BLM

DES 12-01

# Draft Programmatic Environmental Impact Statement and Possible Land Use Plan Amendments for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the Bureau of Land Management in Colorado, Utah, and Wyoming

## January 2012

*Volume 3: Chapter 6*

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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U.S. Department of the Interior
Bureau of Land Management

**MISSION STATEMENT**

It is the mission of the Bureau of Land Management (BLM), an agency of the Department of the Interior, to manage BLM-administered lands and resources in a manner that best serves the needs of the American people. Management is based upon the principles of multiple use and sustained yield taking into account the long-term needs of future generations for renewable and nonrenewable resources.

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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.

## GENERAL ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACEC | Area of Critical Environmental Concern |
| AGFD | Arizona Game and Fish Department |
| AGR | aboveground retort |
| AIRFA | American Indian Religious Freedom Act |
| AMSO | American Shale Oil LLC |
| ANFO | ammonium nitrate and fuel oil |
| API | American Petroleum Institute |
| APLIC | Avian Power Line Interaction Committee |
| APP | Avian Protection Plan |
| AQRV | air quality related value |
| ARCO | Atlantic Richfield Company |
| ATP | Alberta Taciuk Process |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AWEA | American Wind Energy Association |
| | |
| BA | biological assessment |
| BCD | barrels per calendar day |
| BLM | Bureau of Land Management |
| BMP | best management practice |
| BO | biological opinion |
| BOR | U.S. Bureau of Reclamation |
| BPA | Bonneville Power Administration |
| BSD | barrels per stream day |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| | |
| CAA | Clean Air Act |
| CAPP | Canadian Association of Petroleum Producers |
| CARB | California Air Resources Board |
| CASTNET | Clean Air Status and Trends NETwork |
| CBOSC | Cathedral Bluffs Oil Shale Company |
| CCW | coal combustion waste |
| CDC | Centers for Disease Control and Prevention |
| CDOT | Colorado Department of Transportation |
| CDOW | Colorado Division of Wildlife |
| CDPHE | Colorado Department of Public Health and Environment |
| CDW | Colorado Division of Wildlife |

| | |
|---|---|
| CEQ | Council on Environmental Quality |
| CFR | *Code of Federal Regulations* |
| CHL | combined hydrocarbon lease |
| CIRA | Cooperative Institute for Research in the Atmosphere |
| COGCC | Colorado Oil and Gas Conservation Commission |
| CPC | Center for Plant Conservation |
| CRBSCF | Colorado River Basin Salinity Control Forum |
| CRSCP | Colorado River Salinity Control Program |
| CWRQIP | Colorado River Water Quality Improvement Program |
| CSS | cyclic steam stimulation |
| CSU | Controlled Surface Use |
| CWA | Clean Water Act |
| CWCB | Colorado Water Conservation Board |
| | |
| DoD | U.S. Department of Defense |
| DOE | U.S. Department of Energy |
| DOI | U.S. Department of the Interior |
| DOL | U.S. Department of Labor |
| DOT | U.S. Department of Transportation |
| DRMS | Division of Reclamation Mining & Safety (Colorado) |
| | |
| EA | environmental assessment |
| EGL | EGL Resources, Inc. |
| EIA | Energy Information Administration |
| E-ICP | bare electrode in situ conversion process |
| EIS | environmental impact statement |
| EMF | electric and magnetic field |
| E.O. | Executive Order |
| EOR | enhanced oil recovery |
| EPA | U.S. Environmental Protection Agency |
| EPRI | Electric Power Research Institute |
| EQIP | Environmental Quality Incentives Program |
| ESA | Endangered Species Act of 1973 |
| EUB | Alberta Energy and Utilities Board |
| | |
| FAA | Federal Aviation Administration |
| FLPMA | Federal Land Policy and Management Act of 1976 |
| FONSI | Finding of No Significant Impact |
| FR | *Federal Register* |
| FTE | full-time equivalent |
| FY | fiscal year |
| | |
| GCR | gas combustion retort |
| GHG | greenhouse gas |
| GIS | geographic information system |
| GPO | Government Printing Office |

| | |
|---|---|
| GSENM | Grand Staircase–Escalante National Monument |
| HAP | hazardous air pollutant |
| HAZCOM | hazard communication |
| HFC | hydrofluorcarbon |
| HMA | Herd Management Area |
| HMMH | Harris Miller Miller & Hanson, Inc. |
| I-70 | Interstate 70 |
| IARC | International Agency for Research on Cancer |
| ICP | in situ conversion process |
| IEC | International Electrochemical Commission |
| IPPC | Intergovernmental Panel on Climate Change |
| ISA | Instant Study Area |
| ISWS | Illinois State Water Survey |
| IUCNNR | International Union for Conservation of Nature and Natural Resources |
| JMH CAP | Jack Morrow Hills Coordinated Activity Plan |
| KOP | key observation point |
| KSLA | Known Sodium Leasing Area |
| LAU | Lynx Analysis Unit |
| LETC | Laramie Energy Technology Center |
| LPG | liquefied petroleum gas |
| $L_{dn}$ | day-night average sound level |
| $L_{eq}$ | equivalent sound pressure level |
| LWC | lands having wilderness characteristics |
| M&I | municipal and industrial |
| MFP | Management Framework Plan |
| MIS | modified in situ recovery |
| MLA | Mineral Leasing Act |
| MMC | Multi Minerals Corporation |
| MMTA | Mechanically Mineable Trona Area |
| MOU | Memorandum of Understanding |
| MPCA | Minnesota Pollution Control Agency |
| MSDS | Material Safety Data Sheet |
| MSHA | Mine Safety and Health Administration |
| MSL | mean sea level |
| MTR | military training route |
| NAAQS | National Ambient Air Quality Standards |
| NADP | National Atmospheric Deposition Program |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NCA | National Conservation Area |

| | |
|---|---|
| NCDC | National Climate Data Center |
| NEC | National Electric Code |
| NEPA | National Environmental Policy Act of 1969 |
| NHPA | National Historic Preservation Act of 1966 |
| NFS | National Forest Service |
| NLCS | National Landscape Conservation System |
| NMFS | National Marine Fisheries Service |
| NNHP | Nevada Natural Heritage Program |
| NOI | Notice of Intent |
| NORM | naturally occurring radioactive materials |
| NOSR | Naval Oil Shale Reserves |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | National Park Service |
| NRA | National Recreation Area |
| NRHP | *National Register of Historic Places* |
| NSC | National Safety Council |
| NSO | No Surface Occupancy |
| NWCC | National Wind Coordinating Committee |
| | |
| OHV | off-highway vehicle |
| OOSI | Occidental Oil Shale, Inc. |
| OPEC | Organization of Petroleum Exporting Countries |
| OSEC | Oil Shale Exploration Company |
| OSEW/SPP | Oil Sands Expert Workgroup/Security and Prosperity Partnership |
| OSHA | Occupational Safety and Health Administration |
| OSTS | oil shale and tar sands |
| OTA | Office of Technology Assessment |
| | |
| PA | Programmatic Agreement |
| PADD | Petroleum Administration for Defense District |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PEIS | programmatic environmental impact statement |
| PFC | perfluorcarbons |
| PFYC | Potential Fossil Yield Classification |
| P.L. | Public Law |
| PM | particulate matter |
| $PM_{2.5}$ | particulate matter with an aerodynamic diameter of 2.5 μm or less |
| $PM_{10}$ | particulate matter with an aerodynamic diameter of 10 μm or less |
| PPE | personal protective equipment |
| PRLA | preference right lease area |
| PSD | Prevention of Significant Deterioration |
| | |
| R&D | research and development |
| R&I | relevance and importance |
| RBOSC | Rio Blanco Oil Shale Company |

| | |
|---|---|
| RCRA | Resource Conservation and Recovery Act of 1976 |
| RD&D | research, development, and demonstration |
| RF | radio frequency |
| RFDS | reasonably foreseeable development scenario |
| RMP | Resource Management Plan |
| ROD | Record of Decision |
| ROI | region of influence |
| ROS | Recreation Opportunity Spectrum |
| ROW | right-of-way |
| | |
| SAGD | steam-assisted gravity drainage |
| SAMHSA | Substance Abuse and Mental Health Services Administration |
| SDWA | Safe Drinking Water Act of 1974 |
| SFC | Synthetic Fuels Corporation |
| SHPO | State Historic Preservation Office(r) |
| SIP | State Implementation Plan |
| SMA | Special Management Area |
| SMP | suggested management practice |
| SPR | Strategic Petroleum Reserve |
| SRMA | Special Recreation Management Area |
| SSI | self-supplied industry |
| STSA | Special Tar Sand Area |
| SWCA | SWCA, Inc., Environmental Consultants |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWWRC | States West Water Resources Corporation |
| | |
| TDS | total dissolved solids |
| THAI | toe to head air injection |
| TIS | true in situ recovery |
| TL | timing limitation |
| TMDL | Total Maximum Daily Load |
| TOSCO | The Oil Shale Corporation |
| TSCA | Toxic Substances Control Act of 1976 |
| TSDF | treatment, storage, and disposal facility |
| | |
| UDEQ | Utah Department of Environmental Quality |
| UDNR | Utah Department of Natural Resources |
| UDWR | Utah Division of Wildlife Resources |
| UIC | underground injection control |
| 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 |
| USGCRP | U.S. Global Change Research Program |
| USGS | U.S. Geological Survey |

| | |
|---|---|
| VCRS | Visual Contrast Rating System |
| VOC | volatile organic compound |
| VRI | visual resource inventory |
| VRM | Visual Resource Management |
| WDEQ | Wyoming Department of Environmental Quality |
| WGFD | Wyoming Game and Fish Department |
| WRAP | Western Regional Air Partnership |
| WRCC | Western Regional Climate Center |
| WRI | World Resources Institute |
| WRSOC | White River Shale Oil Corporation |
| WSA | Wilderness Study Area |
| WSR | Wild and Scenic River |
| WTGS | wind turbine generator system |
| WYCRO | Wyoming Cultural Records Office |

