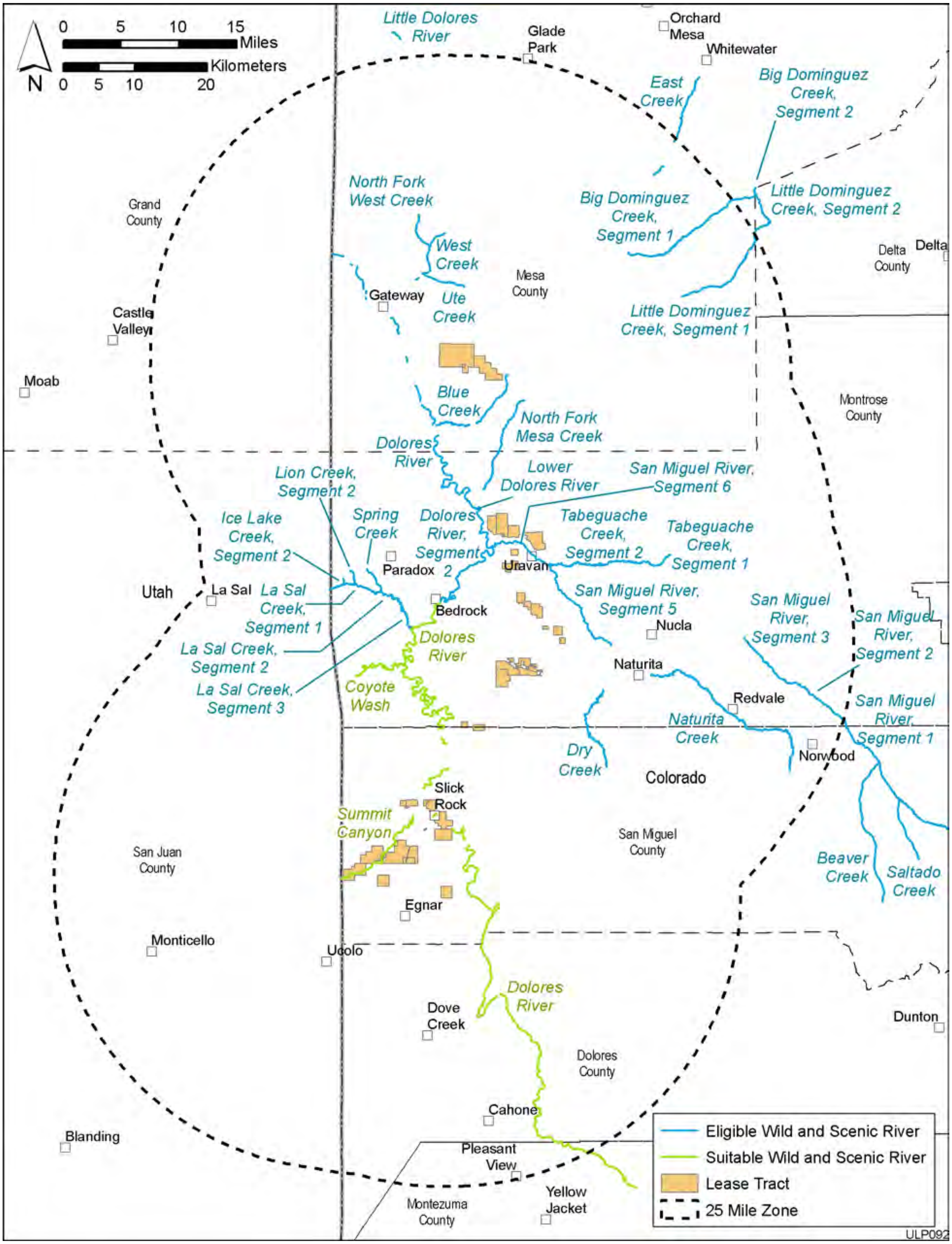


FIGURE 3.7-3 Wild and Scenic River Segments near the ULP Lease Tracts

1 **TABLE 3.7-3 Eligible Wild and Scenic River Segments within 25 mi (40 km) of the ULP Lease**
2 **Tracts[a]**

River Segment (Classification)	Ownership: River Segment (mi)	Ownership: Within 0.5-mi-wide Corridor (acres)	ORVs[b]
Grand Junction Planning Area			
Dolores River Watershed			
Dolores River (Recreational)	32.01 (total), 18.62 (BLM)	NA[b]	Scenic, recreational, geological, paleontological, and fish.
North Fork Mesa Creek (Scenic)	2.05 (BLM)	NA	Vegetation
Blue Creek (Scenic)	11.36 (total), 10.08 (BLM)	NA	Scenic, fish, and cultural
Dominguez Canyons			
Big Dominguez Creek, Segment 1 (Wild)	15.86 (BLM)	NA	Scenic, recreational, wildlife, geological, and cultural
Big Dominguez Creek – Segment 2 (Scenic)	0.78 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dominguez Creek, Segment 1 (Wild)	13.14 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dominguez Creek, Segment 2 (Scenic)	2.45 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dolores River			
Little Dolores River (Scenic)	20.03 (total), 1.1 (BLM)	NA	Cultural and scientific
Unaweep Canyon			
East Creek (Recreational)	20.26 (total), 8.96 (BLM)	NA	Geological
West Creek (Recreational)	23.56 (total), 4.93 (BLM)	NA	Scenic, geological, wildlife, and vegetation
North Fork West Creek (Wild)	8.46 (total), 3.31 (BLM)	NA	Scenic

1 **TABLE 3.7-3 (Cont.)**

River Segment (Classification)	Ownership: River Segment (mi)	Ownership: Within 0.5 mi-wide Corridor (acres)	ORVs[b]
Unaweep Canyon (Cont.)			
Ute Creek (Scenic)	4.22 (total), 4.19 (BLM)	NA	Vegetation
Uncompahgre Planning Area			
San Miguel Hydrologic Unit			
Dry Creek (Wild)	10.42 (BLM), 0.07 (State)	2,760.4 (BLM), 80.7 (State), 2.8 (Private)	Scenic and geologic
Naturita Creek (Scenic)	9.9 (BLM), 14.98 (Private)	3,238.5 (BLM), 2.3 (USFS), 3,176.6 (Private)	Fish
San Miguel, River Segment 1 (Recreational)	17.34 (BLM), 0.08 (USFS), 9.81 (Private)	6,679.2 (BLM), 136.0 (USFS), 1628.8 (Private)	Scenic, recreational, wildlife, historic, vegetation, and paleontological
San Miguel, River Segment 2 (Wild)	3.64 (BLM), 0.37 (USFS)	1,112.0 (BLM), 122.7 (USFS), 21.3 (Private)	Scenic, recreational, wildlife, and vegetation
San Miguel, River Segment 3 (Scenic)	5.30 (BLM), 2.01 (Private)	1,880.7 (BLM), 407.6 (Private)	Recreational, fish, wildlife, and vegetation
San Miguel, River Segment 5 (Recreational)	2.59 (BLM), 11.41 (Private)	2,738.1 (BLM), 1,610.4 (Private)	Recreational, fish, historic, and vegetation
San Miguel, River Segment 6 (Recreational)	2.25 (BLM), 0.98 (Private)	808.7 (BLM), 180.7 (Private)	Recreational, fish, historic, and vegetation
Tabeguache Creek, Segment 1 (Wild)	3.61 (BLM)	1,077.0 (BLM), 6.3 (Private)	Vegetation
Tabeguache Creek, Segment 2 (Recreational)	7.89 (BLM), 3.68 (Private)	2,487.3 (BLM), 515.4 (Private)	Cultural and vegetation

2
3

1 **TABLE 3.7-3 (Cont.)**

River Segment (Classification)	Ownership: River Segment (mi)	Ownership: Within 0.5 mi-wide Corridor (acres)	ORVs[b]
Lower Dolores Hydrological Unit			
Lower Dolores River (Scenic)	6.93 (BLM), 3.60 (Private)	2,197.5 (BLM), 922.7 (Private)	Scenic, recreational, geologic, fish, and wildlife
North Fork Mesa Creek (Scenic)	5.81 (BLM), 2.72 (Private)	2,042.4 (BLM), 424.5 (Private)	Vegetation
Upper Dolores Hydrological Unit			
Dolores River, Segment 2 (Recreational)	5.42 (BLM), 6.08 (Private)	1,820.7 (BLM), 1,423.8 (Private)	Scenic, recreational, geologic, fish, wildlife, and vegetation
Ice Lake Creek, Segment 2 (Scenic)	0.31 (BLM), 0.27 (Private)	104.8 (BLM), 75.8 (Private)	Scenic
La Sal Creek, Segment 1 (Scenic)	0.62 (BLM), 4.20 (Private)	718.1 (BLM), 630.8 (Private)	Fish, vegetation
La Sal Creek, Segment 3 (Wild)	3.37 (BLM)	907.7 (BLM)	Scenic, recreational, fish, cultural, and vegetation
Lion Creek, Segment 2 (Scenic)	1.26 (BLM), 0.31 (Private)	401.5 (BLM), 84.7 (Private)	Vegetation
Spring Creek (Recreational)	1.49 (BLM), 1.16 (Private)	633.0 (BLM), 201.4 (Private)	Vegetation
Tres Rios–San Juan Planning Area			
Dolores River – McPhee to Bedrock	109.02	NA	Wildlife, scenic, recreational
Summit Canyon	12.15	NA	Scenic
Coyote Wash	7.60	NA	Wildlife

[a] River segments in the Tres Rios Planning Area are designated “suitable” for wild and scenic rivers status.

[b] ORVs are river-related values that are unique, rare, or exemplary; these include scenic, recreational, geologic, fish, wildlife, cultural, historical, vegetation, or other similar values (such as paleontological and scientific).

Sources: BLM (2009d, 2010e); USFS and BLM (2013)

TABLE 3.7-4 Number of Farms and Acreage of Agricultural Lands by County

Agriculture Lands	Acreage of Agricultural Lands by County				
	Mesa	Montrose	San Miguel	Grand	San Juan
Number of farms	1,767	1,045	123	90	758
Average farm size	211	307	1,227	561	2,041
Total land in farms	372,511	321,056	150,947	52,729[a]	1,546,914
Total cropland	131,178	93,262	17,807	7,956	143,231
Harvested	47,438	60,094	6,769	3,623	48,168
Pasture/grazing	68,769	27,740	5,104	NA[b]	14,999
Other (fallow, etc.)	14,971	5,428	5,934	NA	80,064
Total woodland	30,223	25,698	15,013	623	34,606
Pastured	25,106	21,237	13,470	NA	20,196
Not pastured	5,117	4,461	1,543	NA	14,410
Permanent pasture and rangeland	197,682	179,935	115,143	37,109[a]	1,360,534
Land in farmsteads, buildings, livestock facilities, ponds, roads, wasteland, etc.	13,428	22,161	2,984	3,012	8,543
Pastureland, all types	291,557	228,912	133,717	40,355[a]	1,414,748
Irrigated land	64,272	85,656	12,694	4,712	5,177

[a] Data for Grand County are from the 2002 census (2007 data were withheld to avoid disclosing data for individual farms).

[b] NA = not available (2007 data were withheld to avoid disclosing data on individual farms).

(9.5%), woodland (2.2%), and land in farmsteads, buildings, and livestock facilities (<1%). Only a small portion of cropland (6.5%) in Grand and San Juan Counties is irrigated.

There are 329,000 acres (1,300 ha) of farmland estimated to be within 25 mi (40 km) of the ULP lease tracts; most of this land occurs to the southwest of the lease tracts in San Juan County (Utah) and Dolores County (Colorado). There are no agricultural activities associated with any of the ULP lease tracts. A few soil types within the ULP lease tracts have been classified by the NRCS as prime or unique farmland, if irrigated (see Section 3.3.2).

3.7.3 Rangeland Resources

3.7.3.1 Livestock Grazing

Domestic livestock grazing is a major and widespread use of public lands managed by the BLM. Grazing on public land is authorized either through a grazing permit or lease issued by the BLM to local ranchers. The BLM administers its grazing program in accordance with the Taylor Grazing Act of 1934; regulations governing grazing are contained in 43 CFR Part 4100. As of October 2010, the BLM had issued 1,510 grazing permits and leases in Colorado (BLM 2011h).

The lease tracts provide some forage for livestock grazing but do not support concentrated grazing. The BLM has determined that in the lease tracts, 30 to 50 acres (12 to 20 ha) of forage constitute one animal unit month (AUM). Nearly all the lease tracts are within areas designated by the BLM as livestock management areas for cattle or sheep (Hurshman 1994; USFS and BLM 2013).

3.7.3.2 Wild Horses and Burros

The Wild Free-Roaming Horse and Burro Act of 1971 (16 USC 1331 *et seq.*) (the Act) gave the BLM and other Federal land management agencies the responsibility for protecting, managing, and controlling wild horses and burros. The general objectives for managing wild horses and burros are to (1) protect, maintain, and control viable, healthy herds with diverse age structures while retaining their free-roaming nature; (2) provide adequate habitat through the principles of multiple use and environmental protection; (3) maintain a thriving natural ecological balance with other resources; (4) provide opportunities for the public to view wild horses and burros; and (5) protect wild horses and burros from unauthorized capture, branding, harassment, or death.

Wild horses and burros are managed within herd management areas (HMAs), with the goal being to maintain both the natural ecological balance of public lands and the ability to support multiple herds (BLM 2011i). An HMA is usually some portion of a herd area (HA), which is an area that was wild horse or burro habitat at the time of the passage of the Act but has not been designated for long-term management of wild horses or burros. The exterior boundaries of both HAs and HMAs can include private or state lands, but the BLM has management authority over only the public lands. Herd population management is important for balancing herd numbers with forage resources and with other uses of the public and adjacent private lands.

There are four HAs in Western Colorado. These occur in Rio Blanco, Mesa, Montrose, and San Miguel Counties. There are also four HMAs, but only three coincide with the HAs: Piceance-East Douglas Creek (Rio Blanco County); Little Book Cliffs (Mesa County); and Spring Creek Basin (San Miguel County). Another HMA, Sand Wash Basin, is located in Moffat County. The HMA nearest to the lease tracts is in Spring Creek Basin, about 20 mi (32 km) to the east of the Slick Rock lease tract (on the east side of Disappointment Valley). There is an HA that straddles the Montrose-San Miguel County line in the canyons south of Paradox Valley near the southern part of the Paradox lease tract.

3.7.4 Mineral Resources and Mining

Mineral resources in southwestern Colorado and southeastern Utah include uranium, vanadium, oil, natural gas, coal, and other metallic and nonmetallic minerals and mineral materials (Figure 3.7-4). These resources are discussed in the following subsections.

3.7.4.1 Uranium

As of June 13, 2011, there were 32 actively permitted uranium mining projects in southwestern Colorado, none of which were producing ore (CDNR 2011). The mines and their status are shown in Table 3.7-5; 15 of the permitted projects in Colorado are in the lease tracts (in Mesa, Montrose, and San Miguel Counties). The most recent ore production occurred at three mines operated by Denison Mines (USA) Corporation in San Miguel County, which operated from 2007 to 2009. Uranium prospecting activities have declined in recent years,[20] but the CDNR expects an increase in these activities once the Piñon Ridge Mill in Paradox Valley is constructed.

There were 23 uranium projects in Utah in 2010, a few of which were producing ore (UGS 2011). The mines and their status are shown in Table 3.7-6; most of the projects in Utah are in the lease tracts area (in Grand and San Juan Counties). Two mines operated by Denison Mines (USA) Corp. (Pandora and Beaver Mines) in San Juan County produced 371,700 lb (168,600 kg) of U_3O_8 and 2,080,000 lb (943,500 kg) of V_2O_5 in 2010. White Canyon's Daneros Mine (also in San Juan County) also produced uranium ore in 2010 (UGS 2011).

According to the BLM's Land and Mineral Rehost 2000 System (LR2000), accessed on September 10 and 11, 2012, there are several authorized notices of intent and one plan of operation on file with the BLM for uranium- and vanadium-related mining activities within or immediately adjacent to the lease tracts; these include:

- *Gateway lease tract*. One notice of intent (COC 071901) filed by Rimrock Exploration and Development, Inc. for uranium mining on a claim in the vicinity of Lease Tract 27, in section 13 of T50N, R18W; operations authorized in 2008.

- *Uravan lease tract*. One notice of intent (COC 071888) filed by Energy Fuels Resources Corp. for uranium and other minerals mining on claims that are adjacent to Lease Tract 25 in sections 5 and 6 of T47N, R17W; operations authorized in 2009.

[20] As measured by the number of uranium prospecting notices of intent filed with the state (CDNR 2011).

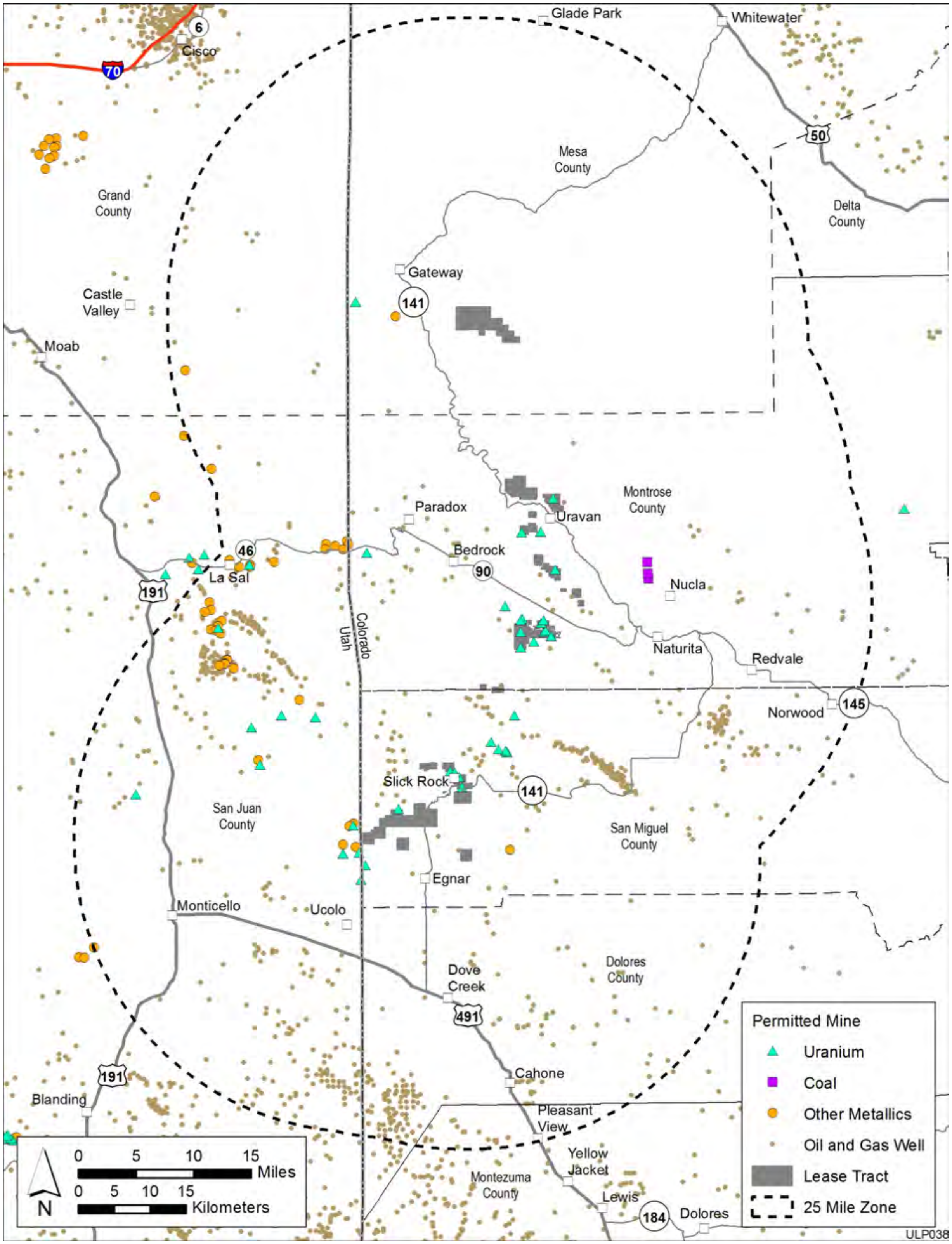


FIGURE 3.7-4 Permitted Oil and Gas Wells and Mines within 25 mi (40 km) of the ULP Lease Tracts

1 **TABLE 3.7-5 Active Uranium Mining Permits in Southwestern Colorado**

Site Name	Permittee	County	Permit/Site Status[a]
C-JD-5[b]	Gold Eagle Mining, Inc.	Montrose	INT/Maintenance
Mineral Joe Claims	Cotter Corporation	Montrose	INT/Tied to JD-6 Mine
Sunday Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
Deremo-Snyder	Umetco Minerals Corporation	San Miguel	INT/Reclaimed
Monogram-Jo Dandy	Nuvemco, LLC	Montrose	INT/Maintenance
Burros Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
C-LP-21 Mine[b]	Cotter Corporation	Montrose	INT-TC/Reclaimed
JD-9 Mine[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
CM-25 Mine[b]	Cotter Corporation	Montrose	INT/Reclaimed
C-JD-7[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
JD-6 Mine[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
SR-13A Mine[b]	Cotter Corporation	San Miguel	INT-TC/Reclaimed
Carnation Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
Sego Mine	Sutherland Drilling	San Miguel	INT/Maintenance
Ike No. 1 Mine[b]	Cotter Corporation	San Miguel	INT/Maintenance
Tramp Mine	Bluerock Energy Corp.	Montrose	INT/Maintenance
St. Jude Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
SM-18 Mine[b]	Cotter Corporation	Montrose	INT/Maintenance
Monogram Mines	Nuvemco, LLC	Montrose	INT/Maintenance
Hawkeye Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
Ellison Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
JD-7 Pit[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
Wright Group[b]	Cotter Corporation	Montrose	INT/Maintenance
Topaz Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
West Sunday Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
C-JD-8[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
Centennial	B-Mining Company	San Miguel	INT/Maintenance
Van 4 Shaft	Denison Mines (USA) Corp.	Montrose	AC/Maintenance
J Birds	Rimrock Exploration and Development, Inc.	Montrose	INT/Maintenance
Whirlwind Mine	Energy Fuels Resources Corp.	Mesa	INT/Maintenance
Last Chance #3 and #4	Nuvemco, LLC	Montrose	AW
October Ore Pile Reclamation	Nuvemco, LLC	Mesa	AC/Maintenance

[a] The status listed is as of March 2014. AC = active; AW = awaiting warranty; TC = temporary cessation; and INT = intermittent. Maintenance includes general upkeep as required for operations with intermittent (INT) status or temporary cessation (TC) status, but it does not include development or production activities.

[b] Mines that are on the DOE ULP lease tracts.

Source: CDNR (2011)

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TABLE 3.7-6 Uranium Projects in Southeastern Utah, 2010[a]

Site Name	Permittee	County	Site Status
Whirlwind	Energy Fuels Resources Corp.	Grand	Permitted resource
Thompson Project	Energy Fuels Resources (USA) Inc.	Grand	Acquired 6,672 acres; exploration project
Dunn Mine	Energy Fuels Resources (USA) Inc.	San Juan	Resource quantified
Rim-Columbus	Energy Fuels Resources (USA) Inc.	San Juan	Permitted resource
Marcy-Look	Energy Fuels Resources (USA) Inc.	San Juan	Acquired 907 acres; exploration project
Blue Jay	Energy Fuels Resources (USA) Inc.	San Juan	Acquired 289 acres; exploration project
Energy Queen (Hecla Shaft)	Energy Fuels Resources Corp.	San Juan	Permitted resource
North La Sal	Vane Minerals PLC	San Juan	Acquired 80 acres
North Alice Extension	Vane Minerals PLC	San Juan	Resource quantified
Pandora/Snowball/Beaver	Energy Fuels Resources (USA) Inc.	San Juan	Standby mode
DAR-RAD	West Lisbon LLC	San Juan	1,000 acres of property
Lisbon Mine	Mesa Uranium Corp.	San Juan	22 holes completed
Velvet	Uranium One, Inc.	San Juan	Resource quantified
Calliham (J.H. Ranch)	Energy Fuels Resources Corp.	San Juan	Resource quantified
Crain	Energy Fuels Resources Corp.	San Juan	Resource quantified
Daneros (Lark Royal)	Energy Fuels Resources (USA) Inc.	San Juan	Standby mode
Geitus	Energy Fuels Resources (USA) Inc.	San Juan	Resource quantified
Happy Jack	Vane Minerals PLC	San Juan	22 holes completed
LaSal II	Laramide Resources, Ltd.	San Juan	Permitted resource

[a] Table lists only projects occurring in San Juan and Grand Counties because these are the only Utah counties within 25 mi (40 km) of the DOE ULP lease tracts in which uranium projects are located.

Source: UGS (2011); White (2014)

- *Paradox Valley lease tract*. One plan of operation (COC 062522) filed by Energy Fuels Resources Corp. for uranium mining on claims immediately adjacent to Lease Tract 9 in section 29 of T46N, R17W; operations authorized in 1998. Two notices of intent (COC 070985 and 072947) filed by Energy Fuels Resources Corp. for uranium and other mining in the same section; operations authorized in 2007 and 2008, respectively.

- *Slick Rock least tract.* One plan of operation (COC 052755) filed by Umetco Minerals Corp. for vanadium mining on claims that are adjacent to Lease Tract 13 in sections 29 and 30 of T44N, R18W; operations authorized in 1993.

3.7.4.2 Coal

Coal-bearing areas in the Colorado Plateau region are extensive, and many of these areas (about 50%) occur beneath lands administered by various Federal agencies (BLM, National Park Service [NPS], and USFS). About 23% of the areas are beneath Native American tribal lands; another 26% are administered by state agencies or are privately owned (USGS 2001). In 2011, Colorado counties within 25 mi (40 km) of the ULP lease tracts produced about 2.6 million tons of coal from both surface and underground mines, with most of the production coming from Delta County (CDRMS 2011).[21] During that same year, there was no coal production in the two Utah counties (Grand and San Juan) within 25 mi (40 km) of the lease tracts (most coal production in Utah is to the west, in Carbon and Emery Counties) (UGS 2012).

According to the LR2000, accessed on September 10 and 11, 2012, there are no coal leases within any of the 31 ULP lease tracts (BLM 2012b). The New Horizon Mine (operated by Western Fuels Association, Inc.), located near Nucla in Montrose County about 10 mi (16 km) to the east of Paradox Valley, is the only active coal mine near the lease tracts. The surface mine is located in the Nucla-Naturita coal field that produces coal from minable coal beds in the Dakota Sandstone.[22] The mine is the exclusive supplier of coal to Nucla Station power plant, a 100-MW power plant located about 3 mi (4.8 km) southeast of Nucla. The New Horizon Mine produced 360,000 tons of coal in 2011, a 23% increase over production in 2010 (CDRMS 2012d, e). Coal production at the New Horizon Mine is expected to continue for the life of the power plant (Montrose County 2010).

3.7.4.3 Oil and Gas

Oil production and natural gas production in the region are concentrated in the Paradox Basin, especially along the Colorado–Utah border (Figure 3.7-4). In 2011, Colorado counties within 25 mi (40 km) of the ULP lease tracts produced 255,000 barrels (bbl) of oil and 314,000,000 million cubic feet of natural gas (including coalbed methane), with most of the production coming from Montezuma County (COGCC 2012a). During that same year, 3,580,000 bbl of oil and 11,300,000 million cubic feet of natural gas were produced in the two Utah counties (Grand and San Juan) within 25 mi (40 km) of the lease tracts (an 11% and 21% decline in production from the previous year, respectively) (UDOGM 2012).

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[21] Coal production was estimated by adding the production numbers reported in CDRMS (2011) for counties falling within 25 mi (40 km) of the ULP lease tracts. Coal production estimates are from Delta and Montrose Counties only; several counties within this range did not produce coal in 2011; these include Mesa, San Miguel, Dolores, and Montezuma Counties.

[22] The mine produces coal from three coal beds in the Dakota Sandstone with thicknesses of about 3 to 5 ft (0.9 to 1.5 m). Although the coal-bearing formation extends into surrounding counties (Dolores, Mesa, Montezuma, Ouray, and San Miguel), it is not considered important for exploitation, because the coal beds are generally thin and discontinuous (Kirschbaum and Biewick 2012).

There are authorized oil and gas leases within most of the lease tracts.[23] According to the LR2000, accessed September 10 and 11, 2012, most of the oil and gas leases are located along the Dolores River Canyon in the Slick Rock lease tracts (San Miguel County); there are also several leases in the Uravan and Paradox lease tracts, but none in the Gateway lease tract (BLM 2012c). None of the oil and gas leases in the lease tracts have produced oil or gas (COGCC 2012b). There is one pending notice for geophysical exploration activities in the Paradox lease tract, associated with oil and gas leases that overlap Lease Tracts 17-1 and 17-2 in sections 14 and 15 of T45 N, R18W (on Radium Mountain and Wedding Bell Mountain, respectively) (BLM 2012b).

3.7.4.4 Other Minerals and Mineral Materials

In addition to uranium and vanadium, metallic minerals mined in the Colorado counties within 25 mi (40 km) of the ULP lease tracts include gold, silver, platinum (San Miguel County only), lead, zinc, copper, cadmium, and rare earths (Montrose County only). Non-metallic minerals include gypsum and potash (CDRMS 2012e). According to the LR2000, accessed September 10 and 11, 2012, there are four pending potash permits within some of the Slick Rock lease tracts: one pending permit (COC 073566) is located in section 27 of T44N, R19W, which slightly overlaps Lease Tract 15A; two pending permits (COC 073567 and COC 073568) cover most of sections 10, 11, and 14 through 16 of T43N, R19W, in Lease Tracts 16 and 16A; and one pending permit (COC 073572) is located in section 32 of 43N, R18W, in Lease Tract 12 (BLM 2012b).

Mineral materials of commercial value mined in the region include sand and gravel, crushed stone, dimension stone, granite, limestone, sandstone (silica, stone, and quartz), shale, clay, and aggregate (CDRMS 2012e). There is only one authorized mineral material site (for common clay) within all the ULP lease tracts. The site is located on 9 acres (3.6 ha) in Lease Tract 25, in the northeast quadrant of section 5 in T47N, R17W (COC 069589; Umetco Minerals Corp., permittee). No other mineral material contracts or free use permits occur within the lease tracts (BLM 2012b).

3.7.5 Timber Harvest

In 2002 (the latest year for which county-level data are available), the timber harvest in Colorado counties within 25 mi (40 km) of the ULP lease tracts (Mesa, Montrose, and San Miguel) was an estimated 13 million board feet, accounting for about 16% of Colorado’s timber production during that year. The leading species harvested in Colorado, in decreasing order, were ponderosa pine (31%), spruce (Engelmann and blue spruce; 25%), lodgepole pine

[23] The ULP lease tracts are located on BLM lands that are withdrawn from mineral entry. The lands remain open to mineral leasing and the mineral material laws.

(17%), aspen and cottonwood (14%), and douglas fir (10%). Most of these species were harvested for sawlogs. The timber harvest on public lands in Colorado has been in decline since 1982 (with an increasing share being provided by private and tribal land owners) (Morgan et al. 2006).

The timber harvest in Utah counties within 25 mi (40 km) of the ULP lease tracts (Grand and San Juan) was estimated to be about 1.5 million board feet, accounting for only about 3.6% of Utah's timber production in 2002. The leading species harvested in Utah, in decreasing order, were spruce (44%), lodgepole pine (23%), ponderosa pine (13%), aspen and cottonwood (10%), and douglas fir (8%). Most of these species were harvested for sawlogs and house logs. Although National Forests still provide the majority of the state's harvest in Utah, timber harvest on public lands in the state has been in decline since 1992 (with an increasing share being provided by private and tribal land owners) (Morgan et al. 2006).

There are an estimated 3,900 acres (16 km^2) of harvested forest land within 25 mi (40 km) of the ULP lease tracts; most of this land is concentrated along the southwestern edge of the Uncompahgre Plateau and Piñon Mesa to the northeast and the La Sal Mountains to the west (in Utah). Although there is no commercial timber harvesting within the ULP lease tracts, the lease tracts and adjacent public lands provide piñon pine and juniper trees for small-scale harvesting to use as firewood, fence posts, and Christmas trees. In addition, commercial timbering was conducted in 2009 on Pine Mountain, north of Lease Tract 26.

3.7.6 Recreation

BLM-designated SRMAs are areas where the principal land management priority is recreation. There are several SRMAs within 25 mi (40 km) of the ULP lease tracts (Figure 3.7-1). These include Bangs Canyon and Dolores River in Colorado, and Cameo Cliffs, Canyon Rims, Colorado Riverway, San Miguel River, Dolores River, Dolores River Canyons, Indian Creek, and Two Rivers in Utah (Table 3.7-1). The SRMA nearest to the lease tracts is a 100-river mile (160-km) segment of the Dolores River that flows northward from the McPhee Reservoir in Montezuma County to Bedrock in Paradox Valley. The SRMA cuts through the Slick Rock lease tracts area and is a popular rafting destination from late April to early June, except during very dry years (BLM 2010d). Many segments and tributaries of the Dolores and San Miguel Rivers (and others) in the region are designated as WSRs on the basis of numerous ORVs that include recreational value (Figure 3.7-2; Table 3.7-2).

The Gateway area and surrounding Unaweep Canyon have undergone development in recent years to promote recreational activities in the area. Tourism and activities related to the Gateway Canyons Resort (e.g., river rafting) are expected to increase, especially in the summer months.

The Paradox Valley area along Long Park Road (County Road EE22) is a popular location for rock climbing. The Paradox Trail is a 100-mi (160-km), two-track path along the Dolores River that links to the Tabeguache Trail on the Uncompahgre Plateau (to the east) with the Kokopelli Trail in the La Sal Mountains of Utah (to the west). Together, these trails form a

"Grand Loop" of 360 mi (580 km) of back country mountain bike trails. The trail is accessible by mountain bike from May through November; only parts of the trail are accessible by two-wheel drive vehicles (BLM 2011k).

There are developed recreation sites along the San Miguel River and Dolores River SRMAs, including campsites, boat ramps, picnic areas, parking areas, restrooms, and boat ramps. Recreational activities in these areas include off-highway vehicle (OHV) riding (such as four-wheel drive, motorcycle, ATV, and the like), hiking, camping, hunting, mountain biking, horseback riding, recreational mining, fishing, rafting, and kayaking (BLM 2011k).

The Unaweep Tabeguache Byway (Highways 141 and 145) offers opportunity for scenic and historic touring in the region. The byway runs from Whitewater through Gateway, Naturita, Norwood, and Placerville (Figure 3.7-1). Sites along the byway include the Grand Valley Overlook, the Driggs Mansion, Gateway Community Park, the Hanging Flume Overlook, and the San Miguel River Nature Conservancy Preserve (CDOT 2012).

3.8 SOCIOECONOMICS (INCLUDING TOURISM AND RECREATION)

The use of Federal lands for uranium mining affects local communities in the project area by changing demographic characteristics and local economies and altering social structures. The ROI referred to here includes the area that could be affected by uranium mining on the 31 DOE ULP lease tracts and where workers are expected to reside and spend their wages. For this analysis, the ROI includes the counties where the 31 DOE ULP lease tracts are located: Mesa County; Montrose County; and San Miguel County in western Colorado. These lease tracts are located in the westernmost portions of all three counties. For the ROI, three economic indicators are described: employment; unemployment; and personal income. Measures of social activity considered include population, housing, public service employment, and levels of service for education (schools), healthcare, and public safety.

For the most part, the communities within the ROI are rural in nature; the exception is the larger town of Grand Junction. The town nearest the DOE ULP lease tracts in Mesa County is Gateway, an unincorporated town of approximately 650 people that lies 6 mi (9.7 km) to the northwest of the lease tracts. The closest incorporated areas in Mesa County are at least 30 mi (48 km) to the northeast of the potential lease tracts. In Montrose County, the unincorporated towns of Bedrock and Paradox are located 7 mi (11 km) and 9 mi (14 km) to the west of the lease tracts, respectively. The larger towns closest to the lease tracts are Nucla and Naturita, at a distance of 7 to 8 mi (11 to 13 km). The population in San Miguel is concentrated almost entirely in the eastern portion of the county; the lease tracts are located about 43 mi (69 km) west of the populated areas, near the border with Utah.

Two recent studies have estimated the economic impacts of uranium mining in western Colorado. Economic and Planning Systems (EPS) used data from a mining operations plan and the associated socioeconomic impact analysis prepared for an application from Energy Fuels Resource Corp. to describe the impacts of a uranium mining project in Montrose County (EPS 2010). Beginning in 2012, up to 500 tons of ore per day (175,000 tons annually) would be produced by 2020, involving between 5 and 9 mines and the operation of a new mill at Piñon Ridge. If half of the uranium mining, milling, and transportation activity occurred in Montrose County, Energy Fuels Resource Corp. estimated that approximately 200 direct jobs, paying an average of $60,000 per job, and about 500 total jobs (direct plus indirect plus “induced” jobs [the indirect jobs estimated using an IMPLAN model]) would be produced in the county beginning in 2020. If all mining, milling, and transportation activities were located in Montrose County, 315 direct and up to 650 total jobs would be created.

Power Consulting (2010) suggested that the number of direct jobs created at a new uranium mill would be significantly smaller than those estimated in the EPS report, numbering only about 70, and that the total number of jobs (direct plus indirect plus induced) would be 120, as it can only be assumed that a small percentage of mine and mill workers would reside in Montrose County, with few of the projected mill jobs being filled by unemployed workers living in the county. Power Consulting also suggested that many of the industries supplying the uranium resource developments would be located outside the county, and that a small proportion of the uranium supplying the Piñon Ridge Mill would be mined in the county, resulting in reduced positive economic impacts in the county. Power Consulting also suggested that the generation of radioactive waste might discourage the location of new economic activity in the county, particularly income from tourism and retirees, and that economic activity at a level comparable with the development of new mines and milling could be created through uranium mine reclamation activities. Finally, it also suggested that volatility in uranium markets (and the impact this would have on uranium employment in Montrose County) might produce a “boom-and-bust” scenario, creating instability in local labor markets, causing social disruption, and undermining the ability of local governments to plan with regard to providing public and educational services.

Western Colorado has experienced past boom and bust periods from uranium mining activities. The uranium industry’s first boom occurred in the 1950s and crashed after 1970 when the Federal Government phased out financial subsidies. Another boom driven by the expansion of nuclear power in the mid-1970s led to the height of the uranium boom. By the early 1980s, the United States stopped building new nuclear power plants, the price of uranium dropped dramatically, and the uranium boom ended. The boom and bust effects from uranium mining had varying impacts on individual communities. Much of western Colorado began to diversify its economy in the 1980s, focusing on recreation and tourism opportunities.

Taken in its entirety, the population growth rate in the ROI between 1960 and 2010 was generally greater than the average U.S. population growth rate over the same period. The period between 1960 and 1970 was the only 10-year period in which the ROI counties had a lower growth rate than the U.S. average, and the only period in which the population of one of the counties (San Miguel County) fell from the previous decade. Figure 3.8-1 presents the population trend in the ROI over the 50-year period between 1960 and 2010. Although the overall population of the ROI was not greatly affected by uranium mining, the west end of Montrose County lost almost 60% of its population between 1960 and 1990. The town of Uravan, for example, had 600 residents in 1950 and was shut down entirely by 1986. The population of the west end of San Miguel County increased from fewer than 200 residents to

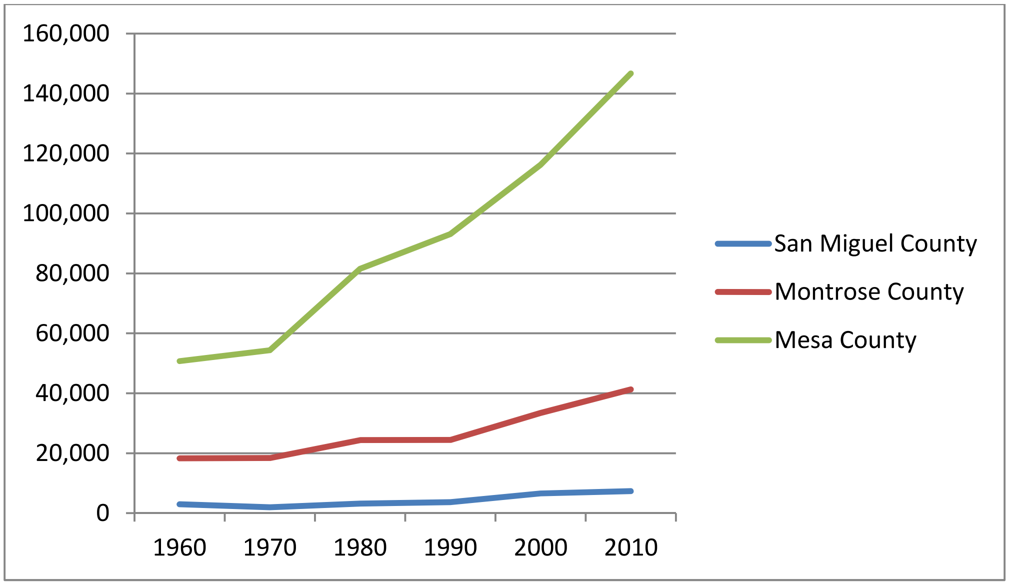


FIGURE 3.8-1 ROI Population from 1960–2010 (Sources: CensusViewer 2013a, b, c; U.S. Bureau of the Census 1995)

more than 1,000 and then collapsed to about 100 residents between 1930 and 1990 (Power Consulting 2010).

3.8.1 Economic Environment

3.8.1.1 ROI Employment and Unemployment

The ROI, like Colorado and the rest of the United States, has experienced an increase in unemployment in recent years. It experienced a sharp rise in unemployment between 2000 and 2010. However, as shown in Table 3.8-1, the overall growth in employment in the ROI (1.9%) was higher than the growth in the state of Colorado as a whole (0.7%). Within the ROI, the average growth rate in employment was higher in Mesa County (2.2 %) than in either Montrose (1.4%) or San Miguel County (0.0%) in the years 2001–2010.

Although the ROI experienced a greater increase in employment during 2001–2010 than did the state as a whole, the unemployment rate was relatively high in the ROI when compared to that of the state of Colorado during the same period (Table 3.8-2). All the counties in the ROI experienced higher rates of unemployment in 2010 and 2011, and during that period, the average unemployment rate was higher in the ROI (10.5% and 9.6%, respectively) than in Colorado as a whole (8.9% and 8.8%). Each county in the ROI experienced a slight decline in the unemployment rate between 2010 and 2011. Unemployment rates in Montrose County were the highest in the ROI in both 2010 and 2011 (11.1% and 11.0%, respectively), while San Miguel County had the lowest unemployment rates in 2010 and 2011 (7.7% and 7.6%, respectively). The

TABLE 3.8-1 ROI Employment, 2001–2010

Location	2001	2010	Average Annual Growth Rate, 2001–2010 (%)
Mesa County	58,066	78,853	2.2
Montrose County	16,203	18,338	1.4
San Miguel County	4,742	4,724	-0.4
ROI	79,011	93,585	1.9
Colorado	2,303494	2,447,712	0.7

Sources: U.S. Department of Labor (2010a,b)

TABLE 3.8-2 ROI and State Unemployment Data, 2001–2011

Location	Average 2001–2010	2010 Average	2011 Average
Mesa County	5.6	10.6	10.3
Montrose County	5.9	11.1	11.0
San Miguel County	4.8	7.7	7.6
ROI	5.6	10.5	9.6
Colorado	6	8.9	8.8

[a] Rates for 2011 are the average for January through September.

Sources: U.S. Department of Labor (2011, 2010a)

unemployment rate for in San Miguel County was also lower than the state average in both 2010 and 2011. Telluride, Colorado, is located in San Miguel County, and the numerous seasonal jobs provided by the ski resort are likely responsible for the lower rates of unemployment. Because Telluride represents 30% of the entire population of San Miguel County, it contributes toward the lower overall unemployment for the county.

3.8.1.2 Employment by Sector

The services industry represents almost 50% of all employment in the ROI because of the high level of recreation and tourism in the area (see Section 3.8.3). Wholesale and retail trade provides the second-highest number of jobs, accounting for 19.7% (Table 3.8-3). Construction jobs make up 8.9% of employment in the ROI. San Miguel County has the highest percentage of people working in the services industry (64.5%), while Montrose has the least, at 41.6%. The Telluride ski area, a popular destination in San Miguel County, brings many service-related jobs to the area. San Miguel County also has a higher percentage of construction-related employment (13%) than either Mesa County (9.8%) or Montrose County (8.3%). Wholesale and retail trade made up the largest percentage of employment in Montrose County (21.4%). Mesa County employed 20.2% of its workforce in wholesale and retail trade, while that category represented only 9.8% of employment in San Miguel County. Montrose County employed a larger percentage of its workforce in agriculture (6.8%) than either Mesa County (3.6%) or San Miguel County (1.3%), which would be expected given that more than 700,000 acres (280,000 ha) in Montrose County is farmland, and the county has been referred to as the agricultural hub of Colorado’s Western Slope (USDA 2007b).

3.8.1.3 Personal Income

In general, in 2010 per-capita income was less in the ROI ($34,898) than in the state of Colorado as a whole ($42,582) (Table 3.8-4), and significantly less than the U.S. average ($52,269). In San Miguel County, however, per-capita income in 2010 was $48,611, exceeding the state average. The towns of Sawpit and Telluride, both located in San Miguel County, had the highest median household incomes in the ROI in 2005–2009, which explains the high per-capita income in San Miguel County. The growth rate in Mesa County was higher in 2010 for both total income and per capita income (3.5% and 0.9%, respectively), while growth rates in Montrose County (3.0% and 0.6%) and San Miguel County (2.2% and 0.6%) were slower during that period. The state of Colorado’s annual growth rate fell between 2000 and 2009.

At $91,222, Sawpit had the highest median household income in the ROI in 2005–2009, although, with a population of 23 residents, it is also the smallest town in the ROI. In addition to Sawpit, the towns of De Beque, Fruitvale, Fruita, Redlands, Ophir, and Telluride also had average median household incomes higher than the U.S. average of $52,269 during the same period. The town of Naturita had the lowest median household income in the ROI, at $29,452, and it experienced a decline in relative household income from the year 1999. Olathe had the second-lowest median household income ($32,035) and also experienced a moderate decrease in individual earnings from the year 1999. All other towns in the ROI had a median household income of $35,000 or higher in 2005–2009.

The towns of Sawpit and De Beque experienced the largest growth in median household income between 1999 and 2005–2009, although the populations of both towns were quite small (Table 3.8-5). Exactly half (9 out of 18) of the towns in the ROI experienced a decrease in median household income during that period. The largest town in the ROI, Grand Junction, experienced an average annual growth rate in median household income of 0.69%, and the larger towns of Clifton, Fruita, and Montrose experienced growth rates of –0.25%, 2.80%, and 0.30%, respectively. Fruita, which had the fastest population growth rate between 2000 and 2010, also had one of the highest growth rates in median household income in the ROI.

TABLE 3.8-3 ROI Employment by Sector, 2009[a]

	Mesa County, Colorado		Montrose County, Colorado		San Miguel County, Colorado		ROI	
Sector	Employment	% of Total	Employment	% of Total	Employment	% of Total	Employment	% of Total
Agriculture[a]	1,970	3.6	836	6.8	64	1.3	2,870	4.0
Mining[b]	1,619	2.9	114	0.9	60	1.2	1,793	2.5
Construction	4,592	8.3	1,203	9.8	637	13.0	6,432	8.9
Manufacturing	2,593	4.7	1,053	8.6	136	2.8	3,782	5.2
Transportation and public utilities	3,022	5.5	740	6.0	50	1.0	3,812	5.3
Wholesale and retail trade	11,151	20.2	2,628	21.4	470	9.6	14,249	19.7
Finance, insurance, and real estate	3,434	6.2	587	4.8	285	5.8	4,306	6.0
Services	26,739	48.5	5,098	41.6	3,159	64.5	34,996	48.4
Other	10	0.0	10	0.1	38	0.8	58	0.1
Total	55,130		12,269		4,899		72,298	

[a] Agricultural employment includes 2007 data for hired farm workers.

[b] Mining employment includes mining, quarrying, and oil and gas extraction; nonmetallic mineral mining and quarrying; sand, gravel, clay, and ceramic and refractory minerals mining and quarrying; construction sand and gravel mining; coal and metal mining; and support activities for mining.

Sources: U.S. Bureau of the Census (2011a); USDA (2007a)

TABLE 3.8-4 ROI Personal Income, 2000–2009

Location	2000	2009	Average Annual Growth Rate, 2000–2009 (%)
Mesa County, Colorado			
Total income ($ billion 2010)	3.8	5.2	3.5
Per-capita income ($)	32,716	35,362	0.9
Montrose County, Colorado			
Total income ($ billion 2010)	1.0	1.3	3.0
Per-capita income ($)	29,170	30,760	0.6
San Miguel County, Colorado			
Total income ($ billion 2010)	0.3	0.4	2.2
Per-capita income ($)	45,874	48,611	0.6
ROI			
Total income ($ billion 2010)	5.1	6.8	3.3
Per-capita income ($)	32,512	34,898	0.8
Colorado			
Total income ($ billion 2010)	186.2	214.0	1.6
Per-capita income ($)	43,293	42,582	–0.2

Sources: U.S. Department of Commerce (2011)

TABLE 3.8-5 ROI Population, 2000–2023

Location	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	2021	2023
Mesa County	116,255	146,723	2.4	174,681	180,835
Montrose County	33,432	41,276	2.1	56,245	59,228
San Miguel County	6,594	7,359	1.1	10,695	11,349
ROI	156,281	195,358	2.3	241,621	251,412
Colorado	4,301,261	5,160,189	1.8	6,281,388	6,491,972

Sources: U.S. Bureau of the Census (2011c); Colorado State Demography Office (2011)

3.8.2 Social Environment

3.8.2.1 Population

Population in the ROI experienced an average annual growth rate of 2.3% from 2000 to 2010, which was higher than the growth rate in the state of Colorado over the same time period (Table 3.8-5). The average annual growth rate indicates that each year the population in the ROI grew an average of 2.3% each year, over the course of ten years. San Miguel County had the smallest population in the ROI, with a 2010 population of 7,359, while Mesa County had the largest population, at 146,723. Mesa County also had the highest rate of population growth between 2000 and 2010 (2.4%), while San Miguel County had the smallest (1.1%). All counties are projected to increase in population size over the next 20 years. By 2023, the ROI population is projected to be more than 250,000, a 29% increase from the 2010 census.

Population growth rates between 2000 and 2010 were highest for some of the ROI's largest cities, including Fruita (6.9%), Grand Junction (3.4%), and Montrose (4.5%) (Table 3.8-6). Fruita experienced the highest rate of population growth (6.9%), almost doubling its population in the 10 years between 2000 and 2010. The town of Sawpit was the only town to experience a negative growth rate (–0.8%), although because of its small population size, the impact on the ROI was negligible. Six towns experienced a growth rate of less than 1% (Orchard Mesa, Redlands, Naturita, Nucla, Norwood, and Telluride), and six towns experienced a growth rate between 1% and 2% (Clifton, Collbran, Fruitvale, Palisade, Olathe, and Ophir). Four towns grew at a rate that was more than 2% (Fruita, Grand Junction, Montrose and Mountain Valley). Of these, only the town of Mountain Village had a population of fewer than 6,000 people. The populations of two of the three largest cities in the ROI (Grand Junction and Montrose) increased fairly rapidly at a rate of more than 3.4%. The second-largest city, Clifton, had a population growth rate of 1.4%. Overall, relatively high growth rates in the larger towns contributed to the moderate population growth in the ROI as a whole.

3.8.2.2 ROI Housing

On average, vacant housing in the ROI increased from 8.8% in 2000 to 10.0% in 2009 (Table 3.8-7). The ROI had a total of 8,117 total vacant units. As would be expected, Mesa County contained the most housing units, with a total of 58,329 units. Mesa County and Montrose County have similar rates of housing vacancy; in 2009, Mesa County had 6% of its available housing vacant, and Montrose County had a vacancy rate of 8.9%. San Miguel County, however, had the highest vacancy rate by far, at 50%. Many residential units in San Miguel County are used as vacation accommodations or second homes rather than for primary housing. Available units are generally priced too high, and it is estimated that 44% of the households in San Miguel County are living in houses that are not affordable (RRC Associates and Rees Consulting 2011). On the other hand, vacancy rates for rental units are very low; in Telluride, where seasonal housing is in demand, the vacancy rate is only 1.1%. This suggests that most of the vacancy stems from high sale prices, because even though there is a demand for affordable housing, the vacancy rate remains high (RRC Associates and Rees Consulting 2011).

TABLE 3.8-6 ROI Urban Population and Income, 1999–2010

	Population			Median Household Income ($ 2010)		
City in Colorado	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	1999	2005–2009	Average Annual Growth Rate, 2005–2009 (%)[a]
Clifton	17,345	19,899	1.4	44,174	43,073	–0.25
Collbran[b]	389	439	1.2	42,538	43,985	0.34
De Beque[b]	474	543	1.4	38,784	59,431	4.36
Fruitvale	6,936	7,675	1.0	58,163	56,732	–0.25
Fruita	6,478	12,646	6.9	43,099	56,815	2.80
Grand Junction	41,986	58,566	3.4	43,391	46,460	0.69
Orchard Mesa	6,456	6,836	0.6	53,513	51,465	–0.39
Palisade[b]	2,585	2,931	1.3	36,306	44,600	2.08
Redlands	8,043	8,685	0.8	70,067	67,490	–0.37
Montrose	12,344	19,132	4.5	44,174	45,497	0.30
Naturita[b]	637	669	0.5	29,777	29,452	–0.11
Nucla[b]	736	744	0.1	37,258	49,761	2.94
Olathe[b]	1,601	1,764	1.0	34,405	32,035	–0.71
Mountain Village[b]	991	1,389	3.4	40,134	35,447	–1.23
Norwood[b]	438	460	0.5	51,536	38,702	–2.82
Ophir[b]	113	128	1.3	75,805	52,345	–3.64
Sawpit[b]	25	23	–0.8	34,358	91,222	10.26
Telluride[b]	2,254	2,400	0.6	67,980	68,970	0.14

[a] Data are averages for the period 2005 to 2009.

[b] Data are for 2009 population estimates.

Sources: U.S. Bureau of the Census (2011b,c,d,e)

3.8.2.3 ROI Community and Social Services

The following sections discuss community and social services, including levels of service, in the ROI. The jurisdictions included in the ROI are listed in Table 3.8-8.

3.8.2.3.1 Education. There were a total of 68 schools located within the ROI in 2010. As shown in Table 3.8-9, there was an average student/teacher ratio of 16.7, which was comparable to the state average of 16.9, but somewhat higher than the nationwide average of 15.4. Mesa County had the highest student-teacher ratio at 17 students per teacher, while San Miguel County had the lowest at 11.3. The levels of service (the number of employees per 1,000 population) ranged from 9.12 in Mesa County to 11.67 in San Miguel County. The overall level of service for the ROI was 9.39. The City of Grand Junction contained the largest number of schools in the ROI by far; Mesa County School District 51 has 44 public schools (elementary, middle, high,

TABLE 3.8-7 ROI Housing Characteristics, 2000 and 2009

Status of Housing	No. of Units 2000	No. of Units 2009[a]
Mesa County		
Owner-occupied	33,313	39,539
Rental	12,510	15,272
Vacant units	2,604	3,518
Percentage vacancy	5.4	6.0
Seasonal and recreational use	508	NA[b]
Total units	48,427	58,329
Montrose County		
Owner-occupied	9,773	11,875
Rental	3,270	3,765
Vacant units	1,159	1,521
Percentage vacancy	8.2	8.9
Seasonal and recreational use	194	NA
Total units	14,202	17,161
San Miguel County		
Owner-occupied	1,556	1,894
Rental	1,459	1,159
Vacant units	2,182	3,078
Percentage vacancy	42	50.2
Seasonal and recreational use	1,741	NA
Total units	5,197	6,131
ROI total		
Owner-occupied	44,642	53,308
Rental	17,239	20,196
Vacant units	5,945	8,117
Percentage vacancy	8.8	9.9
Seasonal and recreational use	2,443	NA
Total units	67,826	81,621

[a] 2009 data for number of owner-occupied, rental, and vacant units for Colorado counties are not available; data are based on 2009 total housing units and 2000 data on housing tenure.

[b] NA = data not available.

Source: U.S. Bureau of the Census (2011f)

TABLE 3.8-8 ROI Jurisdictions

Type of Jurisdiction	Governments
Counties	Mesa, Montrose, San Miguel
Cities	Clifton, Collbran, De Beque, Fruitvale, Fruita, Grand Junction, Orchard Mesa, Palisade, Redlands, Montrose, Naturita, Nucla, Olathe, Mountain Village, Norwood, Ophir, Sawpit, Telluride
School districts	De Beque, Joint District No. 49, Grand Valley Boces, Mesa 51 Grand Junction, Mesa County Valley School District No. 51, Plateau Valley, School District No. 50 In The County Of Mesa, Montrose County School District Re-1j, Montrose Re-1j, West End School District No. Re-2, Norwood School District No. R-2j, Telluride School District No. R-1
Tribal	Jicarilla Apache Nation, New Mexico

Sources: NCES (2011); U.S. Bureau of the Census (2011d); DOI (2011)

TABLE 3.8-9 ROI School District Data, 2010[a]

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service
Mesa County	22,699	1,338	17	9.12
Montrose County	6,867	410	16.8	9.93
San Miguel County	973	86	11.3	11.67
ROI	30,539	1,834	16.7	9.39

[a] Number of teachers per 1,000 population.