**CHEMICALS**

| | | | |
|---|---|---|---|
| $CH_4$ | methane | $N_2O$ | nitrous oxides |
| CO | carbon monoxide | $NO_x$ | nitrogen oxides |
| $CO_2$ | carbon dioxide | $O_3$ | ozone |
| $CO_{2e}$ | carbon dioxide equivalent | | |
| | | Pb | lead |
| $H_2S$ | hydrogen sulfide | | |
| | | $SF_6$ | sulfur hexafluoride |
| $NH_3$ | ammonia | $SO_2$ | sulfur dioxide |
| $NO_2$ | nitrogen dioxide | $SO_x$ | sulfur oxides |

**UNITS OF MEASURE**

| | | | |
|---|---|---|---|
| ac-ft | acre foot (feet) | $ft^3$ | cubic foot (feet) |
| bbl | barrel(s) | g | gram(s) |
| Btu | British thermal unit(s) | gal | gallon(s) |
| | | GJ | gigajoule(s) |
| °C | degree(s) Celsius | gpd | gallon(s) per day |
| cfs | cubic foot (feet) per second | gpm | gallon(s) per minute |
| cm | centimeter(s) | GW | gigawatt(s) |
| | | GWh | gigawatt hour(s) |
| dB | decibel(s) | | |
| dBA | A-weighted decibel(s) | h | hour(s) |
| | | ha | hectare(s) |
| °F | degree(s) Fahrenheit | hp | horsepower |
| ft | foot (feet) | Hz | hertz |

| | |
|---|---|
| in. | inch(es) |
| K | degree(s) Kelvin |
| kcal | kilocalorie(s) |
| kg | kilogram(s) |
| km | kilometer(s) |
| kPa | kilopascal(s) |
| kV | kilovolt(s) |
| kWh | kilowatt-hour(s) |
| L | liter(s) |
| lb | pound(s) |
| m | meter(s) |
| $m^2$ | square meter(s) |
| $m^3$ | cubic meter(s) |
| mg | milligram(s) |
| mi | mile(s) |
| $mi^2$ | square mile(s) |
| mm | millimeter(s) |
| MMBtu | thousand Btu |
| mph | mile(s) per hour |
| MW | megawatt(s) |
| ppb | part(s) per billion |
| ppm | part(s) per million |
| ppmv | part(s) per million by volume |
| psi | pound(s) per square inch |
| rpm | rotation(s) per minute |
| s | second(s) |
| scf | standard cubic foot (feet) |
| $yd^2$ | square yard(s) |
| $yd^3$ | cubic yard(s) |
| yr | year(s) |
| µm | micrometer(s) |

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## ENGLISH/METRIC AND METRIC/ENGLISH EQUIVALENTS[a]

The following table lists the appropriate equivalents for English and metric units.

| Multiply | By | To Obtain |
|---|---|---|
| ***English/Metric Equivalents*** | | |
| acres | 0.4047 | hectares (ha) |
| 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 ($m^3$) | 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 ($km^2$) | 0.3861 | square miles ($mi^2$) |
| square meters ($m^2$) | 10.76 | square feet ($ft^2$) |
| square meters ($m^2$) | 1.196 | square yards ($yd^2$) |

[a] In general in this PEIS, only English units are presented. However, where reference sources provided both English and metric units, both values are presented in the order in which they are given in the source. Where reference sources provided only metric units, only those units are presented.

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# 6 IMPACT ASSESSMENT FOR OIL SHALE AND TAR SANDS ALTERNATIVES

## 6.1 OIL SHALE ALTERNATIVES

This section presents the impacts associated with the four oil shale alternatives. Alternative 1, the No Action Alternative, is discussed in Section 6.1.1. The impacts of Alternatives 2 (Conservation Focus), 3 (Research Lands Focus), and 4 (Moderate Development) are discussed in Sections 6.1.2, 6.1.3, and 6.1.4, respectively. Section 6.1.5 presents a comparison of the oil shale alternatives. Discussions of the cumulative impacts and of other NEPA considerations associated with Alternatives 2, 3, and 4 are presented in Sections 6.1.6 and 6.1.7, respectively.

Information contained in Sections 6.1.1 through 6.1.4 describes (1) the impact of the land allocation decisions proposed in the four programmatic alternatives and (2) the potential impact of future commercial oil shale development on the public lands that could be available for application for future leasing and development in each alternative. Although commercial leasing and development are not being approved at this time, the information on potential impacts is being presented to help agency decision makers and the public understand the effects of potential future development. Together with the information contained in Chapter 4, this analysis aids agency decision makers in making an informed decision regarding the relative merits of the four alternatives. It is also intended that these analyses will help identify information that will be needed to process future applications for commercial development.

Development of the six existing RD&D leases and their associated PRLAs is common to all four alternatives. To avoid duplication, the analysis of impacts of these existing leases is provided only in Section 6.1.3, which describes the impacts of the research lands focused alternative.

On the basis of analyses contained in the PEIS, the BLM has determined that with the exception noted in the socioeconomic analysis regarding potential impacts on land values, the land use plan amendments contained in Alternatives 2, 3, and 4 would not result in any impacts on the environment or socioeconomic setting. However, the future development of commercial oil shale projects that could be approved after subsequent NEPA analysis on lands identified in these alternatives, as well as in Alternative 1, as available for application for leasing would have impacts on the environment and the socioeconomic setting. The bulk of the information presented in Sections 6.1.1 through 6.1.4 identifies in a non-site-specific manner the potential impacts associated with future commercial oil shale development under each alternative. The magnitude of the impacts cannot be quantified at this time because key information about the location of commercial projects, the technologies that may be employed, the project size or production level, development time lines, and mitigation that might be employed are unknown.

### 6.1.1 Impacts of Alternative 1, the No Action Alternative (no change to the 2008 Decision)

Under Alternative 1, the BLM would amend no BLM land use plans, leaving the 2008 ROD decision in place keeping 2,017,741 acres of public land available for application for leasing for commercial development of oil shale within Colorado, Utah, and Wyoming (see Figures 2.3.2-1, 2.3.2-2, and 2.3.2-3). (See Section 2.3.2 for a complete description of Alternative 1.) These lands include about 346,609 acres in Colorado, 670,558 acres in Utah, and 1,000,574 acres in Wyoming (Table 2.3.2-1) and comprise 1,865,542 acres of BLM-administered lands and 125,681 acres of split estate lands. Included within these areas, as discussed in Section 2.3.2, are the six 160-acre RD&D projects leased by the BLM in 2007. These include five projects in Rio Blanco County, Colorado, evaluating in situ processes, and one project in Uintah County, Utah, evaluating underground mining with surface retort (see Figure 2.3-2). A total of 960 acres are involved in the six projects.

On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with Alternative 1, keeping public lands available for application for commercial leasing in three-state study area, but there may be impacts on land values. However, the future development of commercial oil shale projects on lands identified as available for application for commercial leasing could affect these resources. In addition, Alternative 1 would include the same level of development of the RD&D projects and resulting environmental effects, as described in Section 6.1.3 for Alternative 3. The following sections describe the impacts of Alternative 1 on the environment and on the socioeconomic setting. The sections also describe the potential impact of subsequent commercial development that might occur on the lands identified as available for leasing.

In general, potential impacts of future commercial development on specific resources located within the 2,017,741 acres cannot be quantified at this time because key information about the location of projects, the technologies that will be employed, the project size or production level, and development time lines are unknown. Although it is not possible to quantify the impacts of project development, it is possible to make observations and draw conclusions on the basis of certain lands being available for application for leasing and their overlap with specific resources. The following sections identify the potential impacts, many of which might be successfully avoided or mitigated, depending upon site- and project-specific factors and future regulations that will guide leasing actions.

#### 6.1.1.1 Land Use

Under Alternative 1, a total of 2,017,741 acres of public land in Colorado, Utah, and Wyoming would remain available for application for leasing for commercial development of oil shale (approximately 87% of the study area). This is expected to have no impacts on other land uses, although there may be some effect on land values. Retaining these lands as available for application for leasing does not authorize or approve any ground-disturbing activities that could affect these land uses; however, existing land uses could be adversely affected by future commercial oil shale development on these lands.