Source: NCES (2011)

and alternative) within the greater metropolitan area, serving over 22,000 students. Mountain Village, Ophir, and Sawpit are towns in the ROI that do not contain any schools; students from there attend schools in Telluride. Although the student-teacher ratio for each county is comparable to the state average, it varies among towns. For instance, Grand Junction has the highest ratio, but smaller towns, such as Collbran, Telluride, De Beque, and Norwood, have an average of 11.46 students per teacher (NCES 2011).

Colorado Mesa University in Grand Junction is a public university that offers associate's, bachelor's, and master's degrees; it is the only college or university in the ROI. Until April 2011, the school was known as Mesa State College. The school has an enrollment of 9,000 students. Western Colorado Community College, a division of Colorado Mesa University, offers degree programs focused on technical training, including construction technology, machining technology, transportation technology, and welding services, among other technical and nontechnical degree programs.

3.8.2.3.2 Health Care. The number of physicians and the level of service are two measures for determining access to adequate healthcare. In 2010, most of the physicians in the ROI were located in Mesa County (552) (Table 3.8-10). The level of service was the lowest in San Miguel County, which also had the fewest number of physicians (19). The level of service was highest in Mesa County (3.76), and it was 3.51 for the entire ROI. Mesa County has three hospitals, all in Grand Junction: Community Hospital (78 beds); St. Mary's Hospital (350 beds, and the largest medical center between Denver and Salt Lake City); and the Grand Junction Veterans Administration Medical Center (53 beds). Montrose County has one hospital, Montrose Memorial Hospital; it has 75 beds and is located in the city of Montrose. There are also clinics in Olathe and Naturita. The Telluride Medical Center, with 7 beds, is the only hospital in San Miguel County.

3.8.2.3.3 Public Safety. As shown in Table 3.8-11, in 2009, most of the firefighters in the ROI were located in Mesa County. The level of service was the lowest in San Miguel County (0.40), which also had the fewest number of professional firefighters. The level of service was highest in Mesa County (0.60), and it was 0.57 for the entire ROI.

Most of the police officers in the ROI were also located in Mesa County (122).The level of service was highest in San Miguel County (4.37), which also had the fewest number of police officers (33). The level of service was lowest in Mesa County (0.84), and it was 1.08 for the entire ROI. The highest crime rates for both violent crimes and property crimes were also in the most populated county, Mesa County, which also had the lowest level of service with regard to police officers (Table 3.8-12). The incidences of crime in Montrose and San Miguel Counties were comparable to one another, although more property crime occurred in San Miguel County.

TABLE 3.8-10 ROI Physicians, 2010[a]

Location	No. of Physicians	Level of Service
Mesa County	552	3.76
Montrose County	115	2.79
San Miguel County	19	2.58
ROI	686	3.51

[a] Number of physicians per 1,000 population.

Source: AMA (2010)

TABLE 3.8-11 ROI Public Safety Employment, 2009

Location	No. of Police Officers	Level of Service[a]	No. of Firefighters[b]	Level of Service
Mesa County	122	0.84	88	0.60
Montrose County	56	1.35	21	0.51
San Miguel County	33	4.37	3	0.40
ROI	211	1.08	112	0.57

[a] Number per 1,000 population.

[b] Number does not include volunteers.

Sources: DOJ (2009b); Fire Departments Network (2011)

TABLE 3.8-12 ROI and County Crime Rates, 2009[a]

	Violent Crime[b]		Property Crime[c]		All Crime	
Location	No. of Offenses	Rate	No. of Offenses	Rate	No. of Offenses	Rate
Mesa County	185	1.3	1,467	10.0	1,652	11.3
Montrose County	36	0.9	136	3.3	172	4.2
San Miguel County	3	0.4	36	4.9	39	5.3
ROI	224	1.15	1,639	8.39	1,863	9.54
Colorado	21,179	0.45	177,629	3.77	198,808	4.2

[a] Rates are the number of crimes per 1,000 population.

[b] Violent crime includes murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault.

[c] Property crime includes burglary, larceny, theft, motor vehicle theft, and arson.

Source: DOJ (2009a)

The rates of crime for the ROI were higher than those in the state of Colorado for both property crimes and violent crimes.

3.8.3 Recreation and Tourism Economy

Western Colorado is a major tourist destination. Visitors travel to western Colorado year-round for outdoor sports, including hiking, biking, whitewater rafting, horseback riding, skiing, OHV trail-riding, hunting, fishing, and snowshoeing. Most of the land in the ROI is managed by the USFS and BLM. The BLM manages more than 8.4 million acres (3.4 ha) in Colorado and provides recreation opportunities for more than 5 million visitors annually. Much of the public land in the ROI is accessible for public recreational use. Among the many recreation areas that the BLM manages are numerous SRMAs and NLCS units (BLM undated). SRMAs are areas where recreation is the principal management focus and where the objective is to provide specific “structured” recreational opportunities (BLM 2011k). These can include campgrounds, trails, and boat ramps for river access. The Dolores Canyon SRMA in Montrose County is in close proximity to the lease tracts. The distance from the SRMA to the lease tracts ranges from 0.48 mi (0.77 km) (Lease Tract 17) to 8.4 mi (14 km) (Lease Tract 19). In San Miguel County, three of the leases are located within the SRMA. The Dolores Canyon SRMA is a popular location for whitewater rafting and river sports, and its visitors are attracted to the Dolores River’s remote character. Developed recreation sites are located along the San Miguel River SRMA and in the Dolores River SRMA. There are several developed campsites along the San Miguel River corridor that have boat ramps and other amenities such as toilets, picnic areas, and parking areas (BLM 2012a). In addition, the Unaweep-Tabeguache Scenic and Historic Byway is 133 mi (214 km) along CO 141 and 145 and passes through the towns of Nucla, Naturita, Uravan, Redvale, and Norwood. The scenic byway follows the Dolores and San Miguel Rivers and offers recreational opportunities on backroads and trails on BLM and USFS land, as well as whitewater rafting and kayaking (CCCD 1995). There are a variety of unimproved roads on and around the lease tracts, many of which were constructed by the mining and ranching industries and are currently maintained by county agencies or the BLM (see Section 3.10 for additional information on transportation and roads).

As discussed in Section 3.8.2.1.2, employment in the ROI is concentrated in the service industry, and much of that results from the recreation provided by the publicly managed areas discussed above. The tourism industry is difficult to quantify; it covers multiple job sectors and has direct and indirect impacts on the local economy resulting from increased sales from visitor spending, changes to local employment and income, and induced effects reflected in local goods and services purchased by residents who experience changes in income from new economic activity.

In September 2001, the Southwest Colorado Travel Region (SWCTR) and the USFS sought to understand the relationship between tourism and employment in the region, including the regional dependency on tourism, the types of jobs that tourism supports, ways to encourage growth in employment, ways to develop complementary economic industries (e.g., real estate and construction), and the connections between the tourism industry and local government services and revenues. The SWCTR comprises 12 counties, including Montrose and San Miguel

Counties. The study aimed to identify the types of tourism that drive the local economy. A distinction was made between activities that took place on public lands and those that occurred on private lands. This distinction helped to clarify the difference between the impacts from public parks and outdoor recreation and the impacts from private resort recreation (Information Services 2001).

In 2000, the tourism industry accounted for 14% of the jobs and 9% of the income generated in Montrose County. In San Miguel County, the percentages of tourism-related jobs and income were 59% and 53%, respectively. Total wages from tourism employment totaled $27 million in Montrose County and more than $80 million in San Miguel County. Employment in the tourism industry related to public lands represented 7% of all employment in Montrose County, 38% in San Miguel County, and 14% in the SWCTR region. Activities on public lands include skiing and touring, visits to parks and monuments, and outdoor recreation. Outdoor recreation includes hiking, biking, fishing, hunting, rafting, and snowmobiling on public land. In Montrose County, outdoor activities were responsible for the most tourism-related employment in 2000, mostly in the summer and fall months. In San Miguel County, the real estate and construction sector was very strong, although the ski resort in Telluride provided the largest number of jobs in the tourism sector. From 1997 to 1999, tourism employment in San Miguel County grew 14% (Information Services 2001). In 2010, 63% of employment in San Miguel County came from the tourism industry, an increase of 4% since 2000 (Colorado Department of Local Affairs 2011).

Public land use and activity estimates are difficult to quantify accurately and depend on a combination of computerized trail counter data, field observations, and the professional judgment of the recreation staff (BLM 2012i). The general trend across the Grand Junction Field Office has been a 7–10 percent increase in visitation each year. Black Canyon of the Gunnison National Park is located in the eastern portion of Montrose County, 52 mi (84 km) east of the nearest lease tract. In 2010, 176,344 people visited the national park, which was fewer than the number of visitors in 2000 (191,500) and 2007 (219,600) (www.nationalparked.net 2011). A 2010 visitor survey conducted at Black Canyon National Park indicated that out-of-state visitors accounted for more than 65% of those surveyed, which suggests that park visitors probably also spent money outside the park in other sectors, such as for hotel and other accommodations and in eating and drinking establishments.

The Colorado National Monument is located 25 mi (40 km) north of the nearest lease tracts in Mesa County. Other recreation areas in Mesa County include Bangs Canyon SRMA, Grand Mesa Slopes SRMA, and the James M. Robb Colorado River State Park. Visitation to Colorado National Monument increased over the past few years, achieving a record-high number of annual visitors of 714,000 in 2007, a 9% increase from the previous year (National Park Service 2008). Hiking use increased 34% in October 2007 compared to that in October 2006, and the park experienced increases in other types of recreation, including biking and rock climbing. An economic analysis of state parks in Colorado estimated that the average vehicle visiting Colorado River State Park spent $312 within 50 mi (80 km) of the park. Total expenditures for all visitors to the park totaled almost $23 million (Corona Research, Inc. 2009).

3.9 ENVIRONMENTAL JUSTICE

On February 11, 1994, the President signed E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," which formally requires Federal agencies to incorporate environmental justice as part of their missions (59 FR 7629, Feb. 11, 1994). Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

The analysis of how mining projects affect environmental justice concerns follows guidelines described in the CEQ's *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997). The analysis method has three parts. First, a description of the geographic distribution of low-income and minority populations in the affected area is undertaken. Then an assessment is conducted to determine whether exploration, mine development and operations, and reclamation would produce human health or environmental impacts that are high and adverse. Finally, if impacts are high and adverse, a determination is made as to whether these impacts disproportionately affect minority and low-income populations.

Exploration, mine development and operations, and reclamation in the proposed lease tracts could affect environmental justice if any adverse human health and environmental impacts resulting from any phase would be significantly high and if these impacts would disproportionately affect minority and low-income populations. If the analysis determined that human health and environmental impacts would not be significant, there could be no disproportionately high and adverse impacts on minority and low-income populations. In the event a potential for human health or environmental impacts is significant, disproportionality would be determined by comparing the proximity of any high and adverse impacts with the location of low-income and minority populations. For example, the analysis would consider whether potentially significant human health risks would appreciably exceed the risk to the general population.

The analysis of environmental justice issues associated with the development of uranium facilities considered impacts within the proposed lease tracts and an associated 50-mi (80-km) radius around the boundary of the proposed lease tracts. A description of the geographic distribution of minority and low-income groups in the affected area was based on Census Bureau demographic data (U.S. Bureau of the Census 2011g,h). The following definitions were used to define minority and low-income population groups:

- *Minority*. Persons are included in the minority category if they identify themselves as belonging to any of the following racial groups: (1) Hispanic; (2) Black (not of Hispanic origin) or African American; (3) American Indian or Alaska Native; (4) Asian; or (5) Native Hawaiian or Other Pacific Islander.

  Beginning with the 2010 census, where appropriate, the census form allows individuals to designate multiple population group categories to reflect their ethnic or racial origin. In addition, persons who classify themselves as being of multiple racial origins may choose up to six racial groups as the basis of their racial origins. The term minority includes all persons, including those classifying themselves in multiple racial categories, except those who classify themselves as not being of Hispanic origin and as being White or “Other Race” (U.S. Bureau of the Census 2011g).

The CEQ guidance proposed that minority populations should be identified where either (1) the minority population of the affected area exceeds 50% or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

The ULP PEIS applies both criteria in using the Census Bureau data for census block groups, wherein consideration is given to the minority population that is both greater than 50% and 20 percentage points higher than in the state (the reference geographic unit).

- *Low-income.* Individuals who fall below the poverty line. The poverty line takes into account the family size and the ages of individuals in the family. For example, in 2009, the poverty line for a family of five with three children younger than 18 was $26,023. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis (U.S. Bureau of the Census 2011h).

The data in Table 3.9-1 show the minority and low-income composition of the total population located in the proposed lease tracts based on Census Bureau data and CEQ guidelines. Individuals identifying themselves as Hispanic or Latino are included in the table as a separate entry. However, because Hispanics can be of any race, this number also includes individuals who also identify themselves as being part of one or more of the population groups listed in the table.

Within the 50-mi (80-km) radius around the boundary of the proposed lease tracts in Colorado, 18.3% of the population is classified as minority, while 11.9% is classified as low-income. Because the number of minority individuals does not exceed 50% of the total population in the 50-mi (80-km) area and because the number of minority individuals does not exceed the state average by 20 percentage points or more, there is no minority population in the Colorado portion of the proposed lease tracts based on Census Bureau data and CEQ guidelines. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the area; therefore, there are no low-income populations in the Colorado portion of the proposed lease tracts.

Within the 50-mi (80-km) radius in Utah, 25.9% of the population is classified as minority, while 16.1% is classified as low-income. Because the number of minority individuals does not exceed the state average by 20 percentage points or more and because the number of minority individuals does not exceed 50% of the total population in the area, there is no minority population in the Utah portion of the 50-mi (80-km) area based on Census Bureau data and CEQ

TABLE 3.9-1 Minority and Low-Income Populations within the 50-mi (80-km) Radius Surrounding the Proposed Lease Tracts

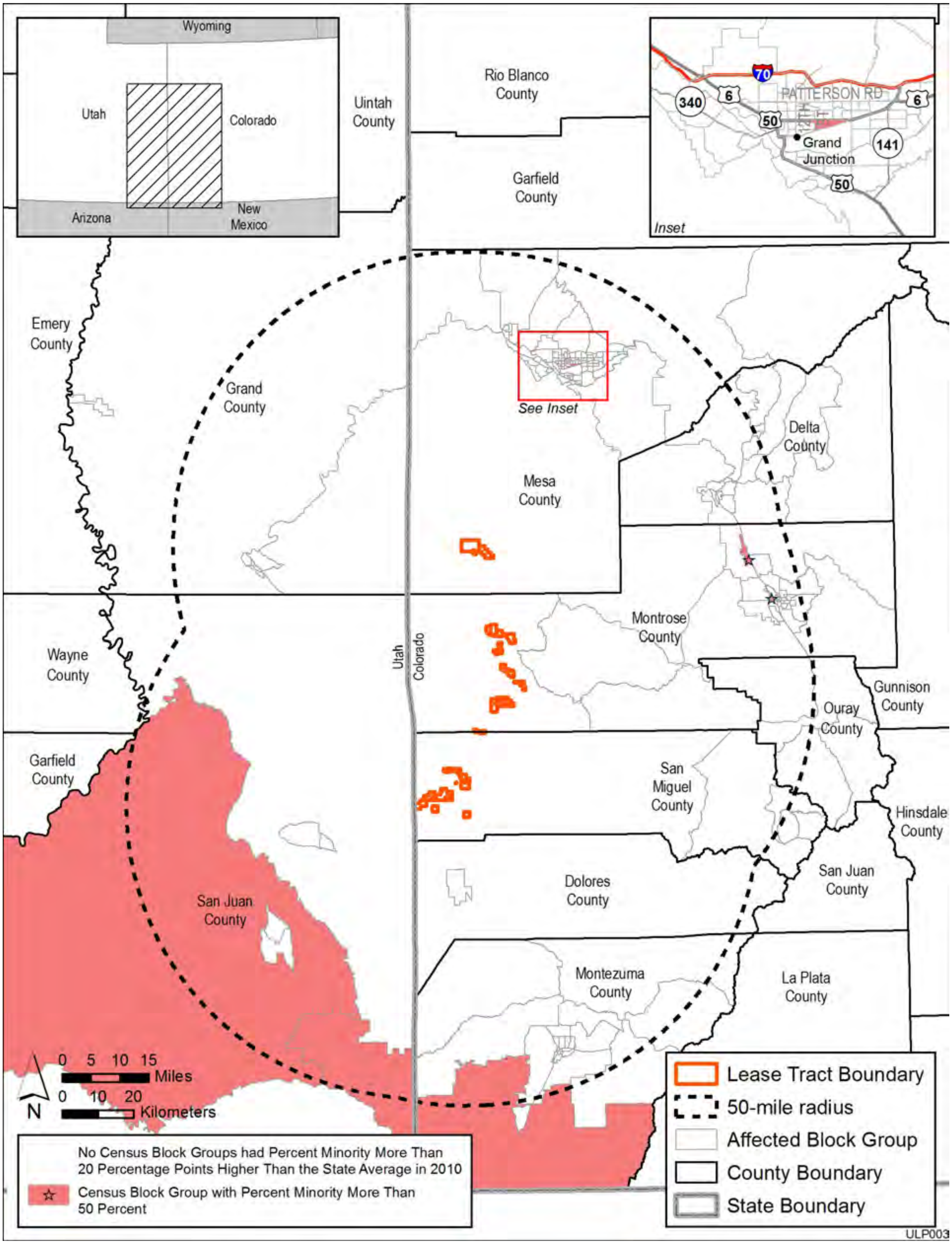
Type of Population	Colorado	Utah
Total population	245,460	22,727
White, non-Hispanic	200,585	16,837
Hispanic or Latino	34,682	1,575
Non-Hispanic or Latino minorities	210,778	21,152
One race	207,210	20,826
Black or African American	1,056	49
American Indian or Alaskan Native	3,544	3,789
Asian	1,578	129
Native Hawaiian or other Pacific Islander	202	11
Some other race	245	11
Two or more races	3,568	326
Total minority	44,875	5,890
Low-income	11,184	1,164
Percentage minority	18.3	25.9
State percentage minority	30.0	19.6
Percentage low-income	11.9	16.1
State percentage low-income	12.2	10.8

Sources: U.S. Bureau of the Census (2011g,h)

guidelines. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the area; therefore, there are no low-income populations in the Utah portion of the proposed lease tracts.

Figures 3.9-1 and 3.9-2 show the locations of the minority and low-income population groups within the 50-mi (80-km) radius around the boundary of the proposed lease tracts.

In the Colorado portion of the 50-mi (80-km) radius, there are single block groups in the cities of Grand Junction, Montrose, and Olathe that are more than 50% minority. One block group in southwestern Montezuma County is also more than 50% minority; it is the location of the Ute Mountain Indian Reservation. In the Utah portion of the 50-mi (80-km) radius, San Juan County has two block groups (one located in the southeastern part of the county, and the other in the central and southwestern part of the county) that are more than 50% minority. There are no block groups in the Utah portion of the 50-mi (80-km) radius that have minority populations that are 20 percentage points higher than the state average but less than 50% minority.

1 

2 **FIGURE 3.9-1 Minority Populations within the 50-mi (80-km) Radius surrounding the Proposed**
3 **Lease Tracts**
4

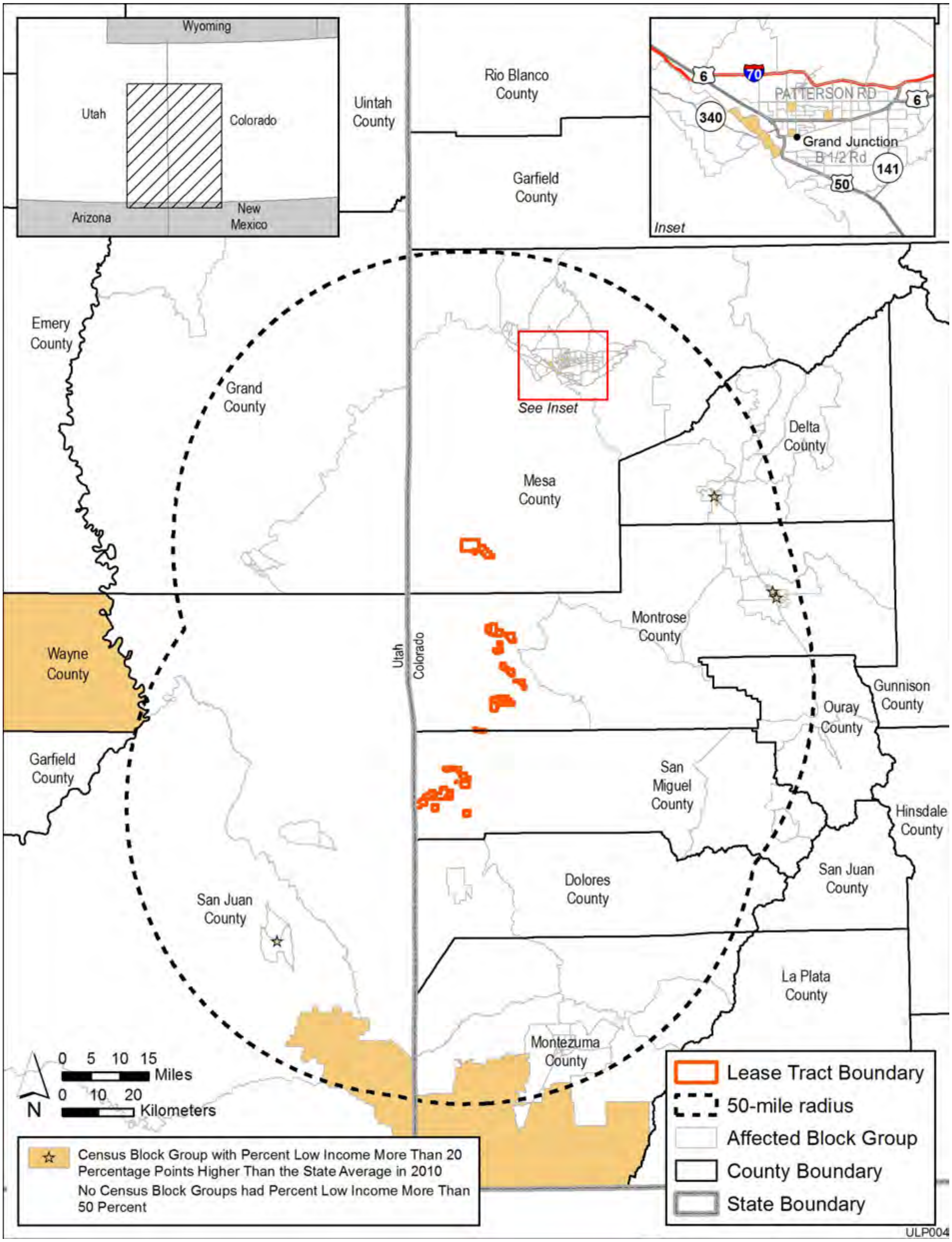


FIGURE 3.9-2 Low-Income Populations within the 50-mi (80-km) Radius surrounding the Proposed Lease Tracts

In the Colorado portion of the 50-mi (80-km) radius, the number of low-income individuals is more than 20 percentage points higher than the state average in four block groups in the city of Grand Junction, in two block groups in Montrose, and in one block group in Delta. There is also a single block group in southwestern Montezuma County, in the Ute Mountain Indian Reservation. In the Utah portion of the 50-mi (80-km) radius, there are block groups in the southeastern part of San Juan County, and in the city of Blanding, that have low-income population shares that are more than 20 percentage points higher than the state average. There are no block groups in either portion of the 50-mi (80-km) radius where the population is more than 50% low income.

3.10 TRANSPORTATION

The road network in western Colorado in the area of the lease tracts and the proposed Piñon Ridge Mill consists of two primary roads, State Highways CO 90 and CO 141, as shown in Figure 3.10-1. A number of county roads provide access to the lease tracts from these highways, as shown in Figures 3.10-2 to 3.10-4. A variety of unimproved roads on public lands exist on and around the lease tracts. Many of these roads were constructed by the mining and ranching industries before the BLM developed regulations for authorizing road construction and use. However, many of these roads are currently maintained by county agencies or the BLM.

Travel on BLM land is currently limited to existing routes. However, as per BLM's planning handbook guidance, the "Limited to Existing Routes" designation will be changed to "Limited to Designated Routes" no later than 5 years after the signing of the Resource Management Plan revision ROD. The use of motorized or mechanized modes of travel (including snowmobiles) during the execution of BLM-issued authorizations or permits would be subject to the terms and conditions or stipulations of each individual authorization on a case-by-case basis. Additional environmental documentation and analysis could be required for some authorizations (BLM2008-64 EA and Land Use Plan Amendment).

Although most of the area roads pass through uninhabited public lands, 15 residences among the 31 lease tracts could be affected by ore shipments travelling on these haul roads en route to the state highways and subsequently to the ore-processing mills. Routes that pass 13 of the 15 residences have been used in the last 10 years to haul uranium ore, and all the routes have been used to haul ore in the last 30 years.

The White Mesa Mill in Utah south of Blanding is served by US 191. Access to the mill from the lease tracts would be via CO 141 south to US 491 at Dove Creek, then west to US 191. An alternate route from the general lease tract would be to take CO 90 west into Utah where it becomes UT 46, which continues westward to US 191. The annual average traffic volume on major roads near the lease tracts each day is listed in Table 3.10-1.