As discussed in Section 3.1, lands within the three-state study area where future commercial oil shale development might occur are currently used for a wide variety of activities, including recreation, mining, hunting, oil and gas production, livestock grazing, wild horse and burro management, communication sites, and ROW corridors (e.g., roads, pipelines, and transmission lines). Commercial oil shale development could have a direct effect on these uses, displacing them from areas that are being developed for oil shale production.

Future indirect impacts of oil shale development could be associated with changing existing off-lease land uses, including conversion of land in and around local communities from existing agricultural, open space, or other uses to provide services and housing for employees and families who move to the region in support of commercial oil shale development. Increases in traffic, increased access to previously remote areas, and development of oil shale facilities in currently undeveloped areas would continue the change in the overall character of the landscape that has already begun as a result of oil and gas development. The value of private ranches and residences in the area affected by oil shale developments or associated ROWs either may be reduced because of perceived noise, traffic, human health, or aesthetic concerns or may be increased by additional demand.

Oil shale development will require off-lease construction and operation of certain infrastructure, such as electric power plants. Such structures and activities would most directly impact uses of nonfederal lands, but could indirectly impact some uses of federal lands. The BLM does not decide the location of electric power plants on nonfederal land. It would be too speculative to attempt to analyze where any such electric power plant would be located, but it is possible that additional generation capacity could be constructed within the socioeconomic ROI.

Transmission and pipeline ROWs associated with commercial oil shale development would not preclude other land uses but could result in both direct and indirect impacts. Direct impacts, such as the loss of lands to physical structures, maintenance of ROWs free of major vegetation, maintenance of service roads, and noise and visual impacts on recreational users along the ROW, would last as long as the transmission lines and pipelines were in place. Indirect impacts of ROW development could include the introduction of new or increased recreational use to an area because of improved access, avoidance of the area for residential or recreational use for aesthetic reasons, and increased traffic.

The specific impacts on land use and the magnitude of those impacts would depend on project location; project size, technology employed, and scale of operations; and proximity to roads, transmission lines, and pipelines. Impacts on various land uses that could be caused by commercial development of oil shale are discussed in Section 4.2 and are summarized below.

- Commercial oil shale development, using any technology under consideration in this PEIS, is largely incompatible with other mineral development activities because each technology would dominate the lease area on which it is located. Oil and gas development is ongoing in many parts of the study area, and conflict between oil shale projects and oil and gas projects may occur. While it is possible that undeveloped portions of an oil shale lease area could be available for other mineral development, such development would be unlikely to occur on a widespread basis, except possibly in areas where a single company is developing multiple resources. A possible exception is being investigated as part of one of the RD&D projects where nahcolite mining is being conducted in advance of oil shale production. Conflict between oil shale and oil and gas or other mineral development would cease when oil shale development and extraction have been completed.

- Where existing agricultural water rights are acquired to support oil shale development, existing irrigation-based agricultural uses of the land from which the water is acquired will be modified to support lower value dry land use of the lands and/or may result in a complete loss of agricultural uses in some areas. Some areas could be converted to nonfarm uses depending upon local zoning decisions.

- Grazing activities would be precluded by commercial oil shale development in those portions of the lease area that were (1) undergoing active development; (2) being prepared for a future development phase; (3) undergoing restoration after development; or (4) occupied by long-term surface facilities, such as production facilities, office buildings, laboratories, and parking lots. Depending on conditions unique to the individual grazing allotment, reductions in authorized grazing use likely will be necessary because of loss of a portion of the forage base. It is possible, depending upon how commercial leases would be developed, that some grazing uses might be accommodated on parts of the leases at various times during the lease period. Once surface restoration of oil shale development areas is complete, a resumption of grazing use would be possible.

  The impact of the removal of acreage from individual grazing leases would be dependent upon site-specific factors regarding the grazing allotment(s) affected. There is a large variation in size and productivity of BLM grazing allotments across the PEIS area, and the loss of up to 5,760 acres for individual oil shale facilities from larger allotments would not be as significant as from smaller allotments. Some allotments could become completely unavailable for use. Others would lose varying percentages of grazing area that might affect their overall economic viability. While lands might be available for grazing use after completion of oil shale development activities, individual permittees may not be able to withstand the economic impacts on their operations during the development period.

- Commercial oil shale development activities are largely incompatible with recreational land use (e.g., hiking, biking, fishing, hunting, bird-watching, OHV use, and camping). Recreational uses, including OHV use, would be precluded from those portions of commercial lease areas involved in ongoing development and restoration activities. Impacts on vegetation, development of roads, and displacement of big game would degrade the recreational experiences and hunting opportunities near commercial oil shale projects. The impact of displacement of recreation uses from oil shale development lease areas would be highly dependent upon site-specific factors, especially the nature of existing uses on the site.

- Specially designated areas, including all designated Wilderness Areas, WSAs, other areas that are part of the NLCS (e.g., National Monuments, NCAs, WSRs, and National Historic and Scenic Trails), and existing ACECs that are currently closed to mineral development, would not be available for application for commercial development and would not be directly affected. They might, however, incur indirect impacts (e.g., degraded viewsheds) resulting from commercial oil shale development on adjacent lands or on areas within the general vicinity. Section 4.9 discusses impacts on visual resources in greater detail.

- ACECs that are not closed to mineral leasing include approximately 44,000 acres and are shown in Table 6.1.1-1. Should oil shale development occur in these areas, the R&I values within these designated ACECs would be lost.

- Lands available for application for lease contain all or portions of areas that have been recognized by the BLM in Colorado, Utah, and Wyoming as LWC. Table 6.1.1-2 lists these areas for all four alternatives. Should commercial development occur on these lands, the identified wilderness characteristics in both the areas that are developed and those that border the developed areas would be lost. Alternative 1 includes approximately 221,000 acres of these lands that could be subject to potential development.

- A portion of the land within the PRLA established for the Enefit RD&D project is not available for application for leasing under Alternative 1 by an applicant other than the Enefit RD&D leaseholder unless the Vernal Field Office prepares a plan amendment to make this area as available for lease (see Figure 2.3.3-8).

- Under this alternative, the 30,720 acres, including the existing RD&D leases, and, absent exceptions such as that noted above, their PRLAs, will be available for future leasing if the current leaseholders relinquish their existing leases.

#### 6.1.1.2 Soil and Geologic Resources

Under Alternative 1, a total of 2,017,741 acres of public land are available for application for commercial oil shale leasing would remain designated as available (Section 2.3.2). Soil and geologic resources could be affected by future commercial oil shale development on these lands.

**TABLE 6.1.1-1 Designated ACECs in the Study Area Not Closed to Mineral Location and Available for Leasing under Alternatives 1, 2, 3, and 4**

| | Area Available for Leasing (acres) | | | |
|---|---|---|---|---|
| ACEC Field Office | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***White River Field Office, Colorado*** | | | | |
| Duck Creek | 3,414 | 0 | 0 | 0 |
| Dudley Bluffs | 1,605 | 0 | 0 | 0 |
| Ryan Gulch | 1,429 | | | |
| ***Glenwood Springs Field Office, Colorado*** | | | | |
| East Fork Parachute Creek | 13 | 0 | 0 | 0 |
| ***Vernal Field Office, Utah*** | | | | |
| Lower Green River | 7,676 | 0 | 0 | 0 |
| Nine Mile Canyon | 530 | 0 | 0 | 0 |
| Pariette Wetlands | 6,532 | 0 | 0 | 0 |
| ***Kemmerer Field Office, Wyoming*** | | | | |
| Special status plant species | 24 | 0 | 0 | 0 |
| ***Rock Springs Field Office, Wyoming*** | | | | |
| Greater Red Creek[a] | 23,055 | 0 | 0 | 0 |
| Pine Springs | 1 | 0 | 0 | 0 |
| Special status plant species | 46 | 0 | 0 | 0 |
| **Total** | **44,325** | **0** | **0** | **0** |

[a] The Red Creek Watershed portion of the ACEC is closed to mineral entry.

Soil and geologic resources could be affected during project construction as a result of removal or compaction (e.g., during site clearing and grading, foundation excavation and preparation, and pipeline trenching) and by erosion during project construction and operation (e.g., erosion of exposed soils in construction areas or of topsoil stockpiles [see Section 4.3.1]). Erosion of exposed soils could also lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust, which could affect local air quality. Project areas could remain susceptible to erosion until completion of construction, mining, oil shale processing, and site stabilization and reclamation activities (e.g., revegetation of pipeline ROWs, surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as to areas where associated off-lease infrastructure (e.g., access roads, utility ROWs, and power plants) would be located. For any project, the erosion potential of the soils would be a direct function of the lease and project location and also the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

**TABLE 6.1.1-2 Areas with Wilderness Characteristics That Overlap with Lands Available for Application for Commercial Oil Shale Leasing under Alternatives 1, 2, 3, and 4 and the Amount of Overlap[a,b]**

| Name of Area with Wilderness Characteristics | Amount of Overlap (acres) | | | |
|---|---|---|---|---|
| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***White River Field Office, Colorado*** | | | | |
| Unnamed Areas | 21,974 | 0 | 0 | 21,974 |
| ***Price Field Office, Utah*** | | | | |
| Desolation Canyon | 86 | 0 | 0 | 86 |
| ***Vernal Field Office, Utah*** | | | | |
| Archy Bench A | 6,731 | 0 | 0 | 6,731 |
| Bitter Creek | 1,218 | 0 | 0 | 1,218 |
| Desolation Canyon | 29,180 | 0 | 0 | 25,625 |
| Lower Bitter Creek | 11,417 | 0 | 0 | 11,417 |
| White River | 17,628 [c] | 0 | 0 | 17,628 |
| ***Rawlins Field Office, Wyoming*** | | | | |
| Adobe Town fringe | 9,495 | 0 | 0 | 0 |
| Kinney Rim North | 4,195 | 0 | | 4,195 |
| Kinney Rim South | 51,537 | 0 | | 51,433 |
| Unnamed | 12,663 | 0 | | 3,273 |
| ***Rock Springs Field Office, Wyoming*** | | | | |
| Adobe Town | 507 | 0 | 0 | 0 |
| Buffalo Hump | 6,121 | 0 | 0 | 6,121 |
| Kinney Rim North | 29,309 | 0 | 0 | 29,309 |
| Kinney Rim South | 18,451 | 0 | 0 | 18,451 |
| Sand Dunes | 38 | 0 | 0 | 38 |
| Unnamed Areas | 1,062 | 0 | 0 | 689 |
| **Total** | 221, 612 | 0 | 0 | 198,188 |

[a] The key characteristics of wilderness that may be considered in land use planning include an area's appearance of naturalness and the existence of outstanding opportunities for solitude or primitive and unconfined types of recreation.