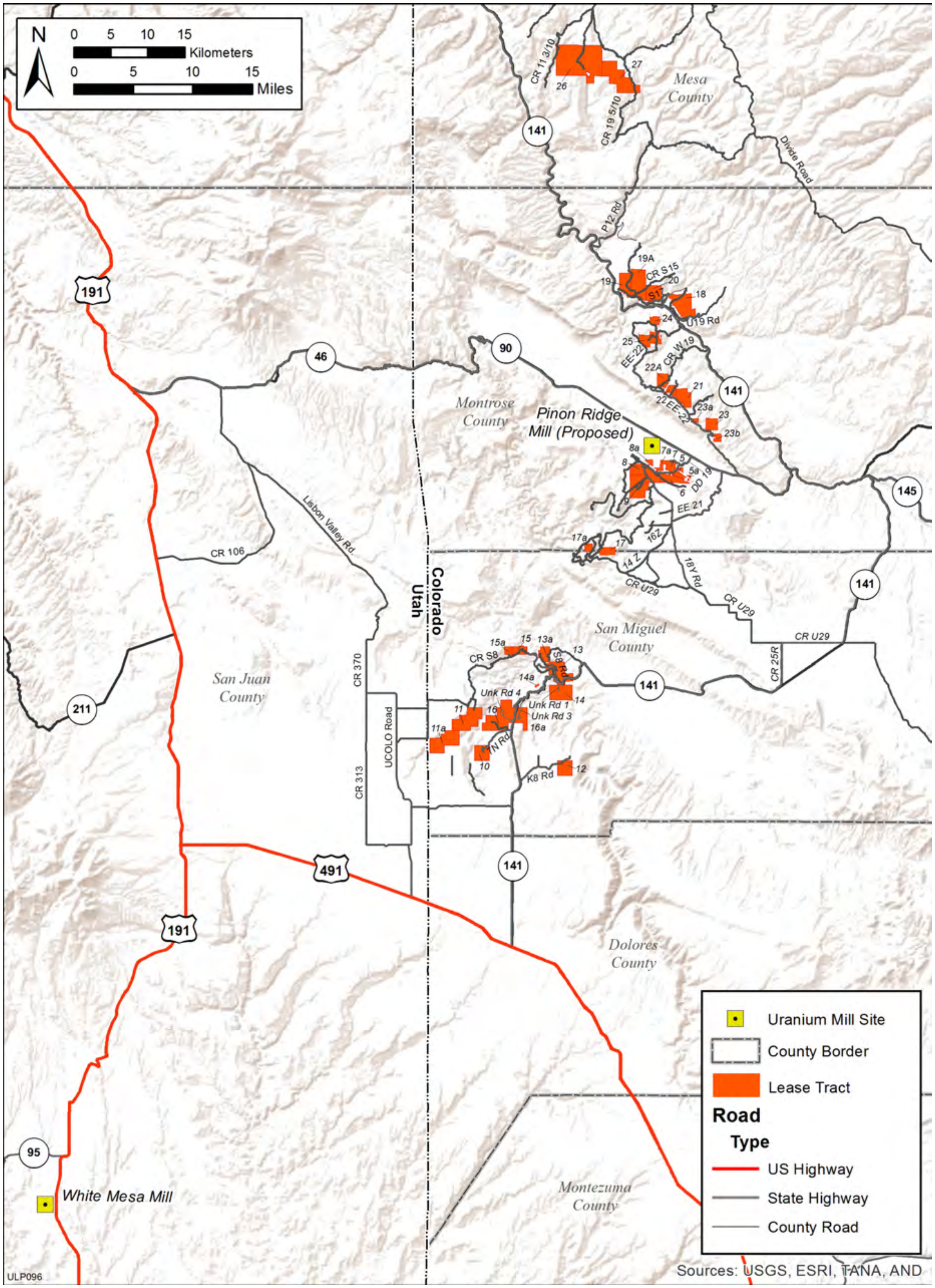
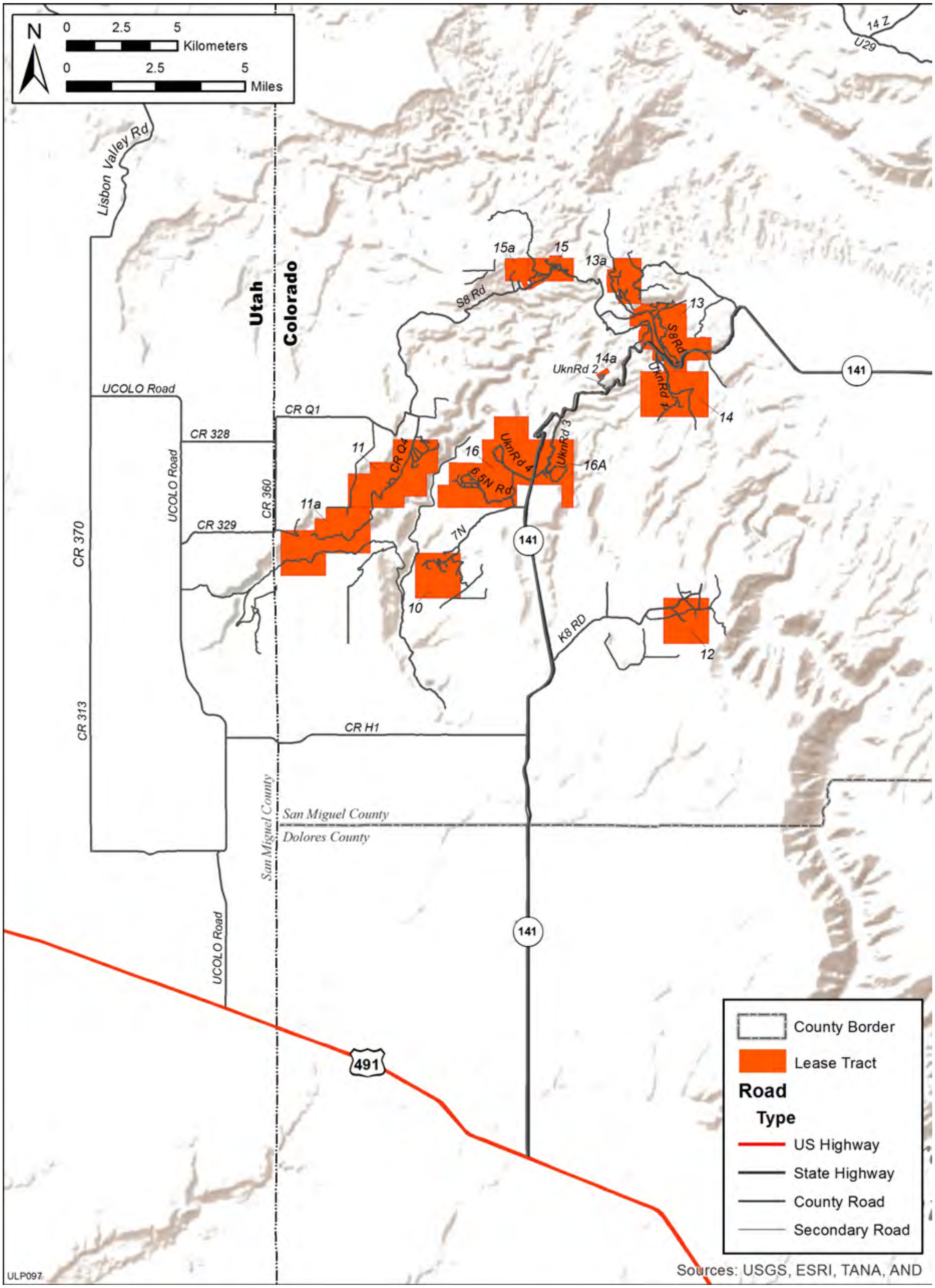
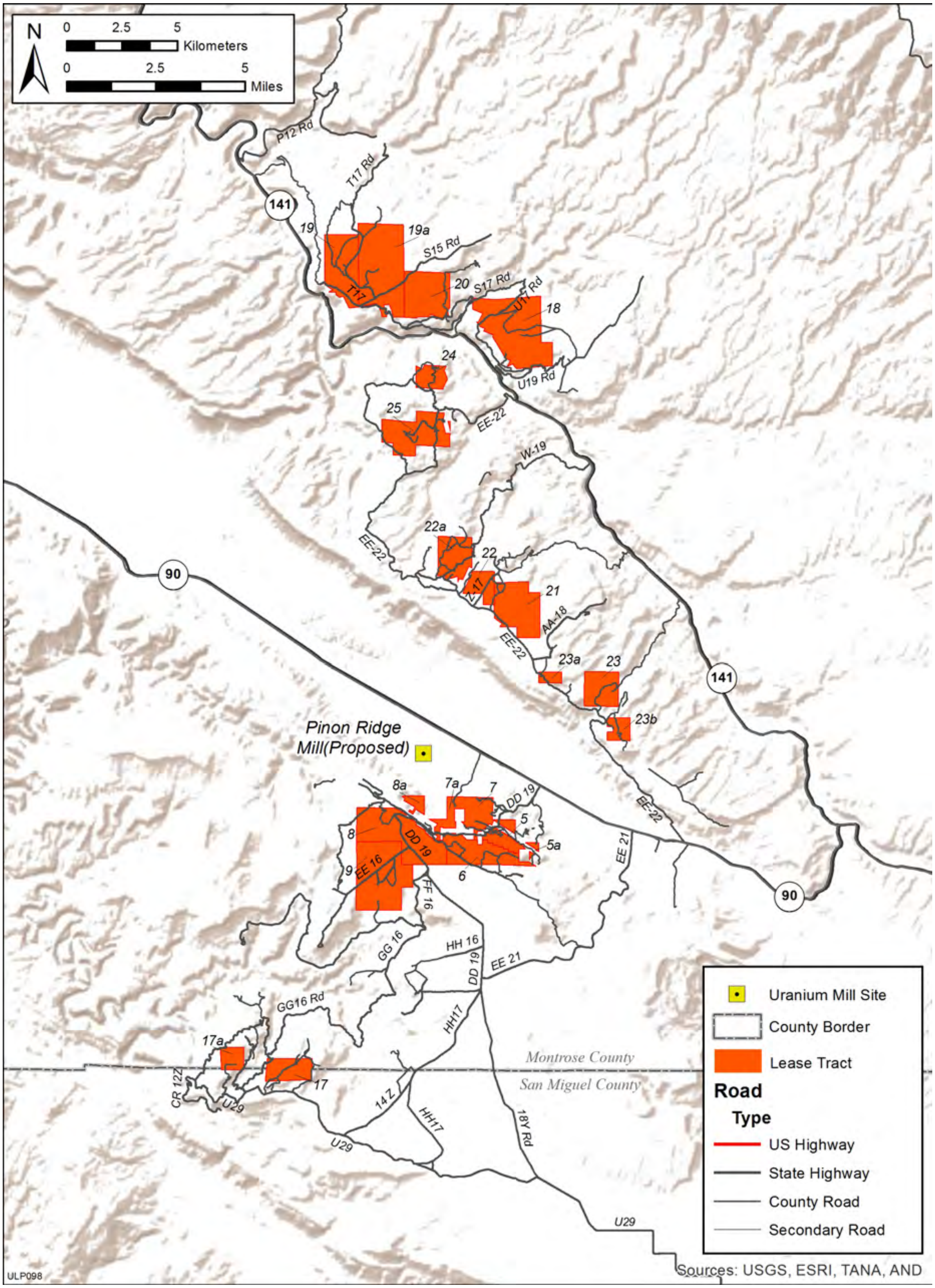


FIGURE 3.10-1 Road Network by the Lease Tracts and Uranium Mills

1 

2 **FIGURE 3.10-2 Local Road Network around the Slick Rock Lease Tracts**

1 

2 **FIGURE 3.10-3 Local Road Network around the Paradox and Uravan Lease Tracts**

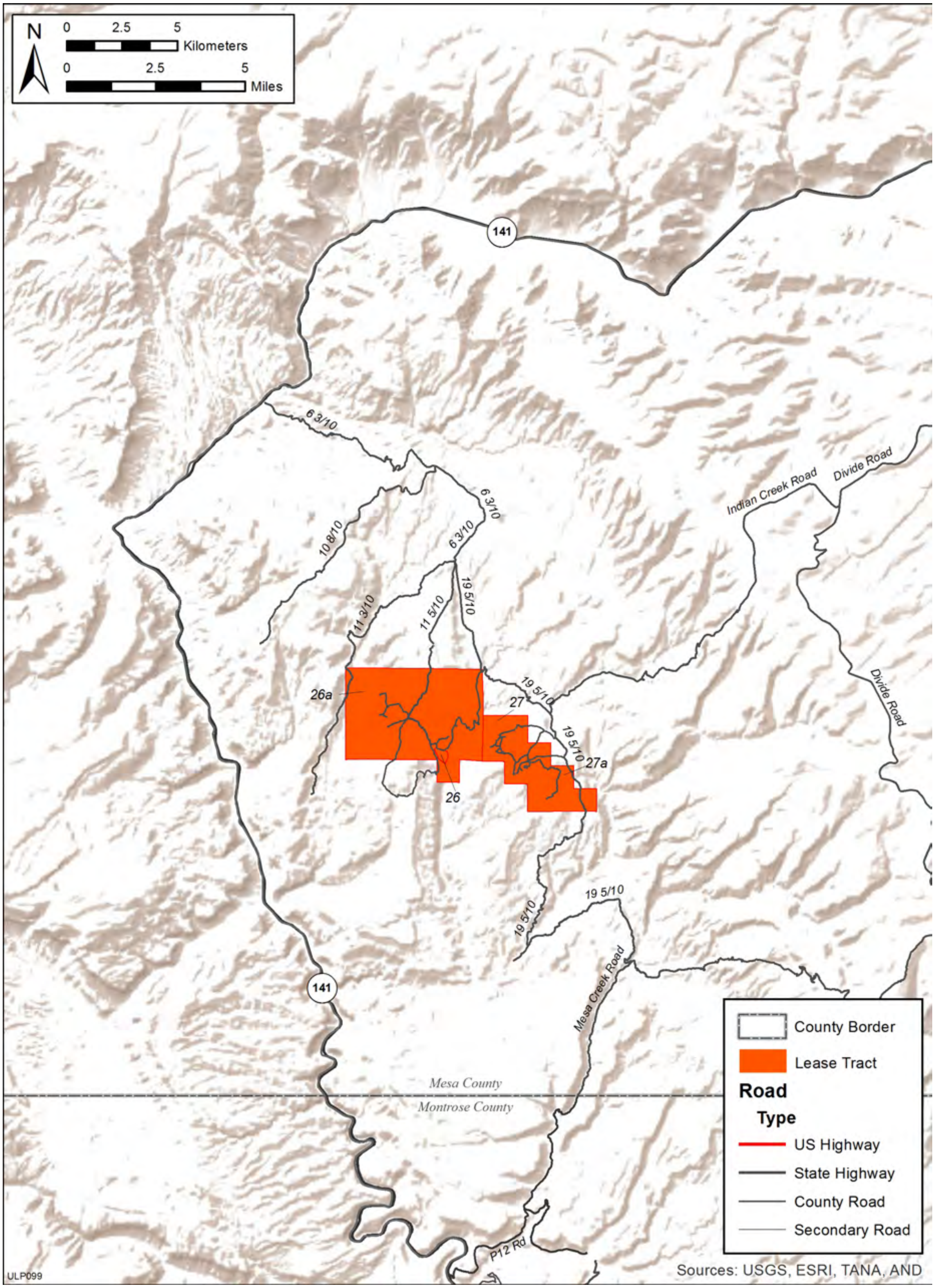


FIGURE 3.10-4 Local Road Network around the Gateway Lease Tracts

TABLE 3.10-1 Annual Average Daily Traffic (AADT) Volumes for Major Roads near the Lease Tracts, 2010

	Mileage Marker			AADT	
Road	Start	End	Location[a]	All	Trucks
***Colorado*[b]**					
CO 90	0	9.5	UT/CO state line east toward Paradox	230	30
	9.5	14.8	Near Bedrock	330	40
	14.8	33.9	Near western junction with CO 141	430	40
	81.7	84.9	East of Shavano Valley Road intersection, western outskirts of Montrose	190	10
CO 141	0	9.4	North of intersection with US 491	590	20
	9.4	11.3	North of Monticello Rd./CR H1 intersection in Egnar	350	50
	11.3	44.1	North of Egnar, southeast of K8 Rd.	250	40
	44.1	55.5	Southeast of junction with CO 145	470	70
	55.5	60.2	Northwest of junction with CO 145	1,300	130
	60.5	60.7	Main St. in Naturita, west of CO 97 (Nucla Rd.)	2,100	110
	60.8	62.4	East of junction with CO 90	600	70
	62.4	64.4	West of junction with CO 90	270	30
	64.4	110.5	Southwest of John Brown Rd. (4 4/10 Rd.) in Gateway	280	30
	110.5	153.8	Northeast of junction with CR Sx 9/10 Rd. in Gateway	660	80
	153.8	154.1	Southwest of junction with CO 50 in Whitewater	1,100	90
US 491	68.7	69.6	At UT/CO state line	2,100	460
	63.3	67.9	Northwest of CO 141	2,300	440
	61.5	63.3	Southeast of CO 141	3,100	550
***Utah*[c]**					
US 191	36.4	47.3	Junction with CO 262	2,525	270
	47.3	50.4	Junction with CO 95, south of Blanding	2,820	340
	50.4	51.7	Blanding, 800 south	5,025	655
	51.7	65.2	Blanding, 200 north	2,970	385
	65.2	71.5	Verdure	2,490	350
	71.5	71.9	Monticello, 400 south	2,670	615
	71.9	72.4	Monticello, junction with US 491	5,965	1,610
	72.4	86.1	Monticello, 600 north	3,575	1,145
US 491	0.0	0.4	Monticello, junction with US 191	4,620	970
	0.4	2.0	Monticello, 500 east	2,430	630
	2.0	17.0	Monticello Port of Entry at Milepost 2 to UT/CO state line	2,270	770

[a] CR = County Road

[b] Source: CDOT (2011)

[c] Source: UDOT (2011)

3.11 CULTURAL RESOURCES

Cultural resources are resources important to maintaining the heritage of the people of the United States. They provide a physical connection to the past and contemporary traditional culture. They include archaeological sites; historic buildings and structures or groups of structures; landscapes; culturally important natural features; and traditional cultural properties important to specific social or cultural groups, such as Native American Indian tribes. Cultural resources that meet the eligibility criteria for listing on the *National Register of Historic Places* (NRHP) (see text box) are termed "historic properties" under the National Historic Preservation Act of 1966, as amended (NHPA). The NHPA requires Federal agencies to take into account the potential effects of their undertakings, such as the leasing of uranium mining tracts, on designated and potential historic properties ranging in date from prehistoric times to the development of the Uravan Mineral Belt.

NRHP Significance Criteria

"The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" and meet one or more of the following criteria for evaluation.

Criterion A: Associative Value – Event: "Properties can be eligible for the *National Register* if they are associated with events that have made a significant contribution to the broad patterns of our history."

Criterion B: Associative Value – Person: "Properties can be eligible for the *National Register* if they are associated with the lives of persons significant in our past."

Criterion C: Design or Construction Value: "Properties can be eligible for the *National Register* if they embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction."

Criterion D: Information Value: "Properties can be eligible for the *National Register* if they have yielded, or may be likely to yield information important to prehistory or history."

Also applicable is this special criteria consideration:

Criteria Consideration G: Properties That Have Achieved Significance within the Last Fifty Years. "A property achieving significance within the last fifty years is eligible if it is of exceptional significance."

(36 CFR 60.4)

3.11.1 Cultural History of Southwestern Colorado

Human presence in western Colorado appears to have begun during the Paleoindian era, although archaeological remains from that era are rarely encountered in the region. Four Paleoindian traditions have been distinguished based on projectile point styles. The earliest remains in western Colorado are part of the Clovis tradition, beginning about 13,400 years ago, sometimes found in association with mammoth or other Pleistocene megafauna. To date, no Clovis artifacts have been found in association with megafauna in the study area, but the distribution of Pleistocene megafauna finds and Clovis points elsewhere suggests that major canyons, well suited to megafauna at the end of the Pleistocene, were a likely focus of Clovis hunters (Reed 2006).

The Clovis tradition appears to have been followed by the Folsom tradition (12,800–11,500 years ago). Likewise focused on big game, Folsom hunters, using finely crafted, fluted lanceolate projectile points, appear to have preferred now-extinct species of bison. Folsom points are relatively rare in the study area, either because Folsom sites have been eroded or because the region was utilized less intensely at this time than in later periods. In the rugged and mountainous environs of southwestern Colorado, the Folsom tradition is followed by the Foothill-Mountain complex (11,500–7,500 years ago). Characterized by unfluted lanceolate points, the Foothill-Mountain complex reflects a broader subsistence base that included smaller game, such as deer, bighorn sheep, and pronghorn, and showed more regional variability than earlier Paleoindian cultures (Reed 2006).

The trend toward a broader subsistence base dependent on an increasingly wide array of smaller game and increased evidence of dependence on plant resources continued in the Archaic era. Milling stones, used in plant processing, increased in frequency, and projectile points, thought to be dart or lance points, were smaller and more variable, including corner- and side-notched varieties as well as certain varieties of stemmed points. Reed and Metcalf (1999) divided the Archaic era in west-central Colorado into four periods: Pioneer (7400–5400 B.C.); Settled (5400–3100 B.C.); Transitional (3100–1200 B.C.); and Terminal (1200–250 B.C.). These periods represent an increasing population and an increasing intensity of subsistence use. Archaic people appear to have followed a seasonal round, taking advantage of resources maturing at different times at different elevations. Winters appear to have been spent in the piñon-juniper woodlands of middle elevations in the winter range of deer and elk. Lower elevations may have been exploited in the spring, and higher elevations exploited in the summer and fall (Reed 2006).

The Archaic tradition was succeeded by the Formative stage (250 B.C.–A.D. 1300), which was marked by the introduction of maize horticulture, the introduction of the bow and arrow, the construction of more permanent dwellings, and the fabrication of ceramics. In southwestern Colorado, the integration of maize horticulture into subsistence strategies appears to have been incomplete. The growing season in the higher elevations of the project area was too short to support maize horticulture.

Sites representing the following four contemporaneous traditions associated with the Formative stage in western Colorado lie within or adjacent to the lease tracts (Reed 2006; Sullivan 2011).

1. The Anasazi or Ancestral Puebloan tradition—characterized by distinctive ceramics, highly patterned residential site layouts, pit structures, kivas, water control structures, and complex intraregional relations—is represented in areas near the southernmost Slick Rock lease tracts. It is likely that Ancestral Puebloan procurement forays from their northernmost settlements included the lease tracts. Social and environmental factors appear to have resulted in the abandonment of southwestern Colorado by Ancestral Puebloan peoples around 1275. Modern Puebloan groups regard the Ancestral Puebloan and Fremont as their ancestors.

2. The Fremont tradition, centered in Utah, may be minimally represented in the Paradox Valley of western Montrose County and in areas near the Gateway lease tracts. This tradition is represented by distinct coiled pottery, one-rod-and-bundle basketry, moccasins made from deer or mountain sheep hides, and artistic renditions of trapezoidal anthropomorphic figures. The Fremont appear to have abandoned the area about the same time as the Ancestral Puebloans for reasons that are not fully understood.

3. In western Montrose and San Miguel Counties, near the Paradox Valley and Uravan lease tracts, a third tradition, designated by Reed (2006) as the Gateway tradition, which reflected both Ancestral Puebloan and Fremont influence, has been recognized. It is characterized by limited reliance on maize horticulture; the manufacture of small arrow points; a lack of ceramic production; short-term use of noncontiguous, circular, masonry habitation structures, granaries, and storage cists constructed in rock shelters; and rock art that reflects both Ancestral Puebloan and Fremont influence. The Gateway tradition appears to be coterminous with maize horticulture. Gateway sites are clustered in western Montrose and San Miguel Counties near the central portion of the project area.

4. At this time, sites without masonry or evidence of horticulture are more common in west-central Colorado. These sites, often associated with the fourth, or Aspen, tradition, reflect a hunting and gathering lifestyle and are characterized by basin houses, tipi rings, and game drive systems. These sites may reflect a more intensive occupation exploiting areas with too short a growing season for maize, or they may be procurement sites for the Gateway population (Reed 2006).

While there is some debate as to when they first arrived in western Colorado (Fritz 2006), the Utes were the primary inhabitants of the project area between the end of the Formative era and their ultimate removal to present-day reservations in the late nineteenth century. The Utes were one of the Numic-speaking peoples centered in the Great Basin and the Colorado Plateau. Linguistic and archaeological evidence suggests that the Utes migrated from southwestern Nevada and southeastern California around A.D. 1100 (Ott et al. 2010). They were highly mobile hunters and gatherers, whose habitation structures were wickiups—brush structures with neither excavated floors nor post holes. They manufactured small amounts of brownware pottery, locally termed Uncompahgre brownware, and desert side-notched projectile points.

The period between 1100 and the beginning of an equestrian lifestyle in about 1650 is termed the Canalla phase. In this phase, the Utes followed a pedestrian hunting and gathering lifestyle following a seasonal round. During the following Antero phase (1650–1881), the acquisition of horses allowed the Utes to range farther onto the plains to hunt bison and to raid in the south and west, supplying slaves to Spanish immigrants. The Utes begin to take on aspects of Plains culture during this period, and Euro-American artifacts become increasingly more common at Ute sites.

The Spanish explorer Juan de Rivera led an expedition through the heart of the area in 1765 in search of mineral wealth. Later, in 1776, the Escalante-Dominguez party passed though western Colorado seeking a route from Santa Fe to California, which eventually led to the establishment of the northern branch of the Old Spanish Trail. The trail was followed by Spanish traders and by fur trappers and explorers. Euro-Americans began to explore the area's natural resources in the 1820s, when fur trappers such as James Pattie and Antoine Roubideau travelled through the area. The fur trade began to wane in the 1830s due to over-trapping and falling prices. During the next two decades, the Euro-American presence was limited primarily to U.S.-Government-sponsored exploratory expeditions.

The situation changed in 1859 with the discovery of gold on Cherry Creek near present-day Denver. The resulting influx of Euro-Americans into Ute territory led to conflict. In response, the treaty of 1868 established much of western Colorado as a reservation for the Utes, but subsequent discoveries of ore bodies in the San Juan mountains led to further conflict, and the Utes relinquished the San Juans in the Brunot Treaty of 1873, whereby the Moache, Capote, and Weeminuche Ute bands were restricted to the Southern Ute Reservation along the New Mexico border. Hostilities increased, which led to the Meeker Incident in 1879 and the removal of the White River and Uncompahgre Utes to reservations in northeastern Utah and southern Colorado (Reed 2006).

With the removal of the Utes, a limited amount of Euro-American farming and ranching increased along the canyon bottoms of the area, but it was the discovery of a parrot-yellow mineralization in a sandstone bed at the confluence of the Dolores River and Roc Creek about 1880 that led to the world's first discoveries of radioactive metals, in the form of carnotite ore, and to the development of the Uravan Mineral Belt. Historically, the prosperity of the towns of Bedrock, Nucla, and Naturita can be attributed to the construction of uranium- and vanadium-ore processing plants. As is a common occurrence with mining and mineral extraction, the Uravan Mineral Belt experienced a repeated boom-and-bust cycle tied to the supply of and demand for radioactive metals and vanadium. Six periods of historical significance have been identified for the Uravan Belt (Twitty 2008). The remains of the prospects, mines, roads, mining camps, drill pads, and other modifications of the landscape remain in the Uravan Mineral Belt. Those that retain their integrity and association with significant periods may be eligible for listing on the NRHP.

In the late nineteenth century, about the time that the Curies working in France were identifying radioactivity, it was discovered that carnotite ore, unique to the Uravan Mineral Belt, contained the radioactive metals of radium and uranium. The period from 1898 through 1905 was a time of interest in radium in Europe. A growing demand for radium, first in the scientific community and then in the medical industry, stimulated a minor wave of prospecting along the San Miguel and Dolores Rivers. Ore bodies were identified, and the first successful uranium extraction mills were built. However, the remoteness of the belt from Europe led Europeans to rely on pitchblende ores from eastern Germany as a more economical source of uranium and radium (Twitty 2008). Production in Montrose and San Miguel Counties collapsed in 1905.

In the following year, 1906, the construction of the first successful vanadium concentration mill at Newmire (later Vanadium) sparked a revival of mining. Vanadium was in demand as a hardening alloy used in steel production and was especially important for weapons production in Europe during World War I. San Miguel County proved to have rich deposits of roscoelite ore from which vanadium could be extracted. Radium was also in demand, especially after German sources were no longer available in the West. There was a mining boom and associated population growth. However, demand for both radium and vanadium collapsed in the early 1920s when sources were discovered in the Belgian Congo.

Mining in the Uravan Mineral Belt was much reduced until the middle of the Great Depression, when industry had revived enough to create a demand for vanadium. Development of vanadium milling continued, and large-scale companies came to dominate the industry, although smaller operations cumulatively provided a significant amount of ore. The process of vanadium revival accelerated between 1941 and 1945. During World War II, vanadium was in demand. The Government aggressively pursued vanadium production as a key component of weaponry and armor. In addition, under the guise of vanadium production, the Government sought uranium for use in the development of atomic weapons. The area contributed 15% of the uranium used in the Manhattan Project, mostly obtained by processing vanadium mill tailings.

By 1944, however, the U.S. Government's uranium production goals had been met, and in 1945, the bottom fell out of the uranium market. Some of the slack was taken up by the revival of industrial demand for vanadium. In 1947, the Federal Government formulated a strategy to stimulate the discovery, production, and milling of uranium from domestic sources. This became increasingly important during the Cold War. The industry was completely dependent on the Government, which strictly regulated uranium production. In the early 1960s, the U.S. Department of Defense's needs were almost fulfilled, and the AEC began to reduce its financial support of the uranium mining industry. The industry declined but then experienced a brief revival in the mid- to late 1970s, when vanadium was once more in demand for industry and uranium was needed for nuclear power production. Uranium prices collapsed once again in 1980, most of the mines closed, and the region lost much of its economic foundation (Twitty 2008).

3.11.2 Cultural Resource Inventories

The cultural resource site information discussed in this section was obtained from the Office of Archaeology and Historic Preservation in the state of Colorado in December 2011, from the State Historic Preservation Office of the Utah State Historical Society in March 2012, and from survey reports.

Cultural resource inventories can include both field surveys and documentary research studying the results of past field work in the area of interest. Archaeological surveys in the area were initiated by George and Edna Woodbury in 1931, but, by far, the majority of cultural resource surveys have been conducted in response to the requirements of Section 106 of the NHPA. Over time, the rigor and scope of these surveys have increased, so that, in general, Federal land-managing agencies (such as the BLM, which manages the surface resources of the lease tracts) regard the surveys conducted after about 1985 as adequate. Section 106 surveys provide the data that Federal agencies use, in consultation with the SHPO and affected tribes, to evaluate whether the identified sites meet the eligibility criteria for listing on the NRHP.

A cultural resource survey based on documentary evidence in past surveys and investigations is termed a Class I inventory by the BLM. In 2006, Alan Reed conducted a Class I cultural resource inventory of the lease tracts for DOE. He identified 126 mostly small-scale surveys conducted on the lease tracts. Since 2006, 13 additional surveys have been conducted. Table 3.11-1 shows the acreage of land that had been surveyed as of 2011. It shows that 2,800 acres (1,100 ha), or about 11%, of the 26,000 acres (10,500 ha) that lie within the lease tracts have been subjected to cultural resource surveys. This is a somewhat lower percentage than the survey coverage of lands in the surrounding 15 mi (24 km). Approximately 314,000 acres (127,000 ha), or about 18%, of the surrounding 1,700,000 acres (680,000 ha) have been surveyed according to geographical information system (GIS) layers provided by the Colorado and Utah SHPOs (Sullivan 2011; Miller 2012).

Archaeological site data on surveyed lands within 15 mi (24 km) surrounding the lease tracts are also available from the SHPOs. The tracts cluster into four groups, as described in Section 3.12. These four clusters vary somewhat from the named groups used in Section 3.3. Since setting and viewshed are important components of the integrity of historic properties, this section uses the groupings used in Section 3.12, Visual Resources; see Table 3.11-2.