[b] Totals may be off due to rounding. Acreage estimates were derived from GIS data compiled to support the PEIS analyses.

[c] 6,680 acres were identified in the Vernal RMP for management to protect wilderness characteristics. The remainder of the 17,642-acre area is not managed to protect wilderness characteristics.

Under Alternative 1, impacts on soil and geologic resources could occur wherever individual projects are located within the 2,017,741 acres identified as available for application for leasing. Under this alternative, Wyoming would have the most land (1,000,574 acres) and Colorado the least (346,609 acres) where commercial oil shale development could affect soil and geologic resources.

#### 6.1.1.3 Paleontological Resources

Under Alternative 1, a total of 2,017,741 acres of public land available for application for commercial oil shale leasing would remain designated as available (Section 2.3.2). Paleontological resources within these areas could be adversely affected if leasing and subsequent commercial development occur. Of the acreage designated under Alternative 1, a total of 1,784,765 acres (about 88% of the 2,017,741 acres that would be available under Alternative 1) has been identified as overlying geologic formations having a high potential to contain important paleontological resources (Murphey and Daitch 2007). Approximately 335,113 of these acres are in the Piceance Basin; 592,620 acres are in the Uinta Basin; and 857,032 acres are in the Green River and Washakie Basins.

Impacts from oil shale development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development area, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. However, oil shale development may result in beneficial discoveries that would not otherwise have been made. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 4.4.

#### 6.1.1.4 Water Resources

Under Alternative 1, a total of 2,017,741 acres of public land available for application for commercial oil shale leasing would remain designated as available (Section 2.3.2). While both surface and groundwater resources could be affected by future commercial oil shale development on these lands, the amount of water that may be required and the potential mix required among surface water, groundwater, and treated process water is currently unknown.

The inability to predict specific locations for potential future commercial development and the lack of information regarding the type of technology that might be employed make it difficult to predict the specific impacts on water resources that could occur with commercial development. Quantification of such impacts would depend on the specific location of the lease area being developed, as well as the design of the project and associated infrastructure. Future climate conditions may also affect streamflows and create another uncertainty in water availability.

Section 4.5 of this PEIS provides a generic description of the potential impacts on water resources. These impacts could occur anywhere within the 2,017,741 acres available for application for leasing in this alternative. The following is a summary of these generic impacts:

- Accidental chemical spills or product spills and/or leakage that could potentially contaminate surface water and/or groundwater;

- Degradation of surface water quality caused by increased sediment load or contaminated runoff from project sites;

- Surface disturbance that may alter natural drainages by both diverting and concentrating natural runoff;

- Surface disturbance that becomes a non-point source of sediment and dissolved salt to surface water bodies;

- Withdrawal of water from a surface water body that reduces its flow and degrades the water quality of the stream downgradient from the point of the withdrawal;

- Withdrawals of groundwater from a shallow aquifer that produce a cone of depression and reduce groundwater discharge to surface water bodies or to the springs or seeps that are hydrologically connected to the groundwater;

- Construction of reservoirs that might alter natural streamflow patterns, alter local fisheries, temporarily increase salt loading, cause changes in stream profiles downstream, reduce natural sediment transport mechanisms, and increase evapotranspiration losses;

- Discharged water from a project site that could have a lower water quality than the intake water that is brought to a site;

- Spent shale piles and mine tailings that might be sources of salt, metal, and hydrocarbon contamination for both surface and groundwater;

- Dewatering operations of a mine, or dewatering through wells that penetrate multiple aquifers, that could reduce groundwater discharge to seeps, springs, or surface water bodies if the surface water and the groundwater are connected;

- Degradation of groundwater quality resulting from the injection of lower quality water, from contributions of residual hydrocarbons or chemicals from retorted zones after recovery operations have ceased, and from spent shales replaced in either surface or underground mines; and

- Reduction or loss of flow in domestic water wells from dewatering operations or from production of water for industrial uses.

As noted in Section 6.1.1.2, the lands available for application for leasing under Alternative 1 include lands that have been identified in BLM land use plans as having high potential for erosion due to steep slopes and/or highly erosive soils. Surface water quality could be adversely impacted by erosion that could contribute to increases in sediment and salinity loads from these and similar lands throughout the area open for application for leasing under this alternative.

In addition, lands available for application for leasing under Alternative 1 overlap with sensitive hydrologic areas identified by the BLM, including about 7,900 acres of identified riparian areas and wetlands in Colorado; about 6,100 acres of watershed, floodplains, and other sensitive water resources in Utah; and about 31,000 acres of identified floodplains, wetlands, and riparian areas in Wyoming. Disturbance of these areas could occur either by direct manipulation or through indirect effects, including increased sedimentation and runoff of contaminated water from project sites.

The total stream miles within the four oil shale basins is approximately 753 mi. Alternative 1 contains approximately 675 mi of these perennial streams that could be affected either directly or indirectly by commercial oil shale development (see Table 6.1.1-3).

#### 6.1.1.5 Air Quality

Under Alternative 1, a total of 2,017,741 acres of public land would be available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale (Section 2.3.2). The designation of potential leasing areas would not have a direct effect on air quality. Of the acreage designated under Alternative 1, about 346,609 acres are in the Piceance Basin, Colorado; 670,558 acres in the Uinta Basin, Utah; and 1,000,574 acres in the Green River and Washakie Basins, Wyoming. Air resources in the three states would not be affected by this action. However, air resources in and around these 2,017,741 acres could be

**TABLE 6.1.1-3 Perennial Streams Occurring within the Lease Areas with a 2-mi Buffer**

| | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | |
|---|---|---|---|---|---|---|---|---|
| State | Number of Perennial Streams | Length of Streams (mi) | Number of Perennial Streams | Length of Streams (mi) | Number of Perennial Streams | Length of Streams (mi) | Number of Perennial Streams | Length of Streams (mi) |
| Colorado | 17 | 184 | 14 | 110 | 6 | 23 | 17 | 183 |
| Utah | 14 | 262 | 11 | 196 | 1 | 5 | 14 | 261 |
| Wyoming | 18 | 228 | 12 | 80 | 0 | 0 | 18 | 217 |
| Total | 49 | 674 | 37 | 386 | 7 | 28 | 49 | 661 |

affected by potential future commercial development of oil shale. Under Alternative 1, local, short-term air quality impacts could be incurred as a result of (1) PM releases (fugitive dust, diesel exhaust) during construction activities, such as site clearing and grading in preparation for facility construction, and (2) exhaust emissions ($NO_x$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 4.6). These potential impacts would be of short duration and largely limited to specific project locations and the immediate surrounding area. Similar short-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations, such as mining and processing of the oil shale. Processing activities could also result in regional impacts on air quality and air quality-related values (AQRVs), such as visibility and acid deposition, which could extend beyond the boundaries of the lease areas in each state. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during oil shale excavation and processing (see Section 4.6). In addition, ozone precursors of $NO_x$ and VOC from oil shale development could exacerbate wintertime high-ozone occurrences already prevalent in the study area. Operational releases of certain HAPs (e.g., benzene, toluene, formaldehyde, and diesel PM) could also affect on-site workers and nearby residences (if any are present); however, these impacts would be localized to the immediate project location and subject to further analyses prior to implementation.

During all phases of oil shale development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustion sources could contribute to climate change to some extent.

If development of oil shale requires expansion of capacity of existing electric power plants, or the construction and operation of new electric power plants off-lease, those could also have longer term impacts on regional air quality and AQRVs. Table 6.1.6-3 presents a summary of the emissions from coal-fired electric power plants.

#### 6.1.1.6 Noise

Under Alternative 1, a total of 2,017,741 acres of public land would be available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. Ambient noise levels in these areas would not be affected by the identification of these lands for application for leasing. However, ambient noise levels could be affected by the future commercial development of oil shale. Under Alternative 1, local, short-term changes in ambient noise levels could occur during the construction, operation, and reclamation of oil shale projects (see Section 4.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Impacts on wildlife and recreational users are discussed in Sections 4.8.1.3 and 4.2.1.4, respectively.