The extent of archaeological survey coverage and the numbers of sites contained in the 15-mi (24-km) zones circumscribed around these four groups are listed in Table 3.11-3. Calculated site densities are also listed. Site density ranges from 24 to 35 sites per square mile, with density increasing from north to south. This increase may reflect a generally greater accumulation of prehistoric sites (especially those dating to the latter parts of prehistory) along a transect from higher to lower elevation and south toward the Ancestral Puebloan cultural heartland. These site data from the 15-mi (24-km) radius hinterlands also provide a basis for comparison with data from within the lease tracts proper, as summarized in Table 3.11-4.

Individual inventories in the northern cluster of lease tracts near Gateway reported site densities ranging between 13 and 69 sites per square mile (Reed 2006). This range brackets the average frequency of 24 sites per square mile derived from the surrounding 15-mi (24-km) zone. It also brackets the average of 43 sites per square mile determined from Colorado SHPO data for all the northern lease tracts (Sullivan 2011). The anomalously high site frequency figure of 69 sites per square mile is probably a result of sampling error.

One cultural resource inventory in the North Central tracts around Uravan reported a density of 11 sites per square mile (Reed 2006). This figure is less than half the density number derived from the survey in the surrounding 15-mi (24-km) zone. It is also much lower than the average site density within the tracts of 52 sites per square mile derived from SHPO data. The anomalously low number may be attributed to sampling error; however, only 12% of the North Central tracts have been surveyed (Sullivan 2011). Averages based on such small sample sizes may be misleading, especially where large numbers of mining-related sites may be clustered in relatively small areas.

TABLE 3.11-1 Cultural Resource Survey Coverage of the Lease Tracts

Lease Tract	Total Acreage of Lease Tract	No. of Acres Surveyed	Percentage of Total Surveyed
5	151	4	2.6
5A	25	–[a]	0.0
6	530	20	3.8
7	493	259	52.5
8	955	34	3.6
8A	79	3	3.3
9	1,037	12	1.2
10	638	56	8.8
11	1,503	103	6.8
11A	1,293	51	3.9
12	641	513	80.0
13	1,077	128	11.9
13A	517	111	21.4
14	972	7	0.7
15	350	11	3.3
15A	173	8	4.6
16	2,039	8	0.4
16A	811	9	1.1
17	475	5	1.1
18	1,181	313	26.5
19	664	2	0.2
19A	1,205	213	17.7
20	629	–	0.0
21	651	48	7.3
22	224	66	29.3
22A	408	35	8.7
23	596	40	6.8
24	201	1	0.4
25	639	32	5.0
26	3,991	523	13.1
27	1,763	151	8.6
Total	25,911	2,766	10.6

[a] A dash indicates not surveyed.

TABLE 3.11-2 Correlation of Lease Tract Cluster Designations

Geographic Clusters	Named Grouping
North Cluster	Gateway
North Central Cluster	Uravan + Lease Tracts 21-23
South Central Cluster	Paradox south of Paradox Valley
South Cluster	Slick Rock

TABLE 3.11-3 Cultural Resource Survey Coverage, Site Tallies, and Site Density within 15 mi (24 km) of Lease Tract Clusters

Lease Tract Cluster	Surveyed Acreage within a 15-mi Zone	Site Tally	No. of Sites per Acre	No. of Sites per Square Mile
North	40,830	1,498	0.0367	23.5
North Central	99,950	4,223	0.0423	27.0
South Central	96,451	5,029	0.0521	33.4
South	77,065	4,167	0.0541	34.6
Total	314,296	14,917	0.0475	30.4

TABLE 3.11-4 Cultural Resource Survey Coverage, Site Tallies, and Site Density within Each Lease Tract Cluster

Lease Tract Cluster	Surveyed Acreage within Cluster	Site Tally	No. of Sites per Acre	No. of Sites per Square Mile
North	662	43	0.0650	41.6
North Central	694	56	0.0807	51.6
South Central	326	19	0.0584	37.3
South	978	103	0.1053	67.4
Total	2,659	221	0.0831	53.2

South of Paradox Valley, in the South Central lease tracts, individual surveys reported site densities ranging from 21 to 54 sites per square mile (Reed 2006). This range evenly brackets the average of 33 sites per square mile determined for the surrounding 15-mi (24-km) zone. It also brackets the average site density of 37 sites per square mile derived from all previous surveys in the south central lease tracts. Even though only 11% of the South Central lease tracts have received archaeological survey coverage, site density figures generated for this area seem reliable.

In the South tracts near Slick Rock, individual surveys determined site density figures ranging from 14 to 31 sites per square mile (Reed 2006). Data from the surrounding 15-mi (24-km) zone produced an average of 35 sites per square mile. Colorado SHPO data indicated that surveyed land within the South Cluster lease tracts contained an average of 67 sites per square mile (Sullivan 2011). There are clear discrepancies among these results. It seems likely that the discrepancies are the result of incomplete survey coverage in the South Cluster lease tracts, where only 10% of the area has been surveyed.

All the lease tracts are near or overlap areas of known prehistoric occupation as well as areas of early Euro-American settlement, mining, and ranching (Reed 2006). Many of the lease tracts contain structures and artifacts associated with the early uranium mining boom in the United States; some of these features are considered historic and eligible for inclusion in the NRHP. The extent that each lease tract has been inventoried ranges from 0% to 80%. Forty-two individual cultural sites on the lease tracts were eligible for, or potentially eligible for, inclusion in the NRHP. These include sites that have been officially determined to be NRHP-eligible by Federal or state agencies, sites that have been recommended as eligible by site recorders but not formally evaluated by the agencies, and sites that are classified by either the agencies or the recorders as “needs data.” These last sites require additional investigation to determine whether they are eligible for listing on the NRHP. They must be managed as if they were eligible until it is formerly determined otherwise.

Table 3.11-5 lists the number of eligible historic and prehistoric sites known from each tract. Of the 42 cultural sites identified within the tracts, 24 are prehistoric, 14 are historic, and 4 have both historic and prehistoric components. Most of the prehistoric sites are classified as either lithic scatters or as camp sites. In addition, one site is a rock art panel, and two are classified as rock shelters. Historic sites are predominantly mines but also include a highway, a cabin, and a mining camp (Reed 2006; Sullivan 2011).

One site associated with carnotite mining, Calamity Camp, is now listed on the NRHP but has been excluded from Lease Tract 26. It includes approximately 23 stone and wood structures, many of them constructed prior to 1922. At first, from the early 1900s through the early 1920s, radium was the resource sought. Later, the ore was processed for vanadium and uranium. This camp and others on Outlaw and Calamity Mesas, notably Foster Camp, Climax Camp, and Arrowhead Camp, served as community centers for miners and their families during the vanadium and uranium booms in southwest Colorado. To protect the structures and features associated with this camp, BLM and DOE agreed to a “No Surface Occupancy” area that includes and surrounds the camp. No cleanup or remediation work has or will take place within

TABLE 3.11-5 Eligible and Potentially Eligible Sites in the Lease Tracts

Lease Tract No.	No. of Eligible Sites[a]	Prehistoric	Historic[a]	Multicomponent
5	1	0	1	0
5A	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	2	1	0	1
8A	0	0	0	0
9	2	2	0	0
10	1	1	0	0
11	1	0	0	1
11A	1	1	0	0
12	2	2	0	0
13	4	1	2	1
13A	3	3	0	0
14	1	1	0	0
15	2	1	1	0
15A	0	0	0	0
16	0	0	0	0
16A	1	0	1	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
19A	6	6	0	0
20	0	0	0	0
21	3	1	2	0
22	2	0	2	0
22A	3	1	2	0
23	2	0	1	1
24	0	0	0	0
25	0	0	0	0
26	4	2	2	0
27	2	1	1	0

[a] One site, 5SM3670, straddles the boundary between two sites and appears twice in this table.

Source: Information obtained from the Office of Archaeology and Historic Preservation in the state of Colorado in December 2011.

this area, and no remediation or disturbance is allowed within a 98-ft (30-m) buffer zone surrounding the camp boundary.

Cultural site densities within DOE's lease tracts vary greatly. Cultural resource inventories on some of the South Cluster or Slick Rock lease tracts have indicated densities of 14, 31, 22, and 24 sites per square mile (Lease Tracts 10, 11, 13A, and 15, respectively) (Reed 2006). A total of 17 sites in the South Cluster lease tracts are eligible or potentially eligible for listing in the NRHP. An open lithic site in Lease Tract 10 is potentially eligible for inclusion in the NRHP. A prehistoric rock art site with a historic inscription is the only potentially eligible site in Lease Tract 11, and an Ancestral Puebloan site is the only potentially eligible site in Lease Tract 11A. An Archaic Period site with an Ancestral Puebloan component is an eligible site in Lease Tract 12, along with a potentially eligible Archaic site. Four sites in Lease Tract 13 are eligible or potentially eligible: (1) portions of a historic highway also known as CO 141; (2) an open lithic site; (3) a historic mining camp; and (4) a multicomponent site with a sheltered lithic component and historic trail. Three prehistoric sites in Lease Tract 13A are potentially eligible: (1) a possible Archaic open lithic site; (2) an open camp site with a historic prospect pit; and (3) an open camp site with a hearth feature and lithic remains. Lease Tract 14 has one potentially eligible site. It is an open lithic site of unknown cultural affiliation. Two sites in Lease Tract 15 are potentially eligible: (1) a possible Paleoindian open lithic site and (2) the Rimrock Cabins, a historic habitation site. Lease Tracts 16 and 16A are immediately adjacent to the aforementioned eligible historic highway (Sullivan 2011). A survey of historic mine features was conducted by Alpine Archaeological Consultants, Inc. (Moore-McMillian and Omvig 2009) in the South Cluster tracts; however, none of the mines documented were determined eligible for inclusion in the NRHP.

Cultural resource inventories on some of the lease tracts south of Paradox Valley reported densities of 54 and 53 sites per square mile (Lease Tracts 5 and 9, respectively) (Reed 2006). Two well-known cultural sites are located about 2 mi (3.2 km) southwest of Lease Tract 9: the Bull Canyon rock shelter, a prehistoric site; and Indian Henry's Cabin, a noneligible, late-nineteenth century site containing a well-preserved log cabin, corral, and grave site. A historic mine, the Joe Dandy #5 site, is the only eligible site located on Lease Tract 5. An open camp site with a historic rock ring is an eligible site on Lease Tract 8, where there is also a potentially eligible open lithic site. The two sites located on Lease Tract 9 are open camp sites that are potentially eligible for inclusion in the NRHP. The Radium Hill No. 10 Mine is an eligible historic site on Lease Tract 17 (Sullivan 2011).

North of Paradox Valley and near Uravan, inventories of 22, 32, and 21 sites per square mile were reported from Lease Tracts 21, 22, and 22A respectively (Reed 2006). Cultural resource inventories on Lease Tract 18 indicate a density of 11 sites per square mile (Sullivan 2011). Lease Tracts 19, 19A, 20, 24, and 25 are expected to have similar or higher site densities (Reed 2006). Six sites on Lease Tract 19A are eligible or potentially eligible for inclusion in the NRHP: four possible Archaic open camps; an open camp of unknown cultural affiliation; and a rock shelter with an isolated historic find.

Lease Tract 21 has two eligible historic mine sites and a prehistoric open camp (Sullivan 2011). One historic mine site is the Vanadium King No. 5 Mine; extant features of the mine consist of an inclined shaft, an explosives magazine, a hoist house, a track-and-rail system for ore car transportation, and an ore bin. The most intensive activity at the mine likely took place during the Atomic era (1946–1963), although the mine operated until 1992. The mine has retained enough integrity to illustrate uranium mining during the Atomic era and is therefore eligible for NRHP inclusion (Moore and Horn 2010). Long Park Nos. 1 and 16 Mines make up the other historic mine site. The principal remains of this site consist of a mine shaft, a waste-rock dump, head frame, hoist foundation, hoist house, ore bin, ore chute, blower foundation, storehouse ruin, and refuse dump. The No. 1 mine claim was initially located in 1912, and the No. 16 mine claim was located in 1939, and both claims were active until 1992 (Moore and Horn 2010). The site is considered eligible under Criterion A because of its association with the Cold War and under Criterion C because it is an outstanding example of a formally engineered, productive shaft mine (Twitty 2008).

Two sites in Lease Tract 22 are eligible for NRHP inclusion: the Cripple Creek/Donald C Mine, Shaft No. 1 and Shaft No. 2. The extant features of Shaft No. 1 consist of an inclined shaft, two waste-rock dumps, a hoist house foundation, a hoist house platform, a compressor house platform, two rail line remnants, a trestle remnant, a trestle, an ore bin, an ore loading area, a parking area, and a ventilation stack (Moore and Horn 2010). The remains of Shaft No. 2 consist of an inclined shaft, waste-rock dump, hoist foundation, rail line remnant, trestle ruin, parking area, trestle segment, and ventilation stack (Moore and Horn 2010). Both mines are eligible under Criterion A because of their association with the uranium boom in the 1950s as part of the Cold War and under Criterion C because they are excellent examples of inclined shaft mines for surface uranium drilling (Moore and Horn 2010).

Three sites in Lease Tract 22A are eligible or potentially eligible for the NRHP: Hidden Basin Mine; the Republican Camp historic mining site; and an open camp site. Hidden Basin Mine was initially located in 1944, and the extant remains at the site consist of an inclined shaft, waste-rock dump, hoist house remnant, incline frame, rail line remnant, trestle remnant, ore bin, loading area, utility pole, generator foundation, and low-grade ore piles (Moore and Horn 2010). One site, an open camp and historic sweat lodge on Lease Tract 23(3), is potentially eligible for the NRHP.

Cultural resource inventories of the Gateway or North Cluster lease tracts indicate a density of 24 sites per square mile (Sullivan 2011) (Table 3.11-3). Numerous sites associated with historical uranium mining are present. Lease Tract 26 contains four sites that are listed, eligible, or potentially eligible for NRHP inclusion. A late Archaic open camp site has been declared eligible for NRHP inclusion, as has another open camp site. An historic site has been declared eligible for the NRHP; it is known as the New Verde Mine and dates to the 1940s. The Radium No. 5 Mine is the fourth eligible site located on Lease Tract 26. The mine was first located in 1939 and is eligible under Criterion C because of the presence and integrity of the windlass artifact at the mine site (Horn and Moore-McMillian 2009). A historic mining complex is an eligible site located on Lease Tract 27, and a possibly Archaic open camp is potentially eligible on this lease tract.

Taken as a whole, the site distribution pattern found in the lease tracts suggests that prehistoric sites are most likely to be found (1) on level to gently sloping land forms, often on ridge crests or along mesa rims, within the juniper-piñon woodlands, and (2) along benches overlooking rivers and streams. Ranching sites are most likely located along river bottom lands. The distribution of mining sites is dictated by the presence of ore bodies. During the late nineteenth and early-twentieth centuries, these ore bodies were primarily located visually and tested by prospects, often along rims. Mining camps were located near the mines. Later, with the advent of coring, deeply buried ore bodies were discovered well away from the rims, and improvements in the road system allowed miners and their families to reside in the valley towns. In an area where water is scarce, there is little doubt that the development of the mineral belt resulted in historic mines, and settlements have already destroyed much of the prehistoric record in the area. Networks of roads connecting mines, prospects, and drill pads, along with the leveling done for mine facilities, waste rock disposal, and ore storage, are likely to have taken their toll on prehistoric remains as well.

3.11.3 Traditional Cultural Properties

Traditional cultural properties are properties that are associated with the cultural practices or beliefs of a community and are significant to the community's history or may be important in maintaining the community's cultural identity. They can include archaeological sites; burial sites; rock art; culturally important resources such as plants important for medicine or in rituals; natural features such as mountain peaks, springs, caves, and distinctive rock formations; and sacred landscapes. In many cases, they cannot be identified without input from the community that considers them sacred or otherwise culturally important.

Traditional properties may not be readily identifiable during a Class I inventory or a Class III field inventory (required prior to any new surface disturbing activity) alone. A Class III field inventory is an intensive survey of an entire target area, aimed at locating and recording all cultural resources (archaeological sites, historic structures, historic and cultural landscapes, and traditional cultural properties) that have surface indications, and it is performed by walking close-interval, parallel transects until the area has been thoroughly examined. The NHPA requires that these properties or places be considered by Federal agencies in the same manner as are other eligible cultural resources through the Section 106 consultation process.

In order to help identify traditional cultural properties in the study area that could be affected by the proposed alternatives, DOE contracted with a cultural anthropologist in 2006 (Fritz 2006). He identified three Native American tribes with potential historical and cultural ties to the lease tract, the Navajo, the Hopi, and the Utes. These tribes retain cultural ties to their traditional homelands that can lie well beyond the boundaries of their current reservations. They include sacred landscapes, often the settings for traditions regarding tribal emergence. They may believe they have a divinely mandated stewardship over these sacred lands. The tribes and their interests are described briefly here.

- *Navajo.* The Navajo take the view that they have always lived "among the four sacred mountains," having emerged from the four underworlds into this world at Mount Blanca (Two Bears 2012). However, according to linguistic and archeological evidence, today's Navajo, along with the Apache, coalesced out of Athabaskan-speaking groups that probably entered the Southwest from the north only relatively recently. One possible migration route is an intermountain one through western Colorado and eastern Utah that would include the lease tracts. Although evidence is scarce, it is likely that at least some Athabaskan groups entered the study area prior to the fifteenth century. It is possible that early Navajo sites may be found in the area. By the sixteenth and seventeenth centuries, traditional Navajo lands included the canyon tributaries of the San Juan River, Los Pinos River, and Animas River. Some Navajo people were in alliance with the Ute and Paiute peoples in Moab and the Lisbon Valley area close to the lease tract by the mid-nineteenth century (Fritz 2006). In the twentieth century, some Navajos became skilled miners and worked underground in the Uravan Mineral Belt mines. Traditional Navajo hogans and sweat lodges have been documented in the area (Twitty 2008).

- *Hopi.* The Hopi are a Puebloan people whose traditional villages currently lie on three mesas in northern Arizona. However, their current reservation encompasses only a fraction of their traditional sacred and ancestral homeland, or *Tutsqua*. Hopi clans have traditional migration narratives that link them to places north and east of their current home. They are linked to an extensive network of ancestral sites, often marked by clan rock art, that include burial sites, shrines, medicinal gathering places, ancient farming lands, and the habitat for the animals after which the clans are named. They see themselves as descending from the Ancestral Puebloan cultures of the Southwest, including those known to archaeologists as the Fremont and Ancestral Puebloan cultures. The Hopi feel bound to *Tutsqua* by a long history and a powerful spiritual covenant that includes a divine mandate to act as stewards of the land. The lease tracts fall within the northern extent of *Tutsqua* (Fritz 2006).

- *Ute.* As already discussed, the Ute Indians are the Native Americans who most recently dominated western Colorado. The lease tracts lie within the heart of the Ute homeland. Traditionally, Ute populations have been identified living along the Dolores River, along the San Miguel River, in Paradox Valley, and on the Uncompahgre Plateau. Traditional Ute creation and migration narratives and ceremonies, such as the Bear Dance, derive from the natural world. Traditionally, the Utes see the landscape as infused with sacredness and as a source of spiritual power. Utes were traditionally hunters and gatherers following a seasonal round. Ute ceremonial and subsistence patterns incorporate an extensive array of plants, and more than 100 species have been recorded. These indications suggest a high potential for traditional gathering areas within the lease tracts. In spite of their forced removal from their traditional homeland, the Utes have retained a strong bond to these locations (Fritz 2006).

> A recent BLM project brought Utes from Utah and Colorado to areas that included the northern half of the lease tracts to explore their ties to their traditional homeland. They expressed deeply held values on living landscapes and landforms that once were home to their ancestors or figured in their cultural traditions. They were interested in the preservation of Ute trails and wickiup sites. They expressed the importance of preserving access to locations of traditional importance as well as to traditional plant resources. Ute archaeological sites often include wooden surface features, such as wickiups, tree platforms, ramadas, hunting blinds, brush fences, and corrals that, in the past, have not always been recognized as having Ute affiliation (Ott et al. 2010).

In 2006, communication was attempted with Native American tribal members who might have knowledge of such traditional cultural properties being important to the tribes in the lease tracts. During the preparation of the earlier environmental assessment, DOE formally initiated the NHPA consultation process by notifying potentially interested Native American tribes that resided in or had cultural ties to the project area to inform them of DOE’s proposed alternatives and to solicit their concerns or comments. A total of 11 representatives from five Native American tribes—the Ute Mountain Ute Tribe (including the White Mesa Ute Tribe), Southern Ute Tribe, Uintah-Ouray Ute Tribe, Navajo Nation, and Hopi Tribe—were contacted by mail, telephone, and e-mail. All representatives were contacted again in July 2006 and given a copy of the Class I inventory. Follow-up phone calls and e-mails continued through November 2006. Responses were received from four tribes: the Ute Indian tribe of the Uintah and Ouray Reservation; the Ute Mountain Utes; the Hopi; and the Navajo Nation. Both the Utes and the Navajo both requested additional information. The Hopi responded that the area was not a high priority, while the Ute Mountain Utes indicated that the area involved was too small (Fritz 2006). To date, no tribe has made a determination regarding traditional cultural properties on the lease tracts, primarily because future, site-specific development activities and the cultural sites they might affect have not yet been determined. Section 6.1 presents a discussion of government-to-government consultations being conducted for the ULP PEIS.

3.12 VISUAL RESOURCES

For this discussion, the lease tracts were divided into four groups:

1. North Group: Lease Tracts 27 and 26;

2. North Central Group: Lease Tracts 25, 24, 23T-3, 23T-2, 23T-1, 22, 22A, 21, 20, 19, 19A, and 18;

3. South Central Group: Lease Tracts 17T-2, 17T-1, 9, 8, 8A, 7, 6, 5, 5AT-3, and 5AT-2; and

4. South Group: Lease Tracts 16, 16A, 15, 15A, 14T-3, 14T-2, 14T-1, 13, 13A, 12, 11, 11A, and 10.

The North Group is located within Mesa County, east of the Dolores River. The North Central Group and South Central Group are located within Montrose County; however, portions of Lease Tract 17 straddle the borders of Montrose and San Miguel Counties. The South Group is located entirely within San Miguel County adjacent to the Utah–Colorado border (Figure 3.12-1). These groups, as well as portions of these groups, are analyzed for impacts resulting from activities associated with Alternatives 1 through 5.

The grouping of lease tracts for the visual impact analysis differs from the named groupings used in other portions of the ULP PEIS; the requirements of the visual impact analysis dictate that lease tracts in close physical proximity be analyzed as a group, because they will have views of approximately the same landscape. Lease tracts 21–23 north of Paradox Valley have viewsheds (i.e., visible areas of the surrounding landscape) that are similar to those in the Uravan Lease Tracts, but have very limited visibility of lands within Paradox Valley and south of the valley. Lease tracts 6–9 of the Paradox Valley lease group have extensive views of Paradox Valley and lands south of Paradox Valley. Combining the viewsheds of the lease tracts south of Paradox Valley with those north of Paradox Valley would have generated misleading results that would have implied that the more northern lease tracts would have views of activities south of Paradox Valley. This problem was avoided by grouping the lease tracts of the Paradox Valley lease group north of Paradox Valley with the Uravan lease tracts.

3.12.1 Regional Setting

This region within Colorado historically has been utilized for mining activities, including the exploration and development of coal, oil, and gas; sand and gravel; and radium, uranium, and vanadium.

Natural vegetation on and near the lease tracts varies from grasses and shrubs to woodlands of piñon-juniper and Gambel oak. The land forms are characterized by a range of features, including high mountain peaks, rolling plains, basins, valleys, and rock outcrops (Chapman et al. 2006), creating a highly variable landscape with numerous colors, textures, forms, and lines. The three counties are characterized by diverse landscapes consisting of valleys, mesas, and plateaus. Within Mesa County, approximately 76% of the land is publicly owned and controlled.

Montrose County is bisected by the Uncompahgre Plateau. In this county, the area west of the plateau is known traditionally as the West End Planning Area; it contains the towns of Nucla and Naturita, as well as several unincorporated communities. In this area, mining has been a longstanding industry, and similar to land in Mesa County, much of the land in this area is publicly administered. The West End has numerous natural resources, including the Dolores River, which cuts across Paradox Valley (Montrose County 2010a), and the San Miguel River. Portions of this county are also designated for their unique and/or specific environmental, historic, and recreational qualities (e.g., Tabeguache Wilderness, the Unaweep Tabeguache Byway, the Dolores River Canyon SRMA, the Dolores River Canyon Wilderness Study Area, and the Hanging Flume).

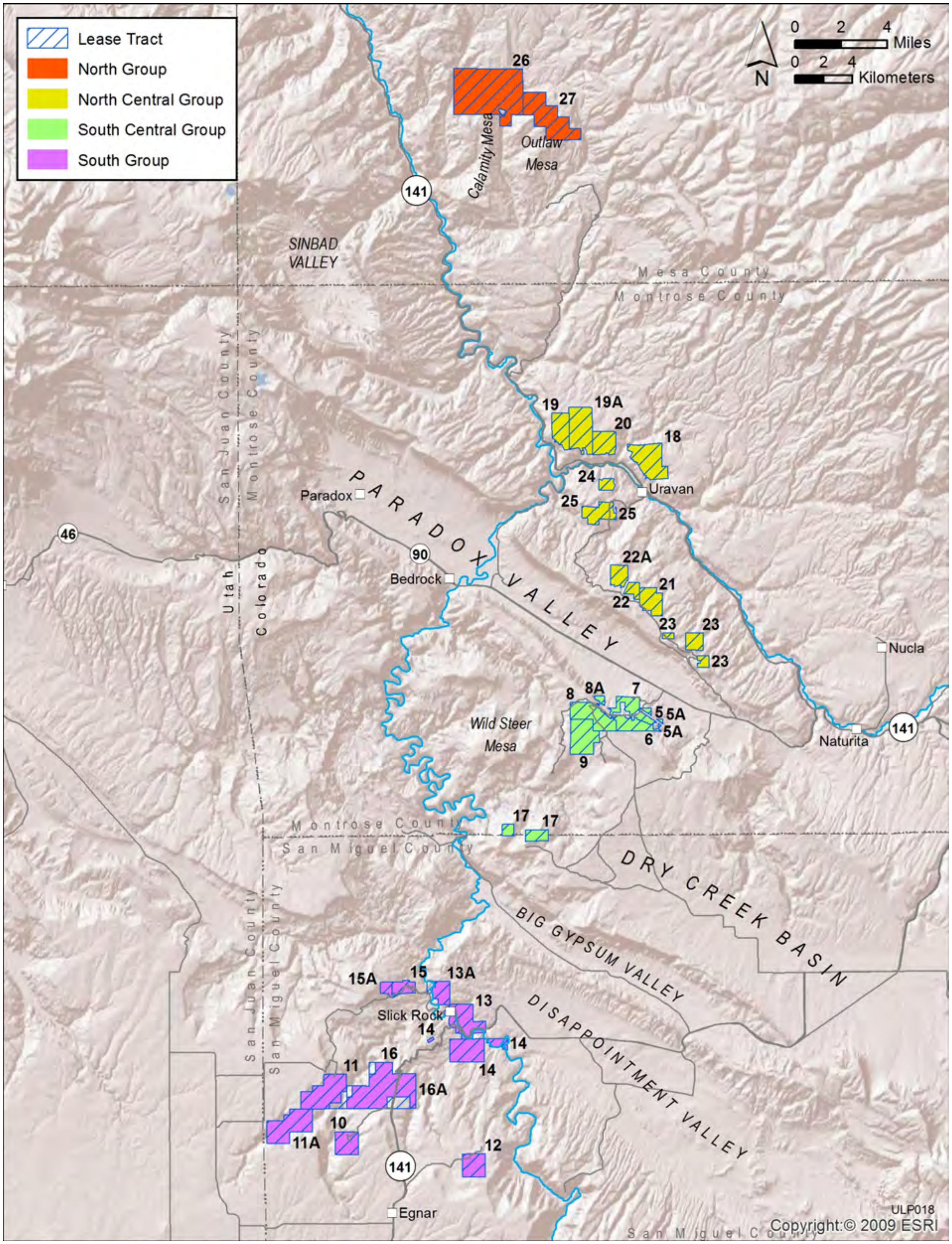


FIGURE 3.12-1 Locations of the Four Lease Tract Groups: North; North Central; South Central; and South

Portions of the lease tracts within San Miguel County are located in the county's West End, as it also is known locally. In San Miguel County, this area includes locations within the Dry Creek Basin, Disappointment Valley, Slick Rock, and Egnar. This area is noted for its wildlife, historical and archaeological sites, natural resources, and landmarks. One of the main goals of the county comprehensive land management plan is to develop the county's natural resources in a way that would maintain the high overall quality of life enjoyed by its citizens. As part of this goal, the county intends to preserve the natural beauty of the San Miguel West End (San Miguel County 2008). Similar to both areas in Mesa and Montrose Counties, areas designated for their unique and/or environmental/recreational qualities also are located within the western portion of the county.