Noise levels could be affected as a result of the operation of construction equipment (graders, excavators, and haul trucks) and as a result of any blasting activities. Increases in ambient noise levels during operations would be associated with mining and oil shale–processing activities and would be more long term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short- and long-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels in the immediate vicinity could also be increased by any pipeline pump stations and by project-related vehicular traffic at the project site and related locations such as access roads to the site.

Construction-related noise levels could exceed EPA guidelines and/or Colorado regulations (there are currently no state guidelines/regulations for Utah or Wyoming). Similarly, operational noise associated with mining and retort activities may, in the absence of mitigation, exceed EPA guidelines and/or Colorado regulations at some project locations. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline and/or Colorado regulation levels except for short durations and very close to road or high traffic areas.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes in ambient noise levels from project development could occur wherever a project is located within the 2,017,741 acres identified for application for leasing under Alternative 1.

#### 6.1.1.7 Ecological Resources

Under Alternative 1, a total of 2,017,741 acres of public land within Colorado, Utah, and Wyoming would remain available for application for leasing for commercial development of oil shale. These lands support a wide variety of biota and their habitats (Section 3.7). Identification of land as available for application for leasing does not have direct effects on ecological resources. However, ecological resources in and around these lands could be affected by the future commercial development of oil shale. The following sections describe the potential impacts on ecological resources that may result from commercial oil shale development within the areas identified as available for application for commercial leasing under Alternative 1.

The magnitude of potential impacts on specific ecological resources that could occur from commercial oil shale development would depend on the specific location of the commercial oil shale projects as well as on the specific project design.

**6.1.1.7.1 Aquatic Resources.** Under Alternative 1, a total of 2,017,741 acres of land in Colorado, Utah, and Wyoming would remain available for application for leasing for commercial development of oil shale. Identification of land as available for application for leasing does not have direct effects on aquatic resources. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Potential impacts on aquatic resources from oil shale development could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 4.8.1.1. As described in Section 4.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals are occurring. Consequently, the analysis here considers the potential for impacts on waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities become more distant from waterways, the potential for negative effects on aquatic resources could be reduced. For the analysis of potential impacts on each of the alternatives considered in this PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increase.

Under Alternative 1, these are 33 perennial streams and about 251 mi of perennial stream habitat within the Piceance, Uinta, Green River, and Washakie Basins that are directly overlain by areas potentially available for oil shale development. When an additional 2-mi zone surrounding these areas is considered, there are 49 perennial streams and about 674 mi of perennial stream habitat that could be affected by future development activities (Table 6.1.1-4). The development of commercial oil shale projects in the areas identified under Alternative 1 could affect aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 4.1.1.1, impacts from water quality degradation and water depletions could affect not only resources in areas within or immediately adjacent to leased areas, but also resources in areas farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the Piceance, Uinta, Green River, and Washakie Basins are described in Section 3.7.1, and some of these aquatic habitats are known or likely to contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. Specific impacts would depend greatly upon the locations and methods of extraction used by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing decisions to evaluate potential impacts in greater detail.

**6.1.1.7.2 Plant Communities and Habitats.** Under Alternative 1, a total of 2,017,741 acres of land in Colorado, Utah, and Wyoming would remain identified as available for application for leasing for commercial development of oil shale. There would be no impacts on plant communities or habitat associated with this identification. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.2. These

**TABLE 6.1.1-4 Streams and Approximate Miles of Each Stream in the Geologically Prospective Areas of the Oil Shale Basins and in the Vicinity[a] of Areas To Be Considered for Leasing under Each of the Alternatives**

| | Length of Stream (mi) | | | | |
|---|---|---|---|---|---|
| Stream | Geologically Prospective Area | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Colorado–Piceance Oil Shale Basin*** | | | | | |
| Black Sulphur Creek | 18.8 | 18.2 | 10.2 | 3.9 | 18.2 |
| Clear Creek | 11.3 | 3.8 | –[b] | – | 3.8 |
| Corral Gulch | 10.8 | 10.8 | 4.1 | 5.0 | 10.8 |
| Dry Fork Piceance Creek | 10.1 | 10.2 | 8.3 | – | 10.2 |
| East Fork Parachute Creek | 12.3 | 6.3 | – | – | 6.1 |
| East Willow Creek | 6.5 | 6.5 | 4.1 | – | 6.5 |
| Fawn Creek | 7.0 | 7.0 | 4.3 | 2.2 | 7.0 |
| Hunter Creek | 8.3 | 8.3 | 6.4 | 4.5 | 8.3 |
| Parachute Creek | 6.8 | 5.8 | 3.8 | – | 5.8 |
| Piceance Creek | 37.7 | 37.3 | 24.5 | – | 37.3 |
| Ryan Gulch | 15.0 | 15.0 | 6.8 | 7.0 | 15.0 |
| West Fawn Creek | 6.9 | 6.9 | 4.8 | – | 6.9 |
| West Fork Parachute Creek | 11.5 | 11.5 | 7.2 | – | 11.5 |
| West Fork Spring Creek | 5.6 | 5.6 | – | – | 5.6 |
| West Hunter Creek | 7.2 | 7.2 | 5.2 | – | 7.2 |
| Willow Creek | 8.3 | 8.3 | 6.3 | – | 8.3 |
| Yellow Creek | 14.9 | 14.9 | 13.8 | 0.4 | 14.9 |
| Total | 199.1 | 183.6 | 109.6 | 22.9 | 183.4 |
| ***Utah–Uinta Oil Shale Basin*** | | | | | |
| Asphalt Wash | 5.2 | 5.2 | 5.2 | – | 5.2 |
| Bitter Creek | 29.4 | 29.4 | 28.8 | – | 29.4 |
| Center Fork | 13.9 | 13.9 | 13.9 | – | 13.9 |
| Duchesne River | 2.4 | 2.2 | – | – | 2.2 |
| Green River | 48.9 | 48.9 | 32.5 | – | 48.7 |
| Nine Mile Creek | 3.6 | 3.6 | – | – | 3.3 |
| Pariette Draw | 9.5 | 9.5 | 9.1 | – | 9.5 |
| Petes Wash | 17.6 | 17.6 | 14.2 | – | 17.6 |
| Sand Wash | 24.7 | 24.7 | 19.7 | – | 24.7 |
| Sweetwater Canyon | 9.5 | 9.5 | 5.7 | – | 9.5 |
| Tabyago Canyon | 19.0 | 19.0 | 8.6 | – | 19.0 |
| Wells Draw | 3.5 | 3.5 | – | – | 3.5 |
| White River | 63.5 | 63.5 | 47.8 | 5.2 | 63.5 |
| Willow Creek | 11.1 | 11.1 | 11.1 | – | 11.1 |
| Total | 261.8 | 261.7 | 196.4 | 5.2 | 261.1 |

**TABLE 6.1.1-4 (Cont.)**

| | Length of Stream (mi) | | | | |
|---|---|---|---|---|---|
| Stream | Geologically Prospective Area | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Wyoming–Green River Oil Shale Basin*** | | | | | |
| Big Sandy River | 37.6 | 31.6 | 6.3 | – | 31.6 |
| Bitter Creek | 9.3 | 9.0 | 4.3 | – | 9.0 |
| Blacks Fork | 49.0 | 18.4 | 9.4 | – | 18.4 |
| Bone Draw | 3.6 | 3.6 | – | – | 3.6 |
| Currant Creek | 14.7 | 14.7 | – | – | 9.6 |
| Dry Muddy Creek | 3.1 | 3.1 | 1.5 | – | 3.1 |
| Green River | 63.7 | 42.0 | 21.1 | – | 42.0 |
| Hams Fork | 9.9 | 9.9 | – | – | 9.9 |
| Henrys Fork | 9.0 | 9.0 | 8.9 | – | 9.0 |
| Killpecker Creek | 2.9 | – | – | – | |
| Little Bitter Creek | 1.9 | 1.8 | – | – | 1.8 |
| Little Sandy River | 8.1 | 8.1 | 7.2 | – | 8.1 |
| Pacific Creek | 4.2 | 3.7 | 2.2 | – | 3.7 |
| Sage Creek | 15.2 | 15.2 | – | – | 9.0 |
| Simpson Gulch | 19.9 | 19.9 | 1.7 | – | 19.9 |
| Slate Creek | 0.7 | – | – | – | |
| Total | 252.8 | 190.1 | 62.6 | – | 178.7 |
| ***Wyoming–Washakie Oil Shale Basin*** | | | | | |
| Alkali Creek | 20.2 | 20.2 | 9.3 | – | 20.2 |
| Bitter Creek | 3.2 | 3.2 | 2.7 | – | 3.2 |
| Canyon Creek | 3.6 | 3.6 | – | – | 3.6 |
| Vermillion Creek | 11.6 | 11.6 | 5.0 | – | 11.6 |
| Total | 38.7 | 38.6 | 17.0 | – | 38.6 |
| ***All Basins Combined*** | 752.4 | 673.8 | 385.6 | 28.1 | 661.8 |

[a] Stream lengths for alternatives include portions of streams within each potential allocation area and a 2-mi zone surrounding the potential allocation area.