3.12.2 Lease Tracts

Many of the lease tracts are located along the tops and side slopes of broad mesa tops and benches, as well as within Dolores Canyon and Paradox Valley. During the October 2011 site visit, ephemeral streams also were noted, including some located within Paradox Valley. In some locations, such water sources have created deep incisions into the valley floors. The Dolores and San Miguel Rivers are major features in this area as well and are visible from elevated locations and within the canyons themselves.

Numerous unpaved, dirt and gravel roads cross the areas containing the lease tracts. Many of these roads lead to the individual tracts, providing an interconnected system of state and local roadways. In addition to the roads, other evidence of past mining activities in the region is present, including structures such as ore bins, head frames, gates, and water tanks. Similar types of structures likely would be utilized if mining activities were to continue. Views of the lease tracts and surrounding areas, including existing cultural modifications, are shown in Figures 3.12-2 through 3.12-8.

As observed during an October 2011 site visit, vegetation colors included yellows, greens, and browns, with variable textures and heights sufficient to add some visual interest. Varying levels of intermediate and full growth were indicated within the lease tracts as well. Depending on the season, some or all of the vegetation may be snow-covered or subject to color changes, which could affect the visual qualities of the area. In addition, ongoing reclamation efforts also could alter the existing vegetation.

A GIS viewshed analysis was conducted for each of the four groups of lease tracts. Viewshed calculations were performed by using National Elevation Data (NED) 10-meter Digital Elevation Model (DEM). The analyses included lands within 25 mi (40 km) of the lease tract borders. The ROI for visual resource analysis was set at 25 mi (40 km) because it is the approximate limit at which non-negligible visual contrasts from the structures and landforming activities in the proposed action could reasonably be expected to be visible in this region, assuming favorable viewing conditions and strong contrast between an object and its background. The analyses were conducted by assuming a target height of 30 ft (9 m) and a viewer height of 5 ft (1.5 m) (see Figure 3.12-9). The target height is the approximate maximum

FIGURE 3.12-2 View from the Western Edge of Lease Tract 26 Facing Southwest (The La Sal Mountains are in the background.)

FIGURE 3.12-3 View from Mesa Top near Lease Tract 19 Facing West (showing the Dolores River in the middle ground area)

FIGURE 3.12-4 View of Lease Tract 16A (showing the rubble pile from the previous open-pit mining activities)

FIGURE 3.12-5 View of the Cotter Mine on Lease Tract 11 (Remnants of previous activities are indicated by the presence of the water tank.)

FIGURE 3.12-6 View of the New Verde Mine Reclamation Site on Lease Tract 26 (Remnants of mining structures and an ore bin are present.)

FIGURE 3.12-7 View of Lease Tract 19 Facing West (A headframe structure is located above the closed shaft of the Golden Cycle underground mine.)

FIGURE 3.12-8 View of Entrance to Underground Mine at Lease Tract 18 (The Cotter Mine entrance has a locked gate to prevent unauthorized entrance and is covered with fabric to control ventilation.)

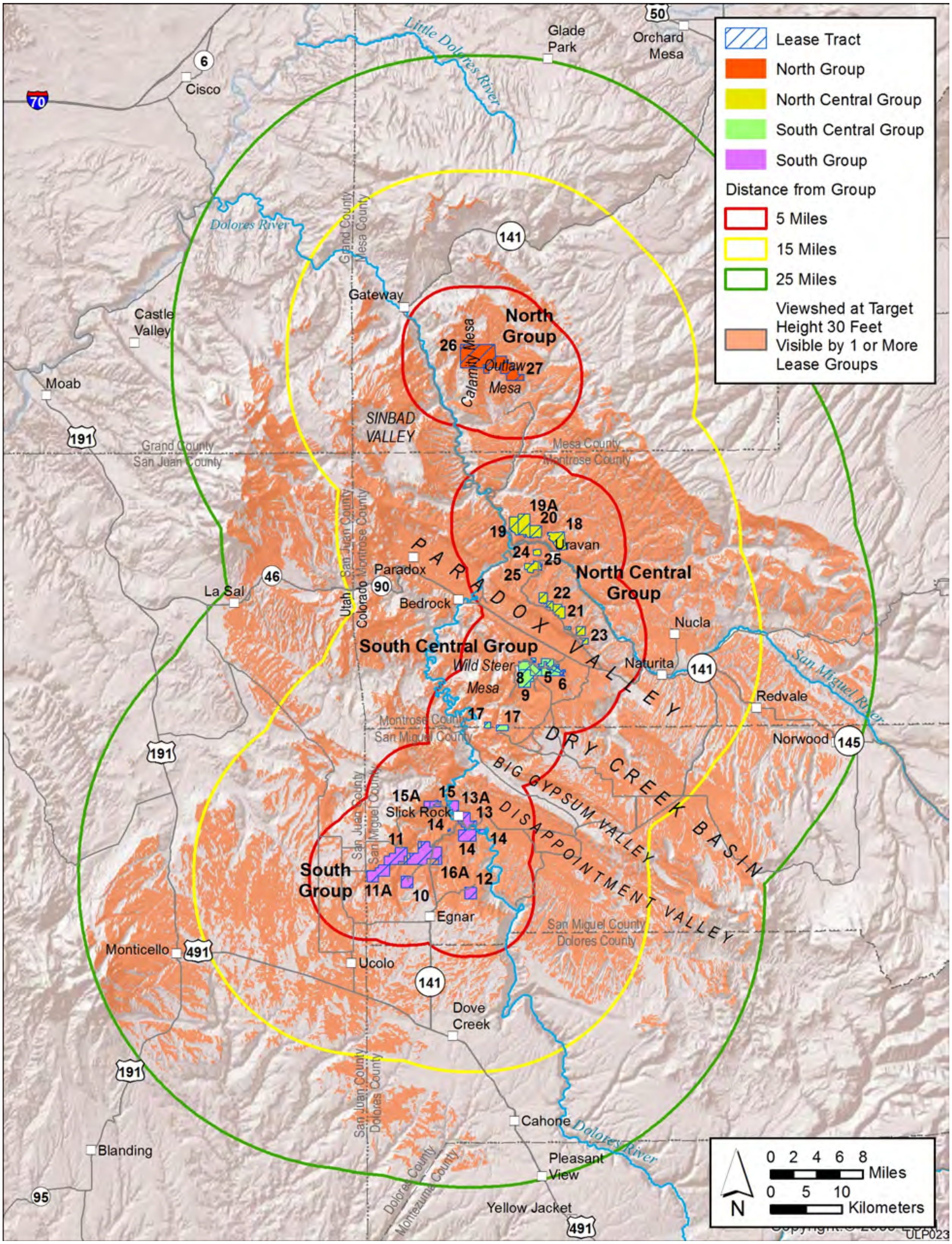
height of structures or other modifications to the landscape anticipated to cause visual contrasts associated with the proposed action or alternatives. The viewshed analyses did not take into account the height or screening potential of surrounding foliage or trees. The viewshed analysis did account for earth curvature and atmospheric refraction.

In addition to the overall viewshed, SVRAs were considered in each of these analyses. These areas included the following:

- National Parks, National Monuments, National Recreation Areas, National Preserves, National Wildlife Refuges, National Reserves, National Conservation Areas, and National Historic Sites;

- Congressionally authorized Wilderness Areas;

- Wilderness Study Areas;

1 

2 **FIGURE 3.12-9 Composite Viewshed of Four Lease Tract Groups**

- National Wild and Scenic Rivers and Congressionally authorized Wild and Scenic Study Rivers;

- National Scenic Trails and National Historic Trails;

- National Historic Landmarks and National Natural Landmarks;

- All-American Roads, National Scenic Byways, State Scenic Highways, and BLM- and USFS-designated Scenic Highways and Byways;

- BLM-designated Special Recreation Management Areas; and

- Areas of Critical Environmental Concern.

Figure 3.12-10 shows the composite viewshed with SVRAs overlaid. No Nationally Wild and Scenic Rivers or Congressionally authorized Wild and Scenic Study Rivers were found to occur in the study area.

3.12.2.1 North Group

The north group of lease tracts is located within the Uncompahgre Plateau, east of Maverick Canyon, on the Calamity and Outlaw Mesas. Elevation within this grouping varies between 5,700 and 7,000 ft (1,700 and 2,100 m). Calamity Creek, Indian Creek, and Cow Creek run through the lease tracts in this grouping. The town of Gateway is located approximately 5.5 mi (8.8 km) northwest of the lease tracts. Off-site views from the northern lease tracts include the Uncompahgre Plateau to the northeast–east, the Dolores River to the west, and the La Sal Mountains to the south–southwest (see Figure 3.12-9). Views to the south also include a mountainous area consisting of mesa tops and canyons cut by tributaries of the Dolores River.

A preliminary viewshed analysis was conducted to identify which lands surrounding the North Group would potentially have views of the activities and infrastructure within the lease tracts. The methodology for this reverse viewshed analysis is provided in Appendix D; this analysis considered Federal, state, and BLM-designated sensitive visual resources. Table 3.12-1 provides a list of SVRAs that would have potential views of the North Group. As shown, the lease tracts within the North Group would be visible from nearly 38% (7,500 acres [3,000 ha]) of the Sewemup WSA, while the North Group would be visible from less than 1% (2 acres [0.8 ha]) of the Tabeguache Wilderness. Figure 3.12-10 illustrates the location of these areas.

Calamity Mine, an NRHP site, is a 38-acre (15-ha) historical mining complex located on Lease Tract 26. A 98-ft (30-m) buffer has been instituted around the site; however, activities within portions of Lease Tract 26 would likely be visible from the camp within the BLM foreground distance of 0 to 3–5 mi (5–8 km), assuming that vegetation did not screen these areas from view of the camp. Distant views (13–25 mi [21–40 km]) of activities within some of the lease tracts in the North Central group would also be possible, assuming that vegetation did not screen these areas from view of the camp.

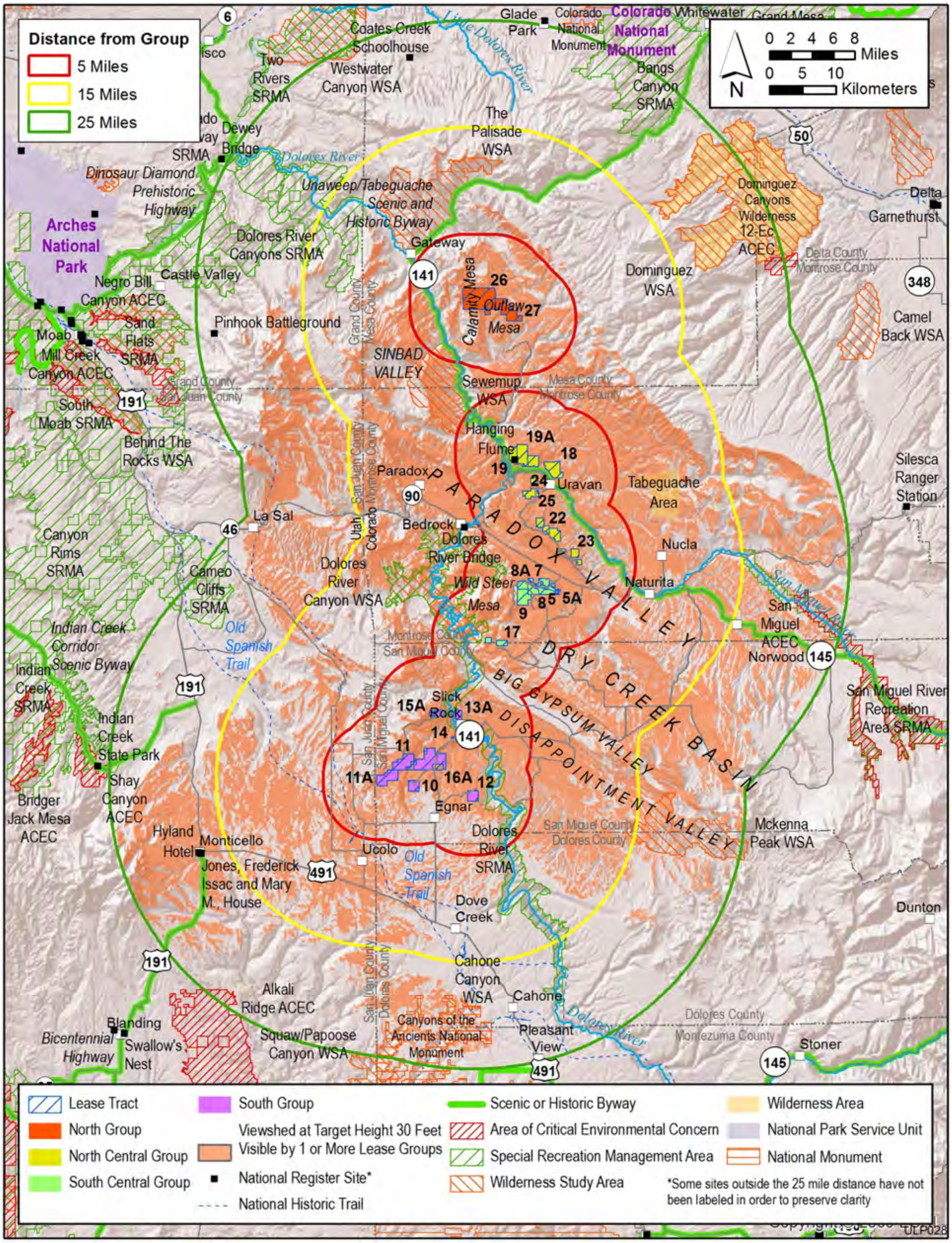


FIGURE 3.12-10 Composite Viewshed with Overlay of Sensitive Visual Resource Areas

TABLE 3.12-1 Sensitive Visual Resource Areas with Potential Views of the North Group

SVRA	Total Acreage	Acreage Visible Within 5 mi	Within 15 mi	Within 25 mi
The Palisade ONA ACEC[a]	23,645	0	555	555
Unaweep/Tabeguache Scenic and Historic Byway	41,348	4	67	67
Dolores River SRMA	65,278	0	0	124
Dolores River Canyon WSA	29,169	0	0	122
Sewemup WSA	19,627	639	7,519	7,519
The Palisade WSA	26,654	0	387	387

[a] The Palisade (ONA) ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

3.12.2.2 North Central Group and South Central Group

The center two groupings of lease tracts are bisected by Paradox Valley. The elevation within these groups varies between 5,000 and 7,200 ft (1,500 and 2,200 m). Portions of these two groupings are located along the Atkinson Mesa, Club Mesa, and Monogram Mesa. Atkinson Creek, a tributary of the Dolores River, crosses through Lease Tract 18.

Highway 141 also runs within the grouping, passing between Lease Tracts 24 and 19, 19A, 20, and 18; this roadway follows the Dolores River and San Miguel River. Hanging Flume, a site on the NRHP, is located west of Lease Tract 19 along this highway. Highway 141 in this area is also known as the Unaweep/Tabeguache Scenic and Historic Byway.

Views from the North Central Group include mountainous areas consisting of mesa tops and canyons in all directions, as well as the Paradox Valley, which is located south of the lease tracts. The Manti La Sal National Forest is also visible from these lease tracts, especially those lease tracts located closest to the Colorado–Utah border. The historic town of Uravan, which is no longer populated, is located within the grouping, between Lease Tracts 18 and 25. The lease tracts likely would not be visible from the valley due to the surrounding topography.

A viewshed analysis was conducted to illustrate areas within the SVRAs that would have views of the lease tracts in the North Central Group. Table 3.12-2 provides a list of these locations. The North Central Group would be visible from 4,800 acres (1,900 ha), or 58.6%, of the Tabeguache Wilderness. In addition, four SVRAs would have views not only of the North

TABLE 3.12-2 Sensitive Visual Resource Areas with Potential Views of the North Central Group

SVRA	Total Acreage	Acreage Visible Within 5 mi	Within 15 mi	Within 25 mi
San Miguel ACEC[a]	24,204	0	0	51
Unaweep/Tabeguache Scenic and Historic Byway	41,348	4,067	6,097	8,820
Dolores River SRMA	65,278	0	879	879
San Miguel River SRMA	39,373	0	0	285
Tabeguache Wilderness	8,187	0	4,802	4,802
Dolores River Canyon WSA	29,169	0	860	860
Sewemup WSA	19,627	309	6,947	6,947

[a] The San Miguel ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

Central Group but also of the lease tracts within the North Group; they are the Dolores River SRMA, the Tabeguache Area, the Dolores River Canyon WSA, and the Sewemup WSA.

Areas within the South Central Group have views down to the Paradox Valley, the Dolores River SRMA, and the Mt. Pearle Ecological Research Natural Area (ERNA). Portions of the North Central Group are also within view of elevated locations in the South Central Group, and there is intervisibility between the individual lease tracts within the South Central Group.

A preliminary viewshed analysis was conducted to identify which lands surrounding the South Central Group would have views of the lease tracts. Table 3.12-3 provides a list of SVRAs that have potential views of the lease tracts in the South Central Group. As shown, all the areas listed have views of both the South Central Group and the North Central Group. One additional area, the McKenna Peak WSA, has potential views of the South Central Group. The South Central Group is visible from approximately 720 acres (290 ha), or 3.5%, of this WSA.

The SVRAs within the 25-mi (40-km) viewshed of the North Central and South Central Groups are depicted in Figure 3.12-10.

TABLE 3.12-3 Sensitive Visual Resource Areas with Potential Visibility of the South Central Group

SRVA	Total Acreage	Acreage Visible		
		Within 5 mi	Within 15 mi	Within 25 mi
San Miguel ACEC[a]	24,204	0	0	21
Unaweep/Tabeguache Scenic and Historic Byway	41,348	0	1,053	3,789
Dolores River SRMA	65,278	3,239	8,394	8,937
San Miguel River SRMA	39,373	0	0	285
Tabeguache Wilderness	8,187	0	3,660	3,744
Dolores River Canyon WSA	29,169	3,196	6,485	6,485
McKenna Peak WSA	19,927	0	0	715
Sewemup WSA	19,627	0	0	1,580

[a] The San Miguel ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

3.12.2.3 South Group

The South Group of lease tracts lies to the west–southwest of Disappointment Valley, Big Gypsum Valley, and Dry Creek Basin near Slick Rock. Elevation within this part of the region varies between approximately 5,400 and 8,000 ft (1,650 and 2,400 m). The Dolores River crosses various lease tracts within this grouping. Portions of the Dolores River SRMA are within these lease tracts as well. Highway 141 also crosses through the South Group within Lease Tract 13 and along the borders of Lease Tracts 16 and 16A.

Off-site views from the southern lease tracts include the Dolores River and the Dolores River SRMA. Views to the north also include the South Central lease tracts; to the northwest, Mt. Peale ERNA is also visible from this group. Views to the east include the San Miguel ACEC, the San Miguel River SRMA, the Tabeguache Wilderness, and the Unaweep/Tabeguache Scenic and Historic Byway. In addition, views to the south include the Canyon of the Ancients National Monument; views to the southeast include McKenna Peak WSA and areas within the San Juan National Forest. There is intervisibility among the individual lease tracts within the group as well.

Similar to the analyses for other three groups, a preliminary viewshed analysis was conducted to determine which lands would have potential views of the lease tracts within the

South Group. Table 3.12-4 provides a list of these SVRAs. The South Group is visible from seven of the SVRAs. Of these seven SVRAs, three also have potential views of locations in another lease tract group—the Dolores River SRMA, the Dolores River Canyon WSA, and the McKenna Peak WSA. Figure 3.12-10 shows the location of these areas within the South Group lease tracts.

3.12.3 Visual Resource Management

The lease tracts are located within three BLM field offices: the Tres Rios; Grand Junction; and Uncompahgre Field Offices. In 2009, the Uncompahgre and Grand Junction Field Offices conducted visual resource inventories (VRIs). These inventories included an evaluation of lands contained within some of the lease tracts in the North, North Central, and South Central Groups (Otak, Inc. 2009).[24]

A BLM VRI evaluates BLM-administered lands in terms of their scenic quality, sensitivity level (in terms of public concern for preservation of scenic values in the evaluated lands), and distance from travel routes or key observation points (KOPs). On the basis of these three factors, BLM-administered lands are placed into one of four VRI classes, which represent the relative value of the visual resources. Class I and II are the most valued; Class III represents a moderate value; and Class IV represents the least value. Class I is reserved for specially designated areas, such as national wildernesses and other Congressionally and administratively designated areas for which decisions have been made to preserve a natural landscape. Class II is the highest rating for lands without special designation. More information about the VRI methodology is available in *Visual Resource Inventory, BLM Manual Handbook 8410-1* (BLM 1986a).

Within the Grand Junction Field Office, Lease Tracts 26 and 27 (i.e., the North Group) contain lands assigned a value of VRI Class IV (Scenic Quality Rating Unit 53 – Maverick Mesa), indicating low relative visual values.

Within the Uncompahgre Field Office, Lease Tracts 5, 5A, 6, 7,8, 9, 21, 22, 22A, 23, 24, and 25 (i.e., portions of the North Central and South Central Groups) contain lands assigned a value of VRI Class III, indicating moderate relative visual values. These lease tracts are located in areas defined by their exposed rock faces and mixtures of sage, piñon-juniper, and ponderosa vegetation, as well as by their steep elevation grade from the Paradox Valley and existing mining activities (Otak, Inc. 2009).

Lease Tract 7 (i.e., a lease tract within the South Central Group) primarily contains areas that are assigned to VRI Class III; however, a small portion in the northwest corner is located within an area assigned a value of VRI Class II. The areas contained by this lease tract are defined by an enclosed valley that is surrounded by prominent cliff faces, as well as the presence of the Dolores River and West Paradox Creek.

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[24] Data were not available for the Tres Rios Field Office as of April 2012.

TABLE 3.12-4 Sensitive Visual Resource Areas with Potential Views of the South Group

SRVA	Total Acreage	Acreage Visible		
		Within 5 mi	Within 15 mi[a]	Within 25 mi[a]
Canyons of the Ancients National Monument	181,629	0	0	1,111
Dolores River SRMA	65,278	7,098	8,283	8,391
Cahone Canyon WSA	9,154	0	0	794
Dolores River Canyon WSA	29,169	0	1,100	1,205
McKenna Peak WSA	19,927	0	246	5,421
Squaw/Papoose Canyon WSA	5,017	0	0	46
Trail of the Ancients	46,181	0	0	1,748

Lease Tracts 18, 19, 19A, and 20 (i.e., portions of the North Central Group) primarily include lands that are assigned a value of VRI Class III, although portions of the lease tracts contain areas indicated as VRI Class II. These lease tracts include areas defined by open, rolling landscapes with low hills and gentle drainages, as well as lands characterized by dominant vegetation and a long canyon. The VRI for the areas contained by these lease tracts suggests that former uranium mines and milling are present where reclamation has “significantly reduced visual evidence of human impact” (Otak, Inc. 2009).

A viewshed analysis was conducted for each of the four groups of lease tracts. The viewshed analyses included lands within 25 mi (40 km) of the lease tract borders.

Once VRI classes are established, the information obtained can be used, along with considerations for other land uses, to determine the visual resource management (VRM) objectives for the field office. The VRM system provides guidance for future decisions that allow for protection of visual resources (BLM 2010b). The VRM classes are prescribed within the resource management plans (RMPs) for the individual field offices and district offices.

The Grand Junction RMP includes the North Group lease tracts. The Grand Junction RMP is currently being updated, and the new RMP is anticipated for the spring of 2014 (BLM 2011d).

A majority of the lease tracts within the North Central and South Central Groups are located within lands managed by the Uncompahgre Field Office, while portions of Lease Tracts 9 and 17 are within lands managed by the Tres Rios Field Office. The South Group lease tracts also are located on lands managed by the Tres Rios Field Office.

The Uncompahgre and Tres Rios Field Offices are participating in ongoing revisions of their 1988 and 1985 land use plans, respectively (BLM 1985, 1988).

For the Uncompahgre Field Office, the RMP update process began in the winter of 2009–2010. The final RMP is anticipated for completion in late summer of 2014 (BLM 2010a). According to the RMP Planning Fact Sheet on VRM for this field office, VRM classes that were prescribed in the 1985 and 1989 RMPs "are now insufficient to be used as a management tool because of data inconsistencies and the outdated nature of the class designations" (BLM 2010b). As part of the RMP revision process, all land within the planning area was reevaluated and assigned to a VRI class (BLM 2010b).

The Tres Rios Field Office is involved in the revision of its RMP as part of the San Juan Public Lands RMP revision; that RMP covers the field offices of Dolores (now Tres Rios), Columbine, and Pagosa (BLM 2007b). The Draft EIS for that RMP was prepared in 2007, with a supplement prepared in August 2011. The VRM classes have not yet been established; four alternatives for these classes are presented in the Draft EIS (BLM 2007a).

More information about the BLM VRM program is available in *Visual Resource Management*, *BLM Manual Handbook 8400* (BLM 1984).

3.13 WASTE MANAGEMENT

Waste rock is generated as the ore is segregated from the host and/or cover rock during underground or surface open-pit mining. Mines in the area where the DOE ULP lease tracts are located are expected to generate 2 to 3.5 tons of waste rock per ton of ore (Energy Fuels Resources Corp. and Greg Lewicki and Associates 2008). Once the waste rock has been generated, it can be placed or piled up in a designated area on the mine site that is commonly referred to as the waste-rock area. The optimal locations for waste-rock areas are outside drainages and flat areas where water runoff can be controlled. This approach also facilitates subsequent reclamation activities. Typically, some percentage of the waste rock generated can be placed back into mine openings during reclamation activities. However, a large percentage does remain on the surface, and it is eventually graded to slope that is consistent with the surrounding area, covered with surface soil materials and seeded.

In addition to the waste rock, other waste material is generated while mining activities are conducted; such wastes include the following:

1. Waste (primarily solids) from the treatment of water containing uranium and other metals in concentrations exceeding those specified in the surface water discharge standards. The treated water is then discharged in a manner consistent with discharge permits, and the solid residue is accumulated, dried out, and packaged for off-site disposal (e.g., to a mill or licensed low-level radioactive waste facility).

2. Used oil, antifreeze, and solvents from maintenance activities. These wastes are given secondary containment while they are stored on site in accordance with Federal and state regulations. Then they are transported to a permitted facility for recycling or for disposal.

3. Other solid waste materials generated (including concrete from ore pads and foundations, drill steel, mine timbers, and vent bags). Materials exceeding standards are either placed back into mine workings or taken to a mill for uranium recovery. Inert materials, such as the foundation and concrete, are broken up and buried on the site. These wastes can also be taken to a recycling or a permitted landfill (e.g., landfills located near Nucla or Naturita, Colorado). Soils containing contaminants inherent in the ore are managed as radioactive material. Pollutants, contaminants, wastes, or contaminated media that are not inherent to site geology are be removed from the site and managed as waste under state or Federal regulations.

With regard to sanitary waste, small mines are typically equipped with portable facilities, and these are removed from the site and disposed of. Leach fields with septic tanks are typically found in larger mine operations so that gray water or sanitary wastewater can be released to a subsurface drain field. The solids from the septic tanks are pumped out or removed for off-site disposal (e.g., at a landfill).

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.