[b] A dash indicates the stream does not fall within a potential allocation area or within a 2-mi buffer surrounding the potential allocation area under this alternative.

impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Areas identified as available for application for commercial leasing under Alternative 1 support a wide variety of plant communities and habitats (see Section 3.7.2). These areas include approximately 167,800 acres currently identified in BLM land use plans for the protection of wetlands, riparian habitats, floodplains, special status and sensitive plant species, and remnant vegetation associations. Direct impacts on these resources would not occur in these areas. Direct and indirect impacts could be incurred in the remaining areas during project construction and operation, extending over a period of several decades (especially within facility and infrastructure footprints) (see Section 4.8.1.2). Some impacts (e.g., habitat loss) could continue beyond the termination of shale oil production.

Direct impacts could include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities such as access roads, pipelines, transmission lines, employer-provided housing, and new power plants would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure, and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. Although many impacts would be local (occurring within construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction and facilities occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The area available for application for leasing under Alternative 1 includes locations that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of oil shale development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

The lands available under this alternative include eight ACECs: The Duck Creek, Ryan Gulch, and Dudley Bluffs ACECs, as well as a small portion of the East Fork Parachute Creek ACEC—all located in the Piceance Basin; portions of the Pariette Wetlands and Lower Green River ACECs—both located in the Uinta Basin; and portions of the Special Status Plant Species and Greater Red Creek ACECs—both located in the Green River Basin. Each of these ACECs includes rare plant species and/or rare or important plant communities. Direct and indirect impacts on these sensitive species and communities could occur. However, stipulations currently identified in BLM land use plans that address sensitive resources apply to many of these ACECs. None of the three rare plant communities in the East Fork Parachute Creek ACEC (montane riparian forest, boxelder riparian forest, and western slope grassland) or known locations of three rare plants (hanging garden sullivantia, Utah fescue, and southwest stickleaf) are located in the Alternative 1 footprint. The nearest of these, the boxelder riparian forest, is located upstream along East Fork Parachute Creek approximately 1.5 mi from the Alternative 1 footprint. No direct impacts on these plant communities would be expected; however, indirect impacts, such as from fugitive dust, could occur.

Two ACECs that include rare plant species and/or rare or important plant communities are located adjacent to the Alternative 1 footprint: Trapper Creek/Northwater Creek ACEC, adjacent to the Piceance Basin, and Nine Mile Canyon ACEC, adjacent to the Uinta Basin. Twelve ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) the Alternative 1 footprint: Upper Greasewood Creek (1 mi), Lower Greasewood Creek (3.1 mi), Yanks Gulch (3.6 mi), South Cathedral Bluffs (3.1 mi), East Douglas Creek (2.5 mi), Magpie Gulch (3.4 mi), Deer Gulch (0.5 mi), and White River Riparian (0.6 mi), all near the Piceance Basin; Raven Ridge (2.2 mi), Oil Spring Mountain (4.4 mi), and White River Riparian (0.6 mi), all near the Uinta Basin; and Special Status Plant Species (0.9 mi) and Hells Canyon (2.9 mi), both near the Washakie Basin. Indirect impacts on the sensitive species or communities within these ACECs could occur. Impacts would generally decrease with increasing distance.

**6.1.1.7.3 Wildlife.** Under Alternative 1, a total of 2,017,741 acres of lands in Colorado, Utah, and Wyoming would remain identified as available for application for leasing for commercial development of oil shale. While no impacts on wildlife species associated with lands available for commercial leasing are expected, impacts could result from post-lease construction and operations as described in Section 4.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The areas available for application for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for different wildlife species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) subject to TL (where the BLM may allow specified activities but not during certain sensitive seasons, such as when raptors are nesting or when big game are on their winter ranges). Table 6.1.1-5 presents the acreage of habitat protected by these stipulations in areas available for application for oil shale leasing in Alternative 1. In most instances, the stipulations are for TLs.

Areas identified in Alternative 1 as available for application for commercial leasing overlap areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.1.1-1 and 6.1.1-2, respectively). Table 6.1.1-6 presents the acreage of habitat, identified by the states, that occurs in the Alternative 1 areas available for application for leasing and that could be impacted by potential future commercial oil shale development in these areas.

**TABLE 6.1.1-5 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 1 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | |
|---|---|---|---|
| Habitat Description | Colorado[a] | Utah[a] | Wyoming[a] |
| ***Birds*** | | | |
| Raptor nests | 27,918 (29,349)[b] | –[c] | 78,174 (132,850) |
| Raptor nesting and fledging habitat | 59 (61) | – | – |
| Raptor habitat/nesting area | – | – | – |
| Raptor concentration areas | – | – | 10,043 (11,912) |
| ***Big Game*** | | | |
| Big game severe winter range | 89,310 (90,088) | – | – |
| Big game winter range | 24 (25) | – | – |
| Big game | 30 (31) | – | – |
| Deer and elk summer range | 163,100 (165,409) | – | – |
| Pronghorn crucial winter range | – | – | 269,453 (566,031) |
| Elk crucial winter range | – | 65,834 (67,854) | 71,157 (80,184) |
| Elk calving | – | 1,190 (1,190) | 12,303 (19,389) |
| Mule deer crucial winter range | – | 110,527 (112,993) | 144 (2,922) |
| Mule deer winter range | – | – | 83,237 (106,090) |
| Mule deer fawning area | – | 29,334 (40,789) | – |
| Mule deer migration corridor | – | 5,021 (5,038) | – |
| Moose winter range | – | – | 11 (11) |
| Pronghorn crucial winter range | – | – | 10,600 (20,215) |
| Pronghorn winter range | – | – | 241,673 (455,557) |
| ***Other*** | | | |
| Wildlife seclusion above the rim | 81 (3,282) | – | – |
| Wildlife seclusion areas | 11 (11) | – | – |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the wildlife habitat acreage identified for protection within the most geologically prospective lands.

[c] A dash indicates not identified for protection, or identified otherwise for protection within the state.

Several wild horse and burro HMAs overlap with the lands available for application for leasing, including the Piceance–East Douglas Creek HMA in Colorado (63,248 acres); the Hill Creek HMA in Utah (29,866 acres); and Adobe Town (68,257 acres), Little Colorado (207,702 acres), Salt Wells Creek (117,315 acres), and White Mountain (170,868 acres) HMAs in Wyoming (Figure 6.1.1-3). Any oil shale development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Impacts on wildlife from commercial oil shale projects (see Section 4.8.1.3) could occur in a number of ways and could be related to (1) habitat loss, alteration, or fragmentation;