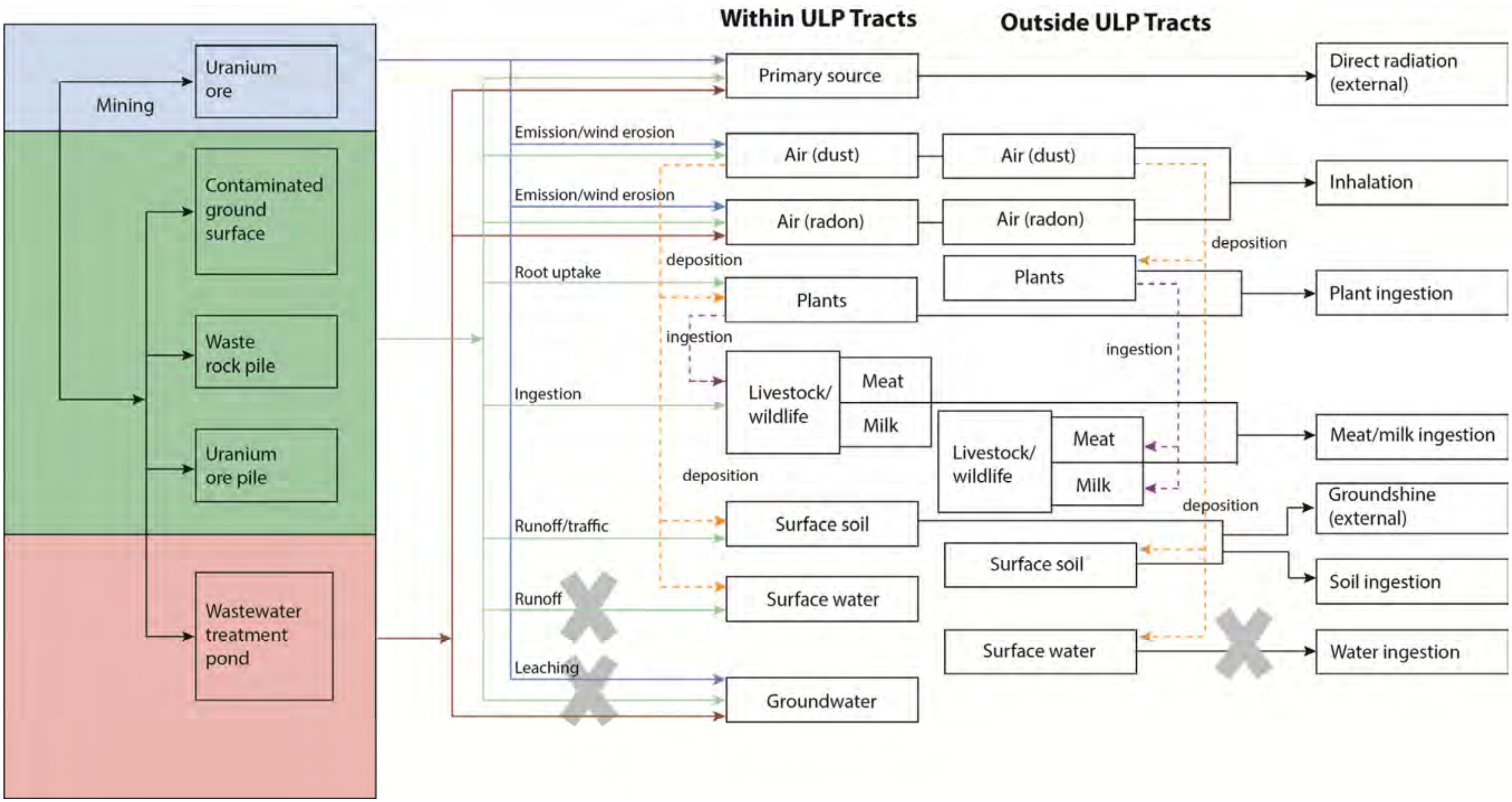


FIGURE 4.1-1 Conceptual Exposure Model for the Exploration, Mining Development and Operations, and Reclamation Phases at the ULP Lease Tracts

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.

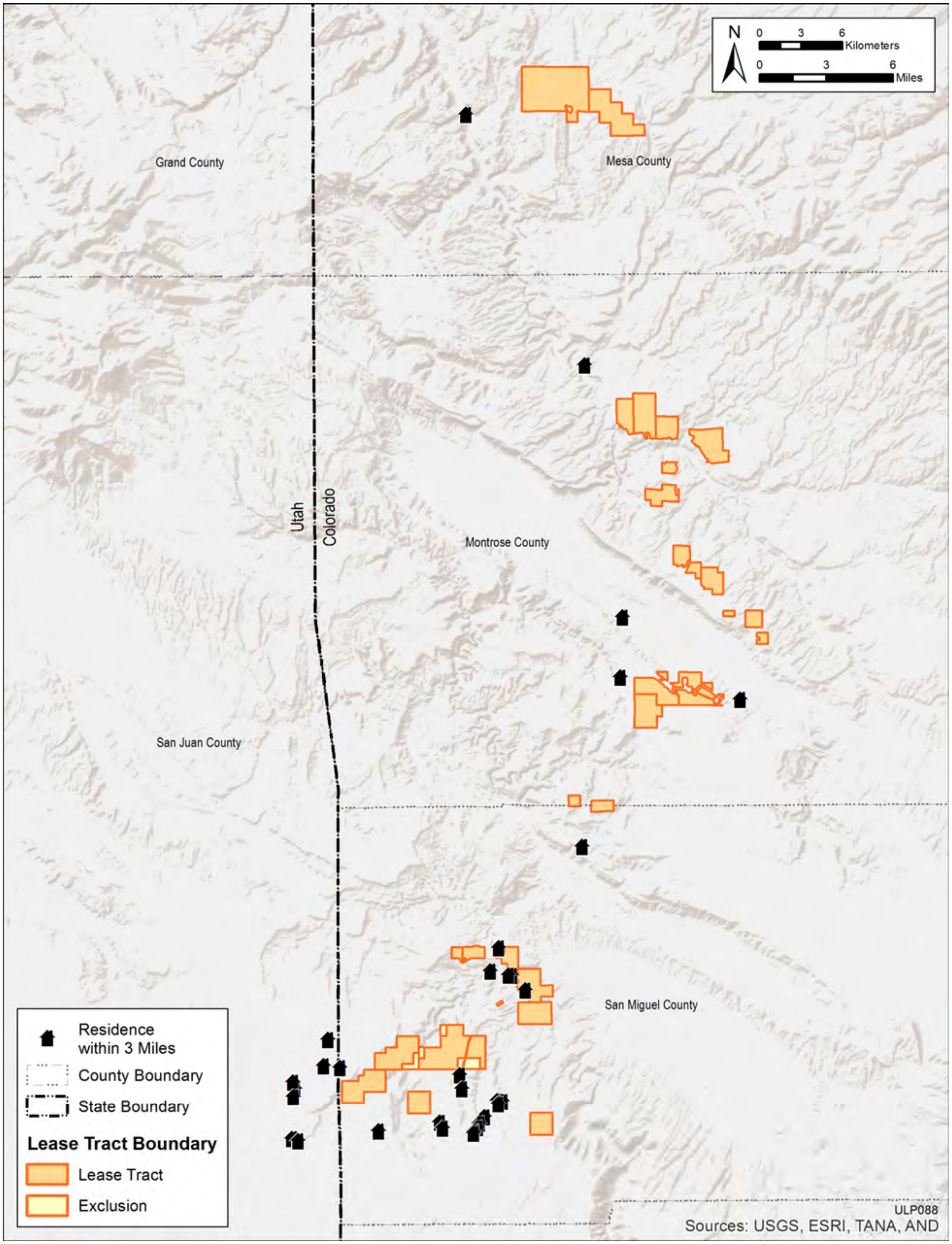
The above analyses consider potential exposures from working on a waste-rock pile, which is the largest aboveground radiation source in a lease tract during the reclamation phase. Therefore, the potential radiation dose associated with reclaiming other above ground mine working areas is expected to be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

	Dose (mrem/yr) Associated with the Four Waste-Rock Pile Sizes				LCF Risk (1/yr) Associated with the Four Waste-Rock Pile Sizes			
Distance (m)	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.

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TABLE 4.1-10 (Cont.)

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[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.

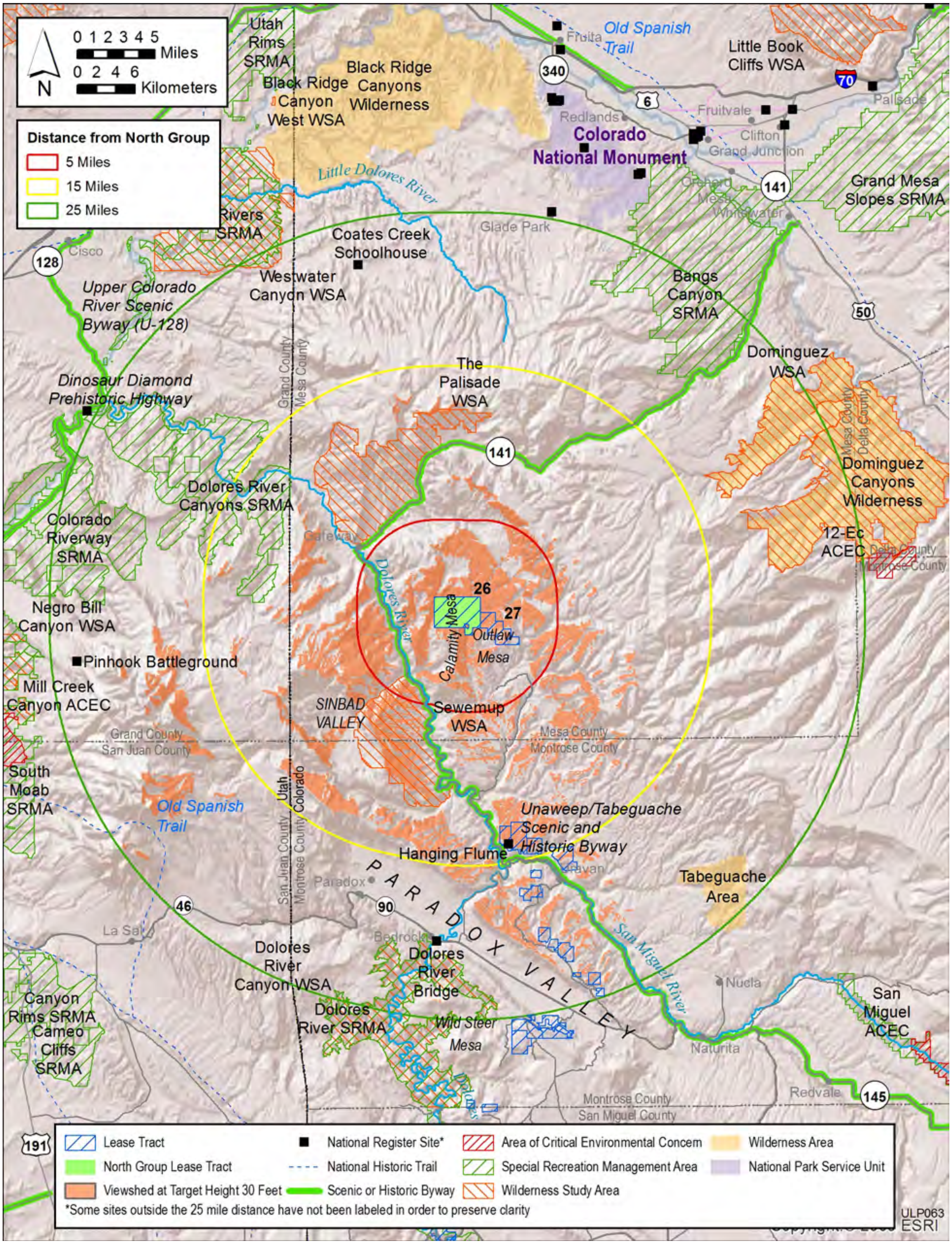


FIGURE 4.1-3 Viewshed Analysis for Portions of the North Lease Group under Alternative 1

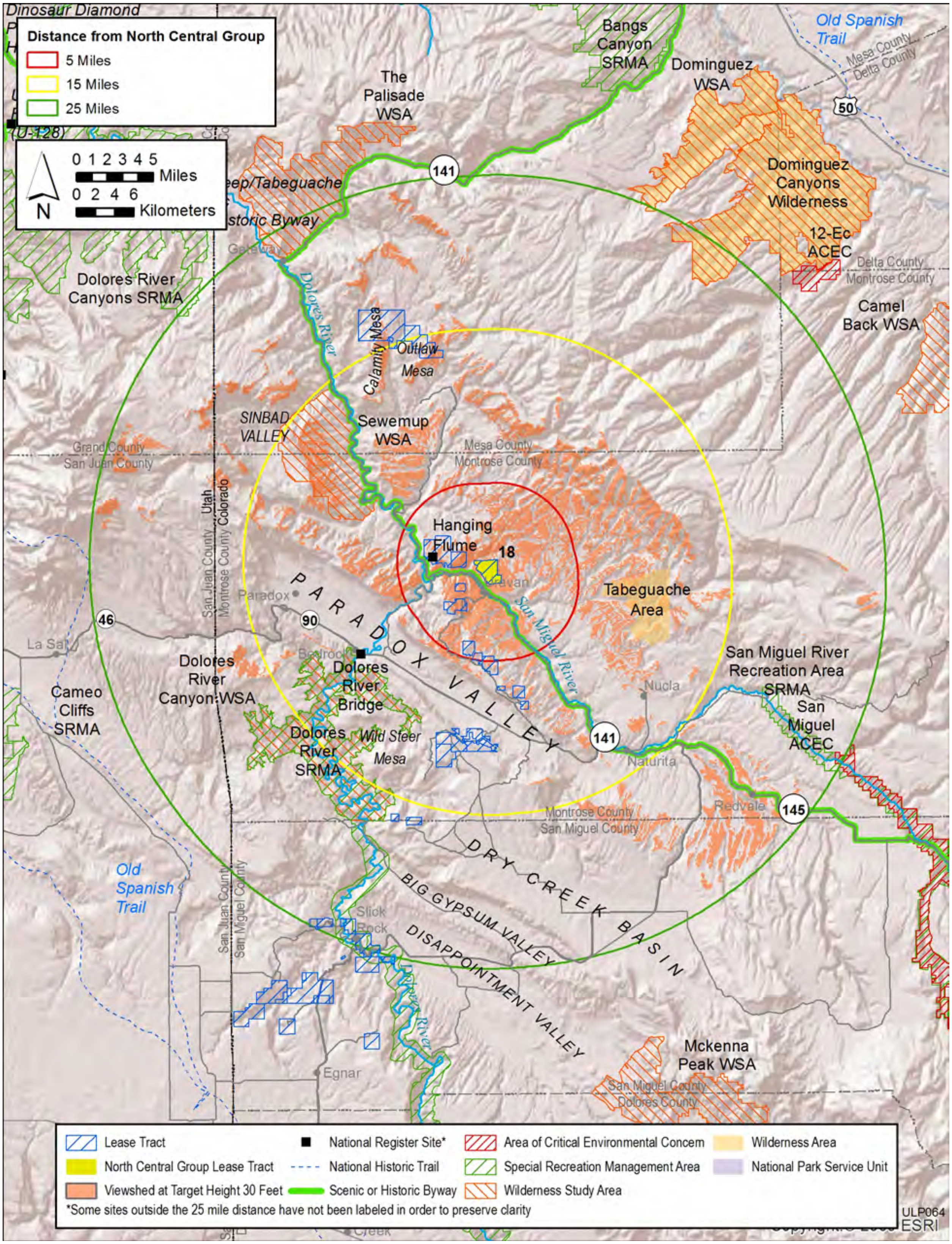


FIGURE 4.1-4 Viewshed Analysis for the North Central Lease Group under Alternative 1

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;

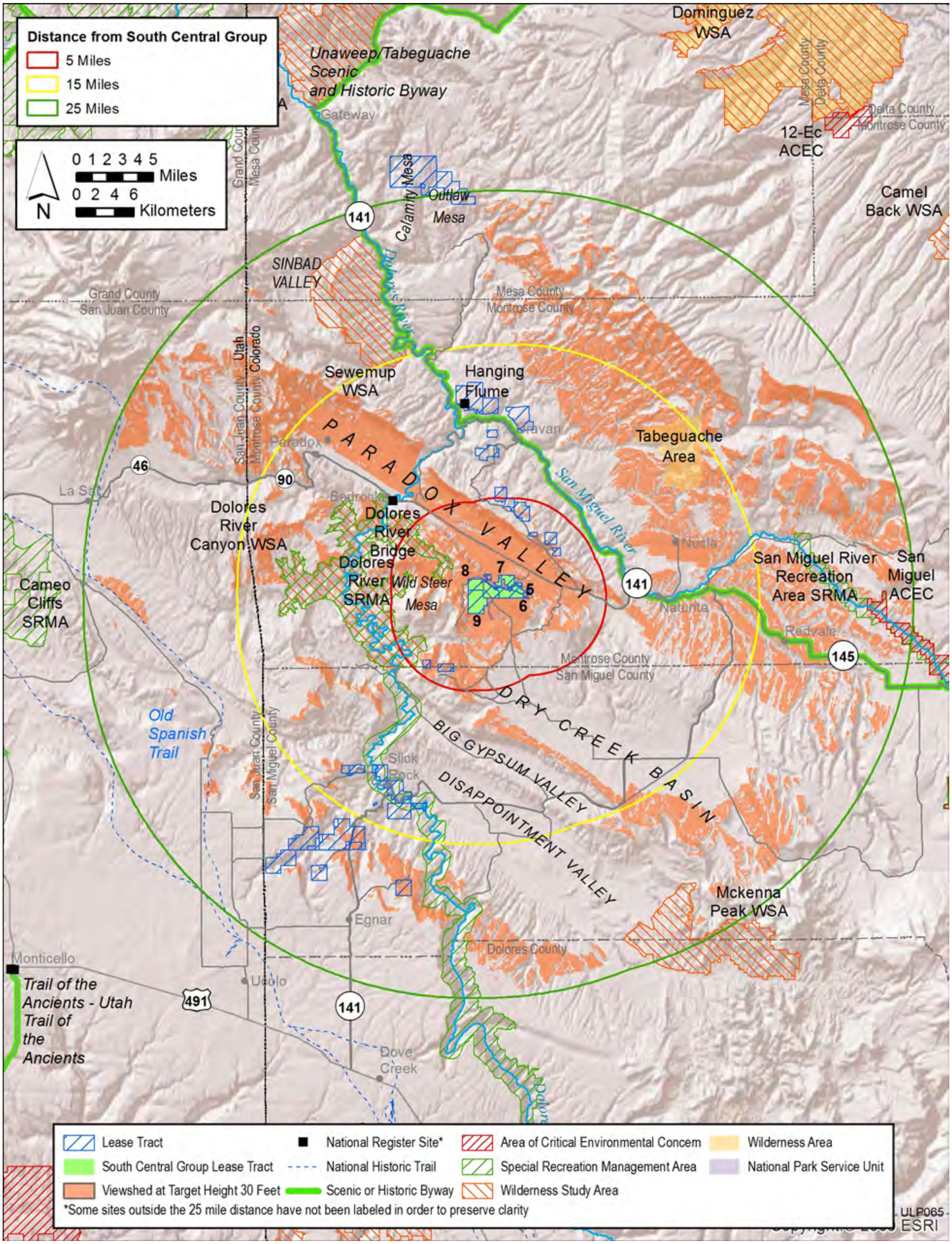


FIGURE 4.1-5 Viewshed Analysis for the South Central Lease Group under Alternative 1

- 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.

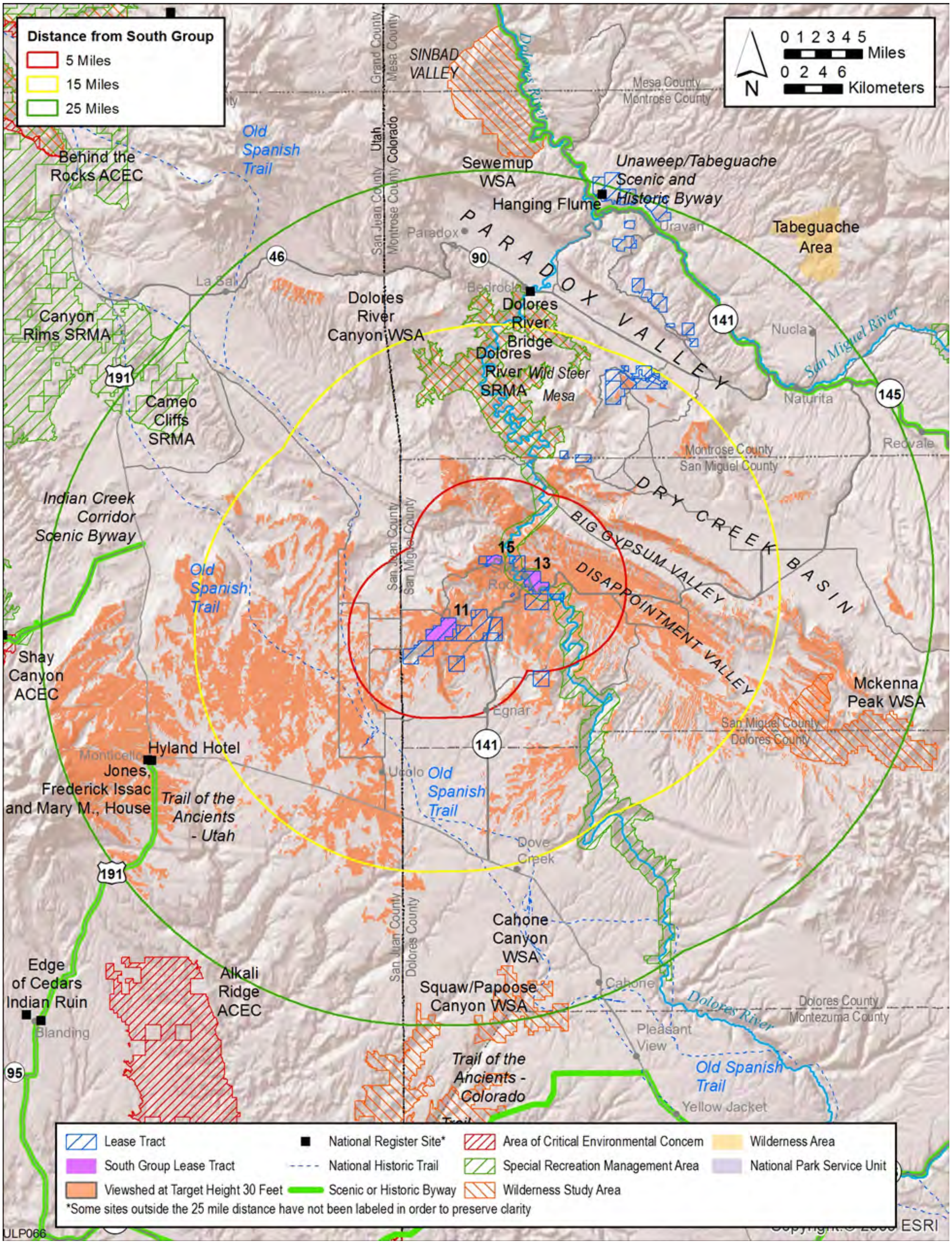
The South Central Group lease tracts would be potentially visible from less than 1% (3 acres or 1.2 ha) of the San Miguel ACEC. Under this alternative, activities would be expected to cause minimal to zero levels of contrast for views from this SVRA due to the limited amount of acreage that would have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

1 

2 **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

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.

> 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.

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%)
	$7{,}311.8 \times 10^6$ [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.

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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."

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.

> 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).

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]: Negligible	Minor	Moderate	Large	Ability to Mitigate Impacts[c]
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]: Negligible	Minor	Moderate	Large	Ability to Mitigate Impacts[c]
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] Negligible	Minor	Moderate	Large	Ability to Mitigate Impacts[c]
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.)

Impacting Factor	Project Phase	Consequence	Expected Relative Impact[a] for Different Wildlife[b] — 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]				Ability to Mitigate Impacts[c]
			Negligible	Minor	Moderate	Large	
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

1 **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.

2

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.)

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[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.

1 **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.

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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

Lease Tract	Distance (km) Piñon Ridge	Distance (km) 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				Accidents per Round Trip	
		Public Dose (person-rem)	Risk (LCF)	Worker Dose (person-rem)	Risk (LCF)	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.

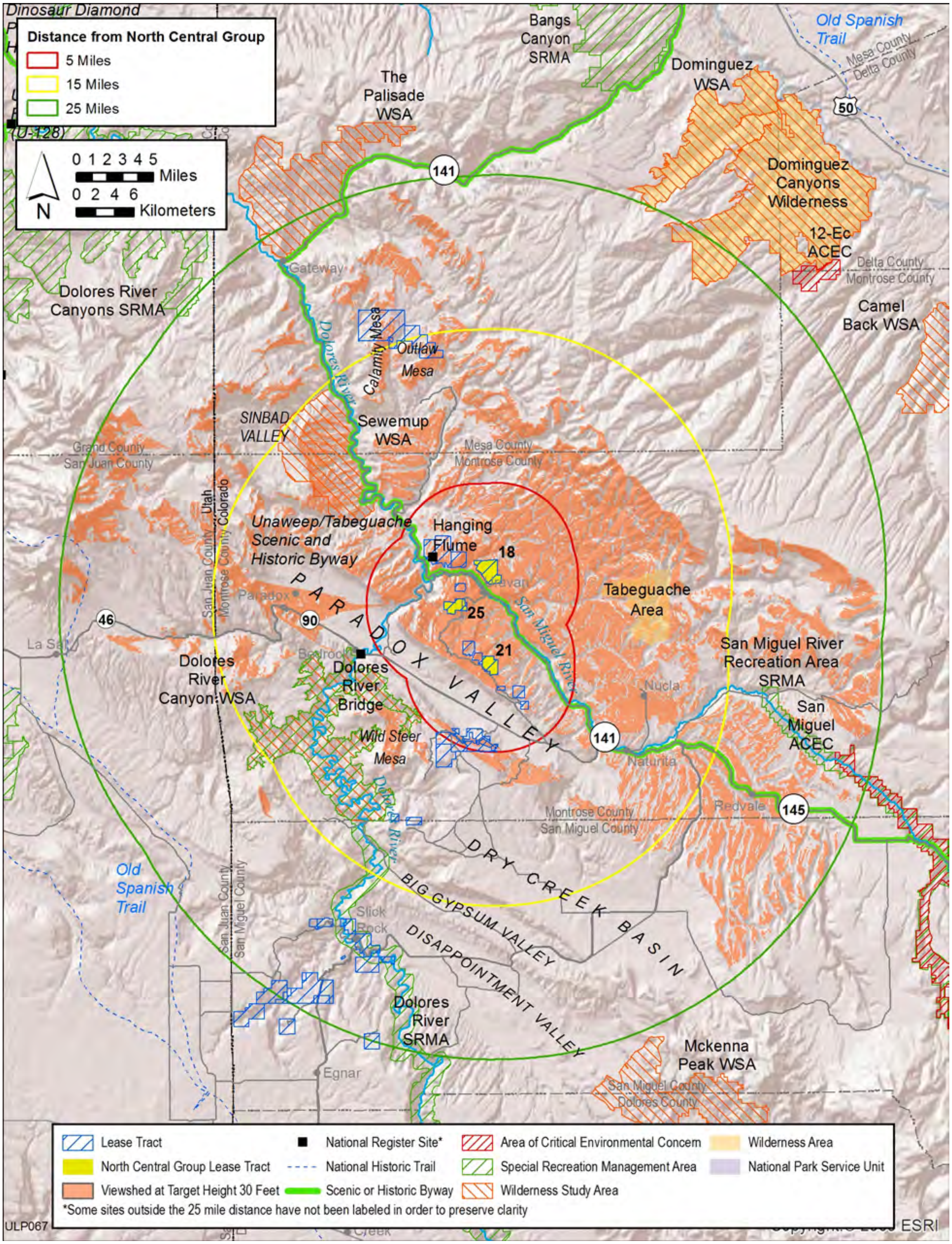

FIGURE 4.3-1 Viewshed Analysis for the North Central Lease Group under Alternative 3

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;

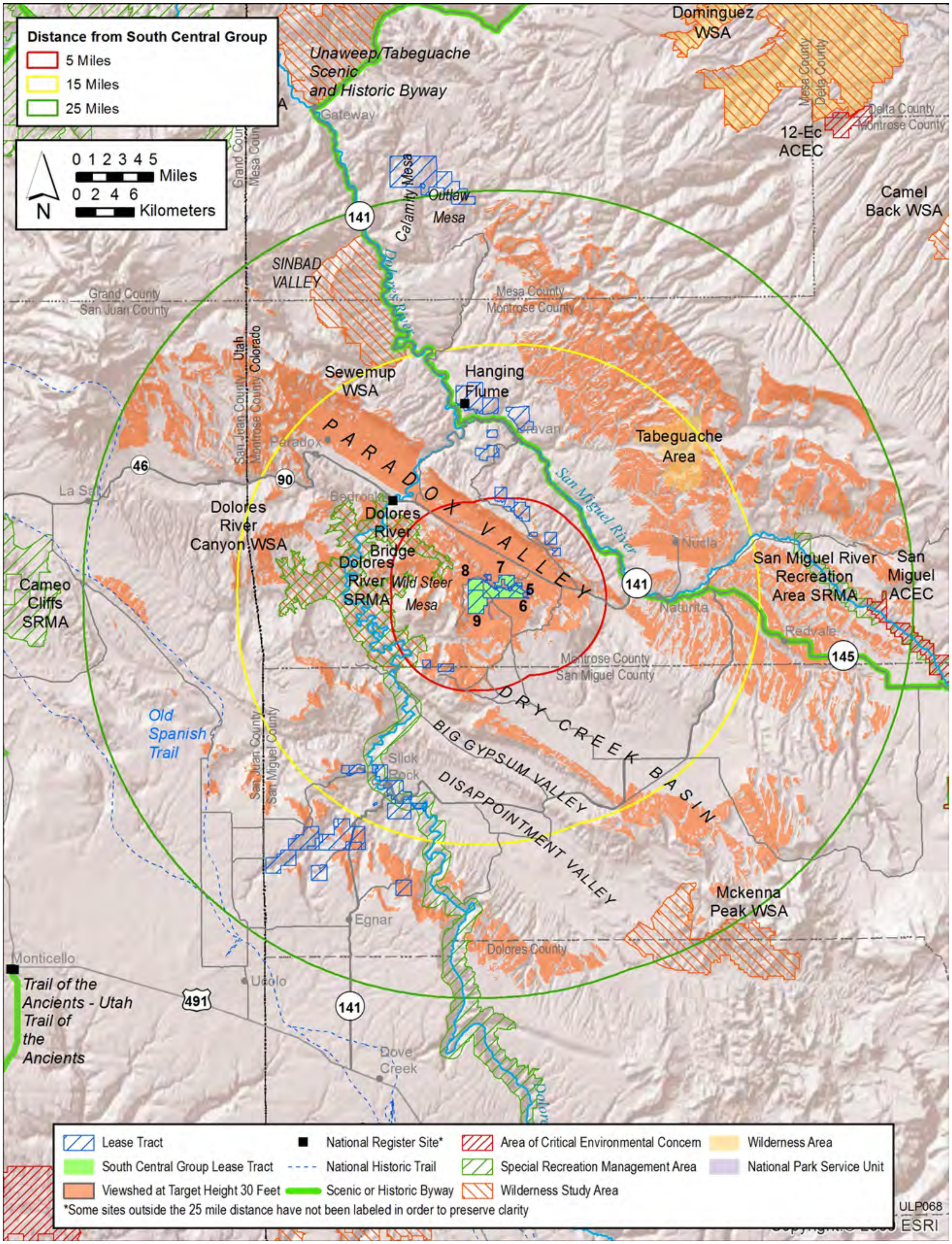

FIGURE 4.3-2 Viewshed Analysis for the South Central Lease Group under Alternative 3