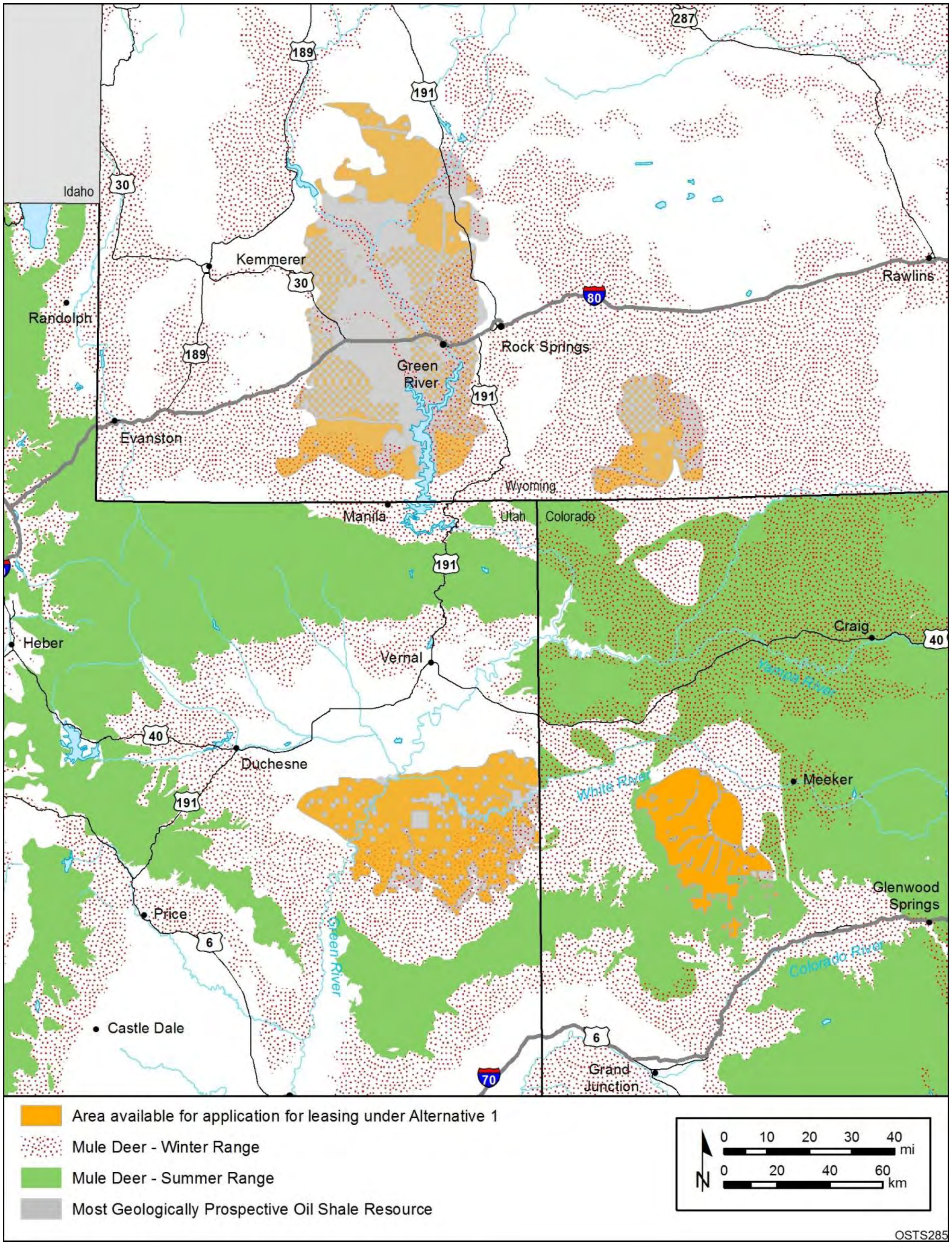


**FIGURE 6.1.1-1 Lands Available for Application for Oil Shale Leasing under Alternative 1 in Relation to the Summer and Winter Ranges of the Mule Deer**

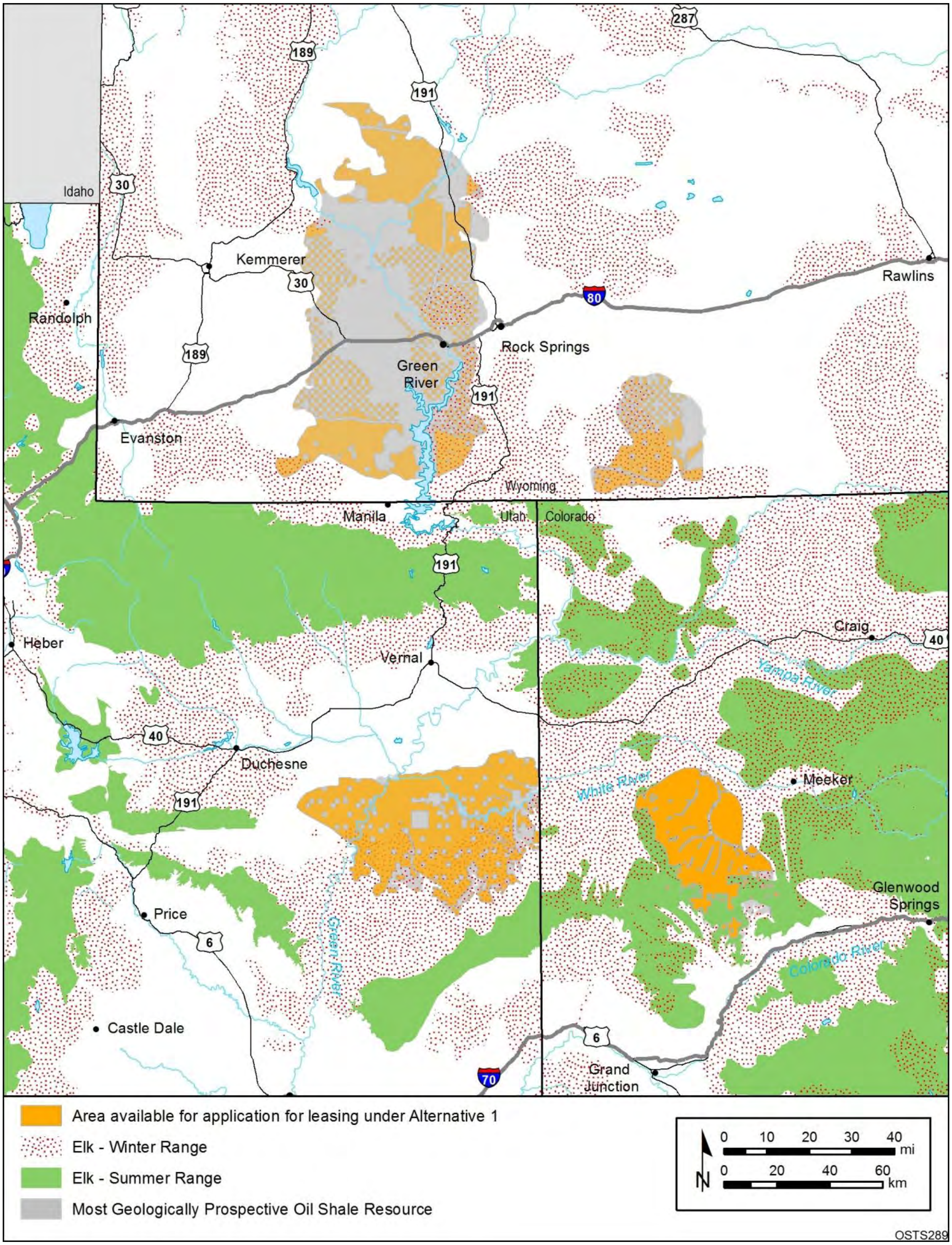


**FIGURE 6.1.1-2 Lands Available for Application for Oil Shale Leasing under Alternative 1 in Relation to the Summer and Winter Ranges of the Elk**

**TABLE 6.1.1-6 State-Identified Elk and Mule Deer Habitat Present in the Alternative 1 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Colorado | Utah | Wyoming | Total |
| ***Mule Deer*** | | | | |
| Winter habitat | 245,634 | 252,727 | 362,798 | 861,159 |
| Summer habitat | 172,773 | 0 | NA[a] | 172,773 |
| ***Elk*** | | | | |
| Winter habitat | 320,262 | 267,877 | 262,303 | 850,442 |
| Summer habitat | 172,542 | 0 | NA | 172,542 |

[a] NA = data not available.

(2) disturbance and displacement of biota; (3) mortality; (4) exposure to hazardous materials; and (5) increase in human access. These impacts can result in changes in species distribution and abundance; habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with the oil shale project or its workforce but instead associated with the potentially increased human access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads may lead to increased human access into the area. Potential impacts associated with increased access include the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation; an increase in the incidence of fires; and increased runoff that could adversely affect riparian or other wetland areas that are important to wildlife.

The potential for impacts on wildlife and their habitats from commercial oil shale development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts on wildlife habitat resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. The magnitude of these impacts is also considered to be proportional to the amount of land disturbance.

**6.1.1.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 1, a total of 2,017,741 acres of land in Colorado, Utah, and Wyoming would be available for application for leasing for commercial development of oil shale. There would be no impacts on threatened and endangered species associated with this identification of lands as available. Impacts could