- Dolores River Canyon WSA;
- Sewemup WSA;
- Dolores River SRMA;
- McKenna Peak WSA;

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- 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:

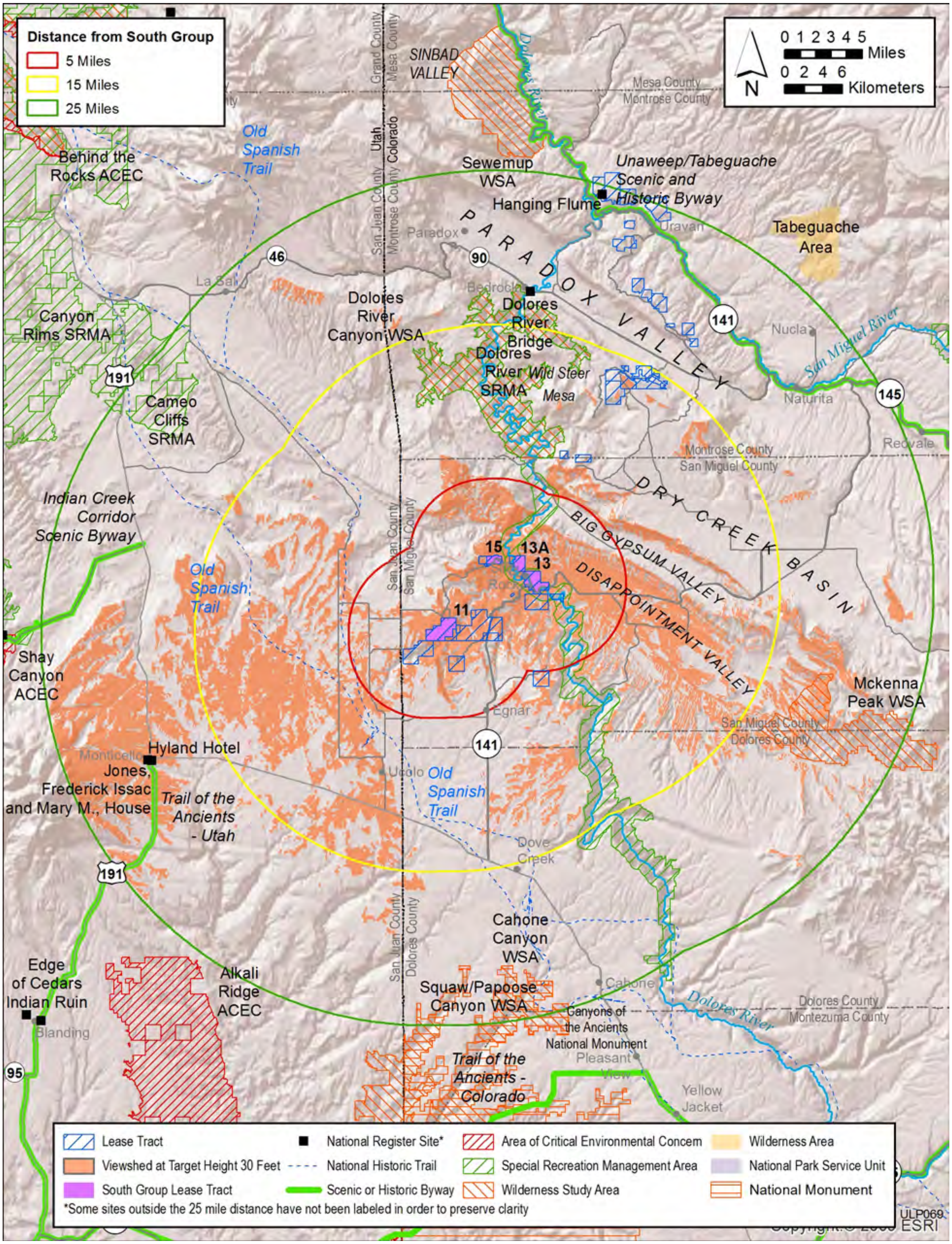


FIGURE 4.3-3 Viewshed Analysis for the South Lease Group under Alternative 3

- 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%)
	$7{,}311.82\times10^6$ [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

[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.

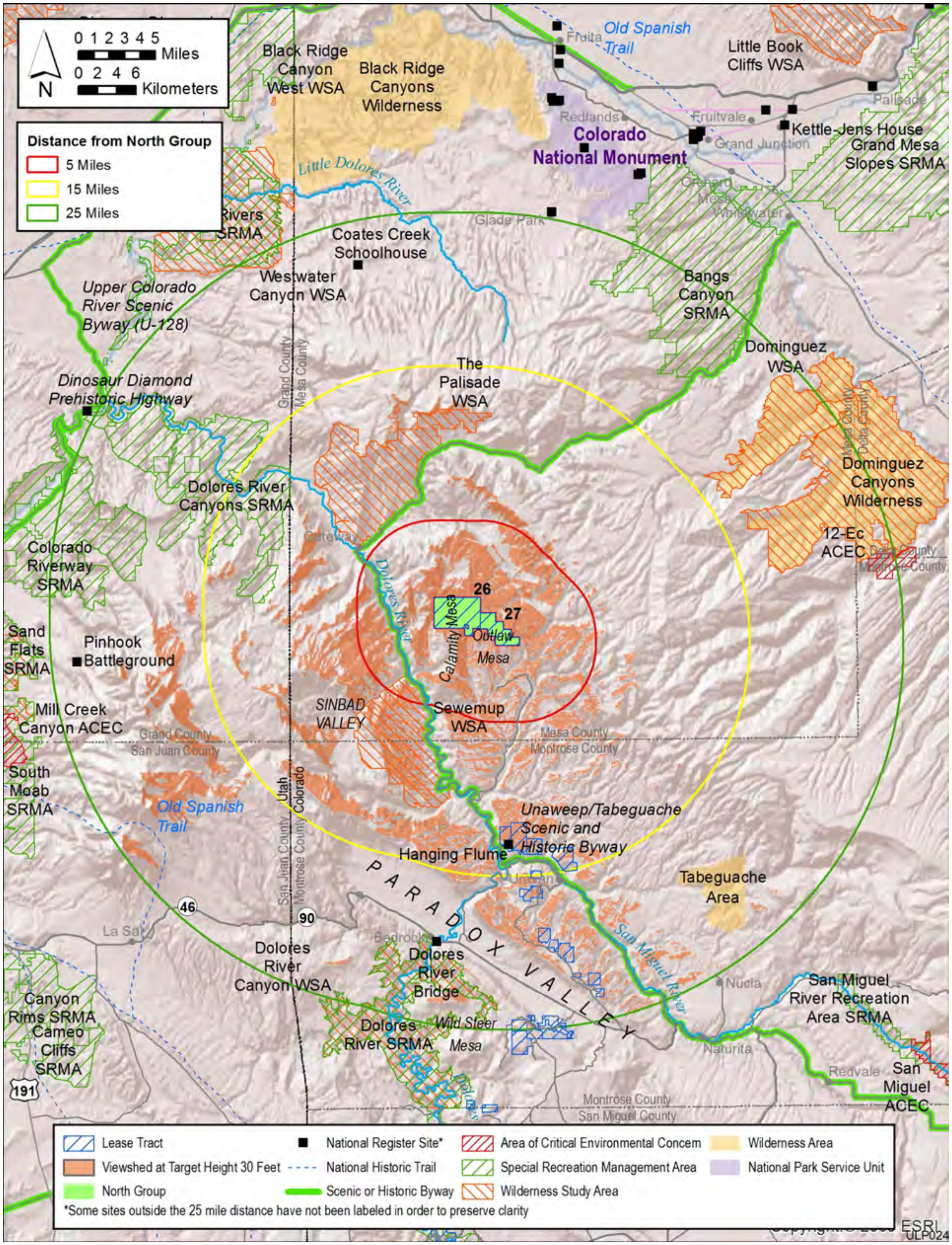


FIGURE 4.4-1 Viewshed Analysis for the North Lease Group under Alternative 4

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;

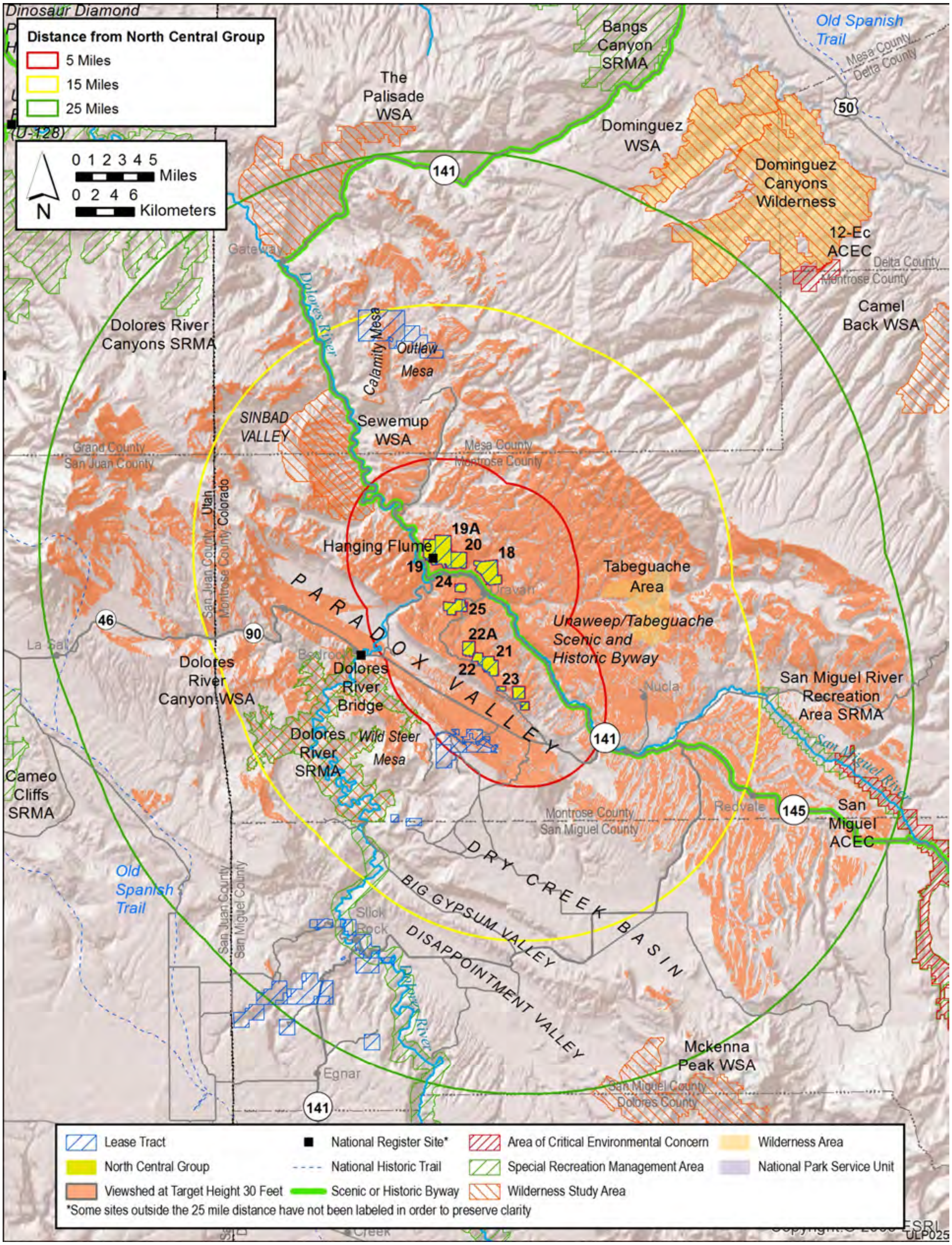


FIGURE 4.4-2 Viewshed Analysis for the North Central Lease Group under Alternative 4

- 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.

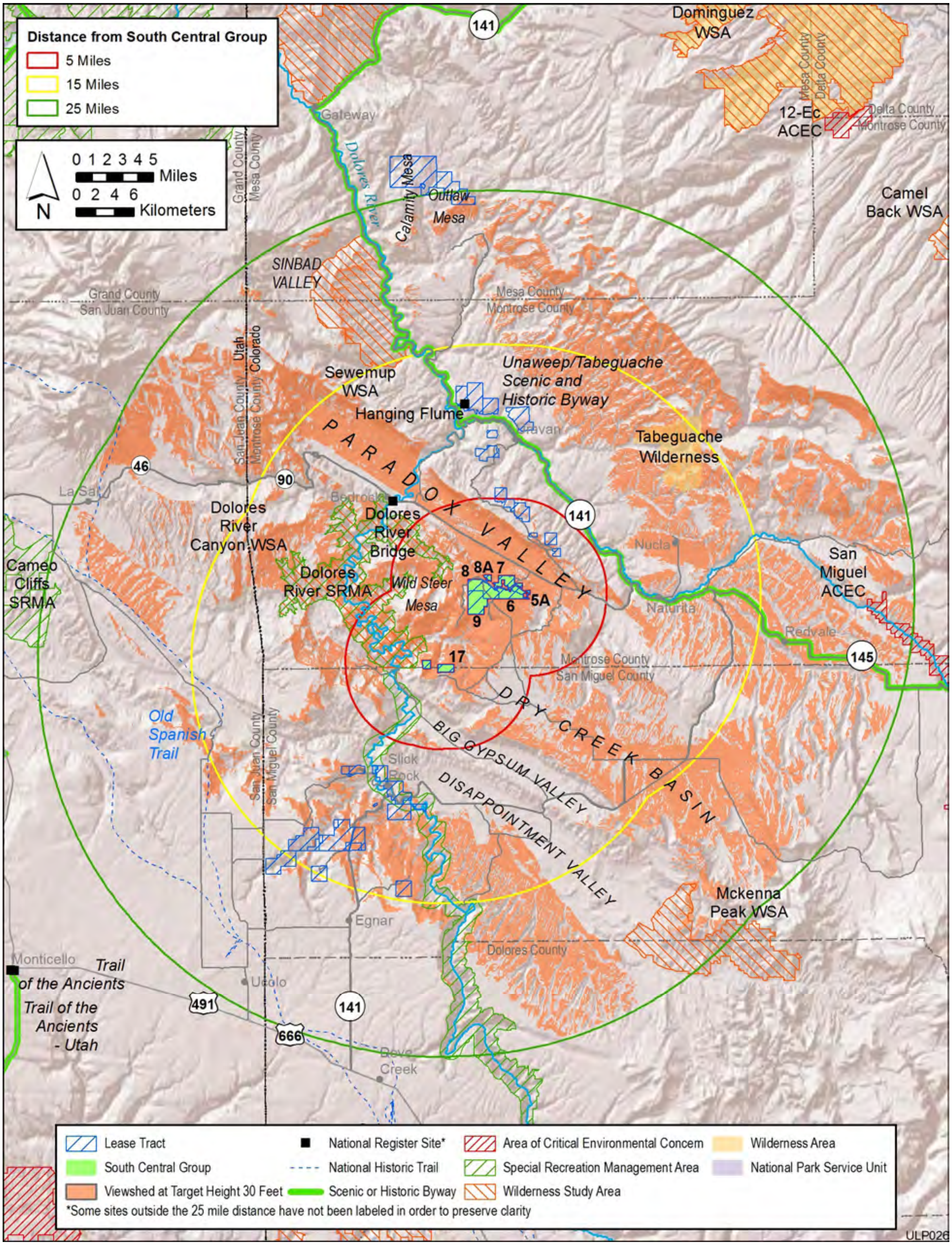
The North Central Group lease tracts would be visible from less than 1% (51 acres or 21 ha) of the San Miguel ACEC. Portions of the ACEC with views of the lease tracts are located between 15 and 25 mi (24 and 40 km) of the North Central Group north of Norwood, Colorado, and Route 145. Views of the lease 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;

1 

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.

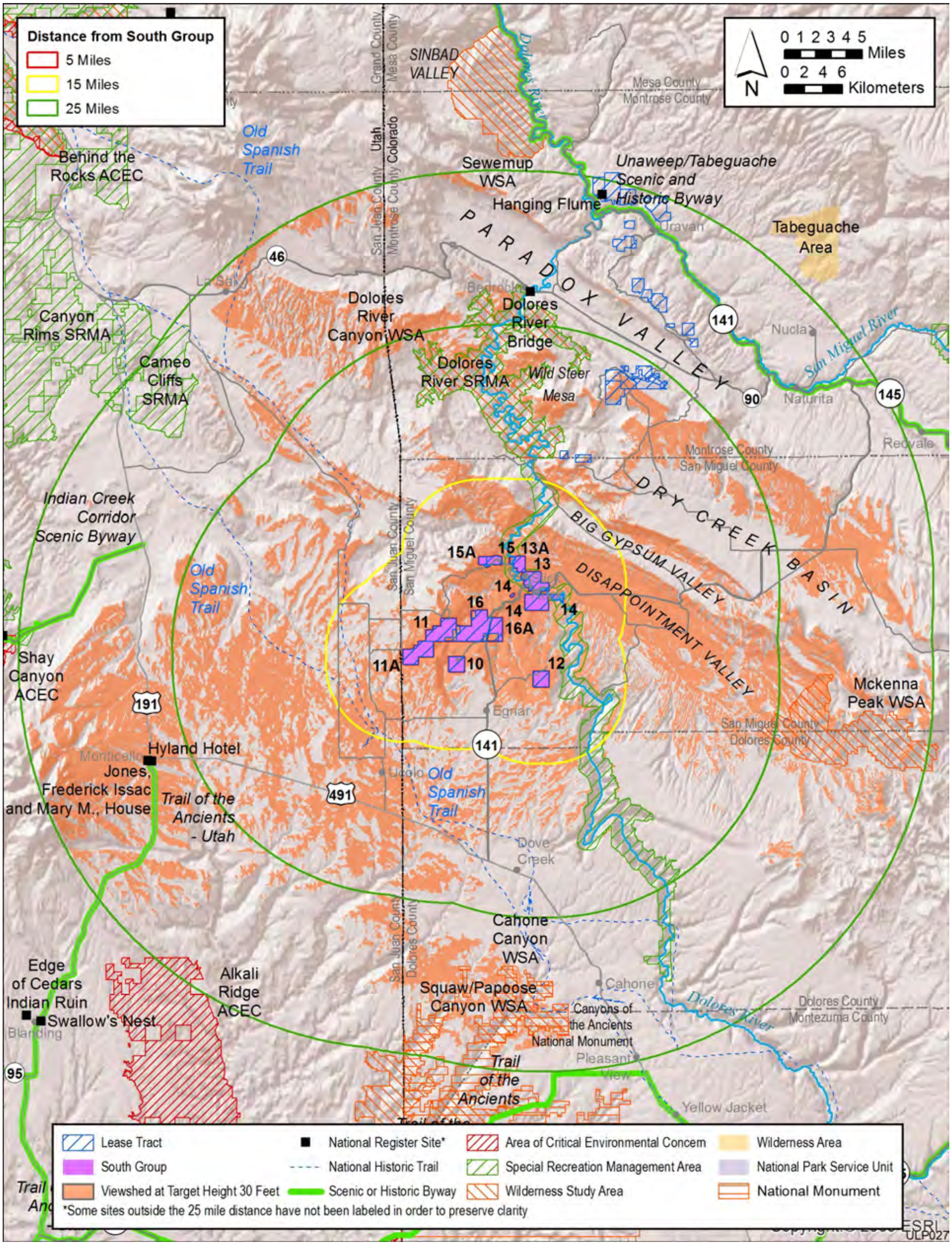


FIGURE 4.4-4 Viewshed Analysis for the South Lease Group under Alternative 4

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

> 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.

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.

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.)

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[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.

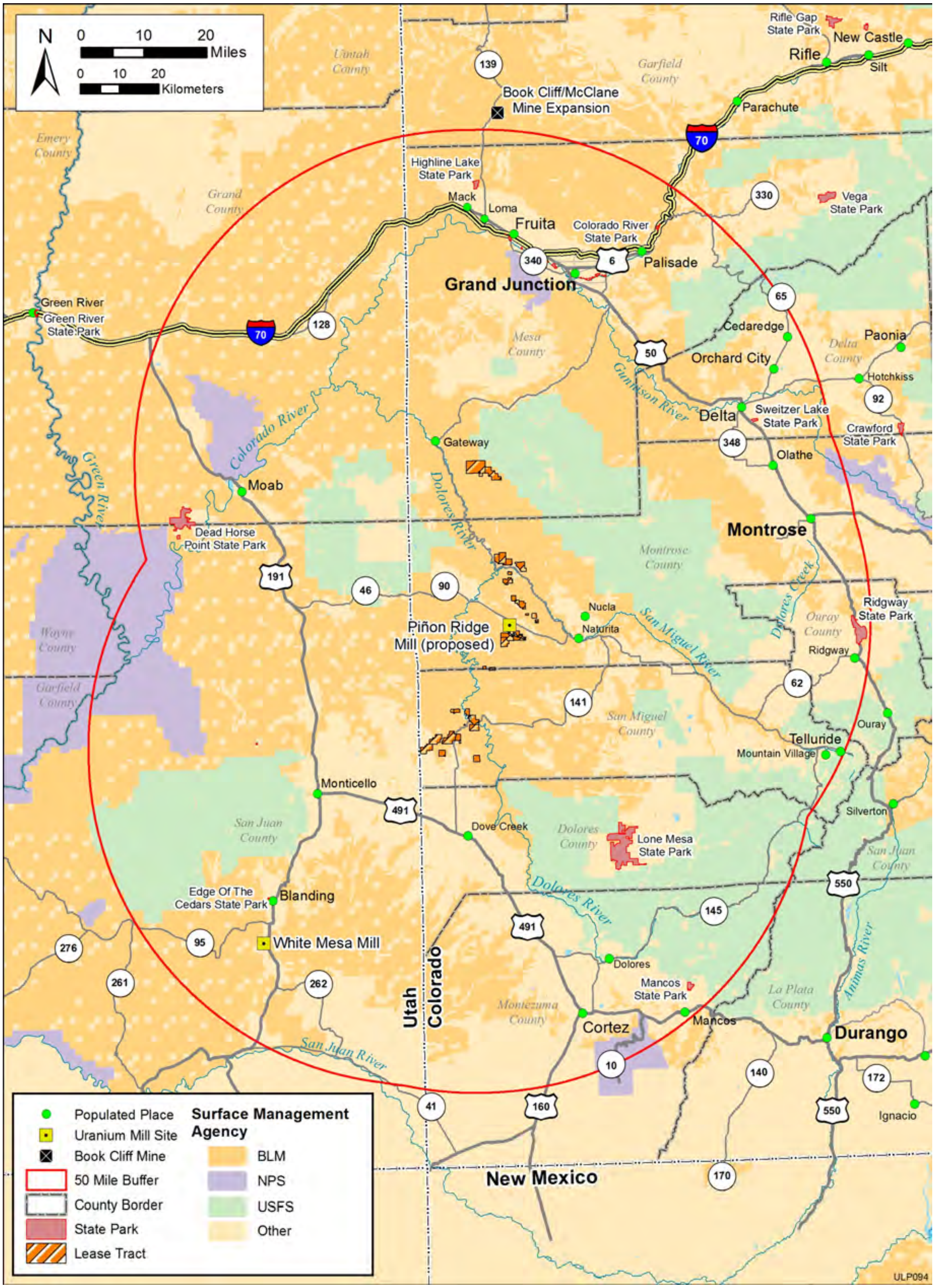

FIGURE 4.7-1 Region of Influence for Cumulative Effects

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.

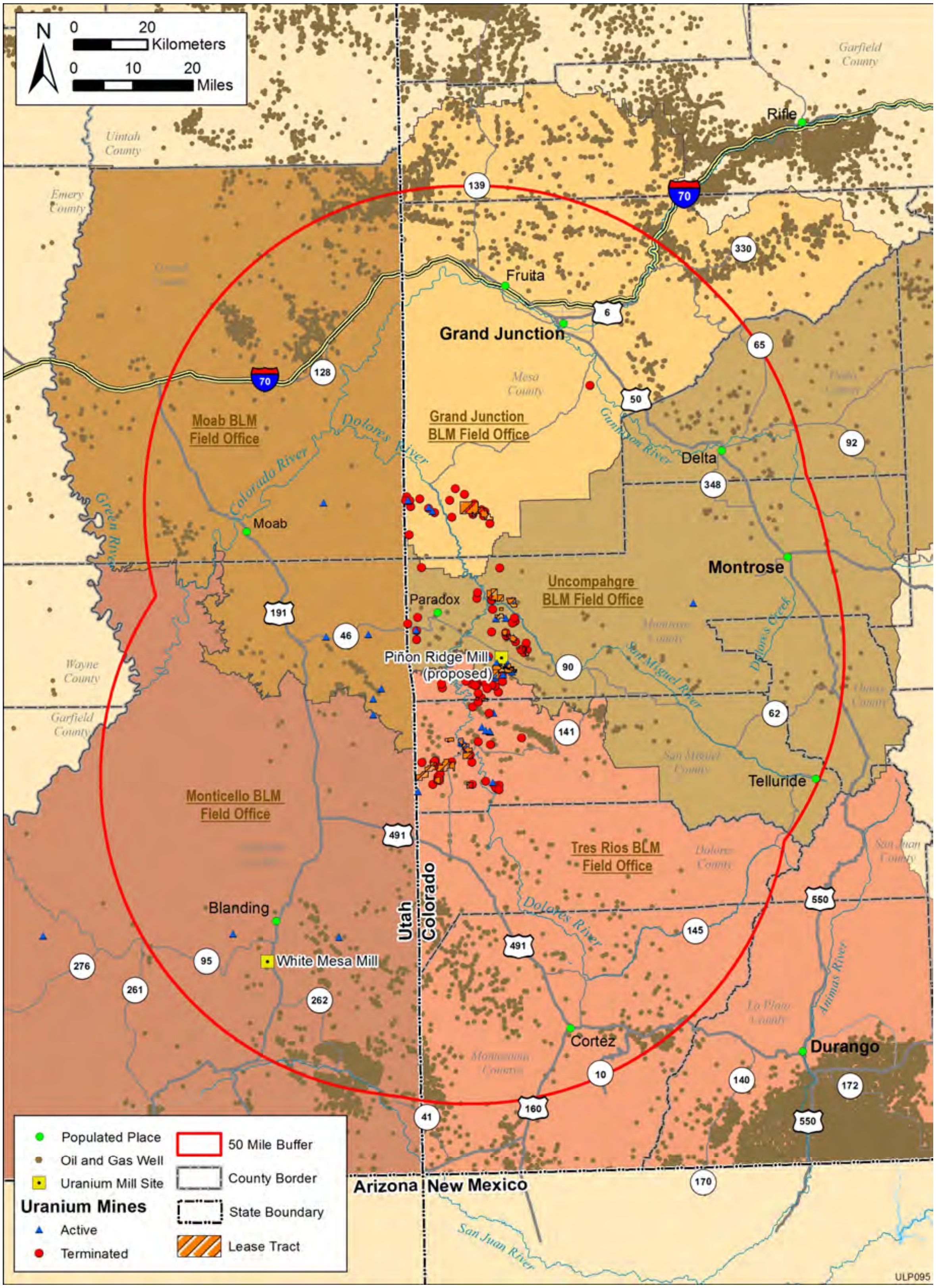

FIGURE 4.7-2 Uranium Mining and Oil and Gas Wells within the Region of Influence for Cumulative Effects

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

1 **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

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

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.)

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]
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.)

	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]
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					White Mesa Mill (Present)	Piñon Ridge Mill (Planned)	Uranium Mines (Present)[a]
	Alternative 1	Alternative 2	Alternative 3	Alternative 4 (Preferred Alternative)	Alternative 5			
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	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.)			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	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.)			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]
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 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.)

	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]
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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