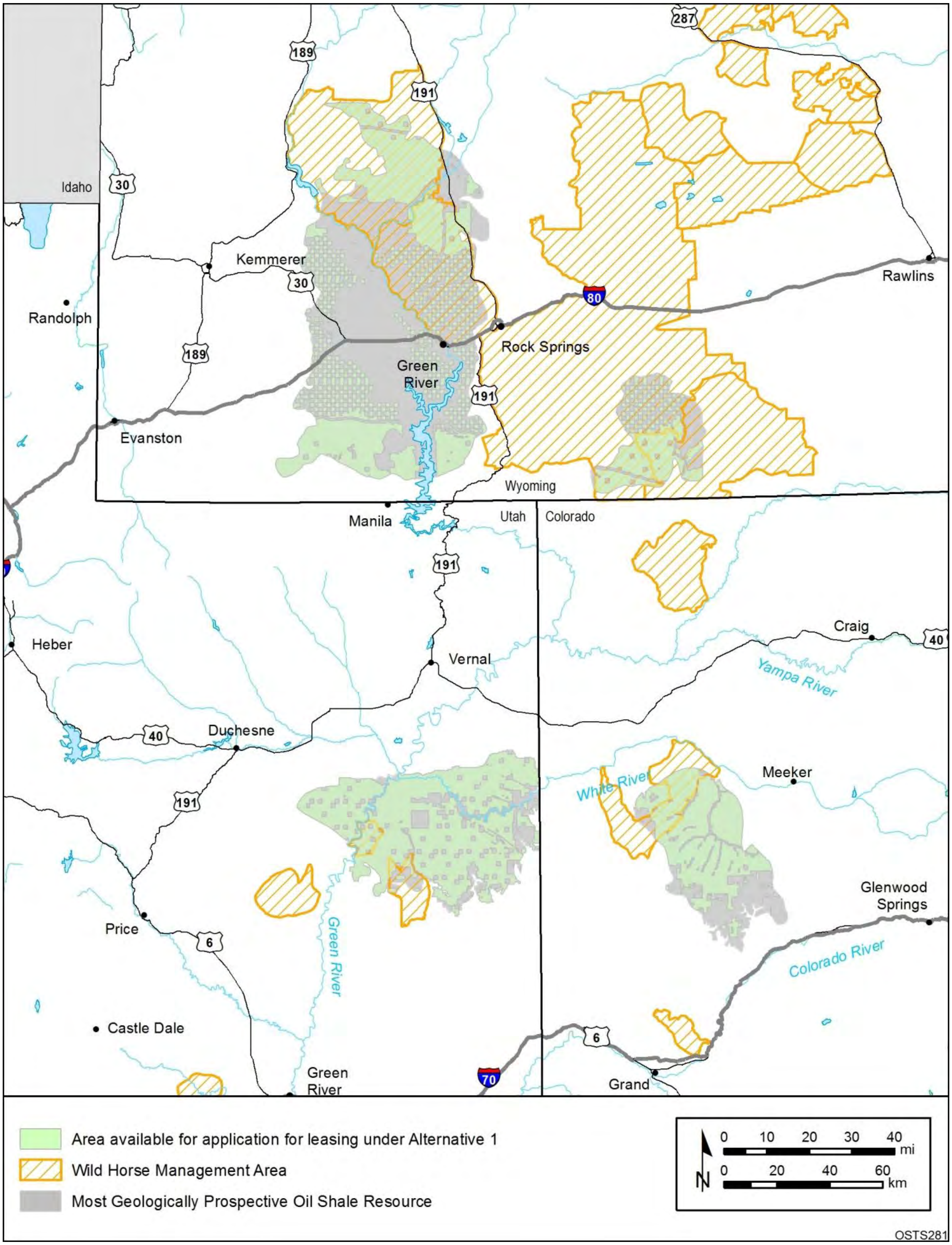


**FIGURE 6.1.1-3 Lands Available for Application for Oil Shale Leasing under Alternative 1 in Relation to Wild Horse and Burro Herd Management Areas**

result, however, from post-lease construction and operation as described in Section 4.8.1.4. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. In addition, the BLM would require all projects to comply with ESA regulations and those policies provided under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Various stipulations are included in the BLM RMPs that provide protection for various threatened, endangered, and sensitive species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities, i.e., with an impact that would last longer than 2 years), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as sage-grouse leks), and (3) TL (where the BLM may allow specified activities, but not during certain sensitive seasons such as sage-grouse brooding seasons). Table 6.1.1-7 identifies the amount of habitats protected by these stipulations in areas available for application for oil shale leasing in Alternative 1. In most instances, the stipulations for these species are TLs.

Under Alternative 1, 179 of the 1,863 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.1.1-8 and 20 of the 22 federally listed threatened or

**TABLE 6.1.1-7 Habitat for Threatened, Endangered, and Sensitive Species Protected by Stipulations in BLM RMPs within the Alternative 1 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | |
|---|---|---|---|
| Habitat Description | Colorado[a] | Utah[a] | Wyoming[a] |
| ***Plants*** | | | |
| Habitat for BLM special status plants | 45,986 (46,680)[b] | –[c] | 985 (985) |
| ***Birds*** | | | |
| Bald eagle habitat | 1,462 (1,463) | 25,025 (36,920) | – |
| Habitat for listed, proposed, or candidate threatened or endangered and BLM-designated sensitive raptors other than bald eagle | 2,100 (2,100) | – | – |
| Sage-grouse habitat | 43,585 (43,806) | 61,987 (62,068) | 266,775 (764,055) |
| ***Mammals*** | | | |
| Black-footed ferret habitat | – | 38,041 (38,046) | – |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the acreages identified for protection within the most geologically prospective lands.

[c] A dash indicates not identified for protection, or identified otherwise for protection within the state.

**TABLE 6.1.1-8 Potential Effects of Commercial Oil Shale Development under Alternative 1 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Abies concolor* | White fir | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat and known occurrences are from Little Mountain in Sweetwater County, Wyoming, approximately 5 mi (8 m) east of the study area. |
| *Achnatherum swallenii* | Swallen mountain-ricegrass | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Amsonia jonesii* | Jones blue star | BLM-S | UT–Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Utah. |
| *Androstephium breviflorum* | Purple funnel-lily | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Antennaria arcuata* | Meadow pussytoes | BLM-S; WY-SC | WY–Sublette | **No impact.** Suitable habitat does not exist in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | UT–Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Artemisia biennis* var. *diffusa* | Mystery wormwood | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus bisulcatus* var. *haydenianus* | Hayden's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus calycosus* var. *calycosus* | King's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus coltonii* var. *moabensis* | Moab milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Astragalus debequaeus* | Debeque milkvetch | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado and Utah. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus lentiginosus* var. *salinus* | Sodaville milkvetch | WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | CO–Garfield; UT–Emery, Garfield, Grand, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 22 mi (35 km) from the study area in Utah. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | CO–Garfield; UT–San Juan | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 8 mi (13 km) from the study area in Colorado. |
| *Astragalus paysonii* | Payson’s milkvetch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus proimanthus* | Precocious milkvetch | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Astragalus racemosus* var. *treleasei* | Trelease's racemose milkvetch | BLM-S; WY-SC | WY–Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences are within 6 mi (10 km) from the study area in Wyoming. |
| *Atriplex falcata* | Sickle saltbush | WY-SC | WY–Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Atriplex wolfii* | Wolf's orache | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera crandallii* | Crandall's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera selbyi* | Selby's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Bolophyta ligulata* | Ligulate feverfew | BLM-S | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area. |
| *Brickellia microphylla* var. *scabra* | Little-leaved brickell-bush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the Wyoming study area. |
| *Ceanothus martinii* | Utah mountain lilac | WY-SC | WY–Lincoln, Sweetwater | **No impact.** This species is not known to occur in the vicinity of the Wyoming study area. Nearest occurrences are approximately 70 mi (113 km) from the study area in Wyoming. |
| *Cercocarpus ledifolius* var. *intricatus* | Dwarf mountain mahogany | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chamaechaen-actis scaposa* | Fullstem | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chrysothamnus greenei* | Greene rabbitbrush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cirsium aridum* | Cedar Rim thistle | BLM-S; WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S; WY-SC | UT–Uintah; WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cirsium perplexans* | Adobe thistle | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Collomia grandiflora* | Large-flower collomia | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Cryptantha gracilis* | Slender cryptantha | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S; WY-SC | CO–Rio Blanco; UT–Duchesne, San Raphael, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado and Utah. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Descurainia pinnata* var. *paysonii* | Payson's tansy mustard | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Descurainia torulosa* | Wyoming tansymustard | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences of this species intersect the study area in Wyoming. |
| *Downingia laeta* | Great Basin downingia | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Draba juniperina* | Uinta draba | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Elymus simplex* var. *luxurians* | Long-awned alkali wild-rye | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences of this species intersect the study area in Wyoming. |
| *Ephedra viridis* var. *viridis* | Green Mormon tea | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriastrum wilcoxii* | Wilcox eriastrum | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Erigeron compactus* var. *consimilis* | San Rafael daisy | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | CO–Garfield; UT–Grand | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Utah. |
| *Eriogonum corymbosum* var. *corymbosum* | Crisp-leaf wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum divaricatum* | Divergent wild buckwheat | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Eriogonum hookeri* | Hooker wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.*** | | | | |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Galium coloradoense* | Colorado bedstraw | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gentianella tortuosa* | Utah gentian | BLM-S | CO–Rio Blanco; UT–Duchesne, Emery, Garfield, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Glossopetalon spinescens* var. *meionandrum* | Utah greasebush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lathyrus lanszwertii* var. *lanszwertii* | Nevada sweetpea | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium integrifolium* var. *integrifolium* | Entire-leaved peppergrass | BLM-S; WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Possible occurrence in wetland habitats of Wyoming study areas. |
| *Lesquerella macrocarpa* | Large-fruited bladderpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 9 mi (14 km) from the study area in Wyoming. |
| *Lesquerella multiceps* | Western bladderpod | BLM-S; WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lesquerella parviflora* | Piceance bladderpod | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Lesquerella parvula* | Narrow-leaved bladderpod | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lesquerella prostrata* | Prostrate bladderpod | WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Possible occurrence in upland habitats of Wyoming study areas. Nearest occurrences are approximately 16 mi (26 km) from the study area in Wyoming. |
| *Listera borealis* | Northern twayblade | BLM-S | CO–Garfield; UT– Duchesne, San Juan; WY–Sublette | **Potential for negative impact.** Possible occurrence in upland habitats of Colorado, Utah, and Wyoming study areas. Nearest occurrences are approximately 28 mi (45 km) from the study area in Colorado. |
| *Lomatium triternatum* var. *anomalum* | Ternate desert-parsley | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia goodrichii* | Goodrich's blazinstar | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia rhizomata* | Roan Cliffs blazingstar | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | UT–Duchesne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Monolepis pusilla* | Red poverty-weed | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *juniperina* | Juniper prickly-pear | WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *rufispina* | Rufous-spine prickly-pear | WY-SC | WY–Lincoln, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Oxytheca dendroidea* | Tree-like oxytheca | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Oxytropis besseyi* var. *obnapiformis* | Maybell locoweed | WY-SC | WY–Sweetwater, Uinta | **No impact.** This species is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 80 mi (129 km) from the study area in Wyoming. |
| *Packera crocata* | Saffron groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | CO–Rio Blanco; UT–Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon acaulis* var. *acaulis* | Stemless beardtongue | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 3 mi (5 km) of the study area in Wyoming. |
| *Penstemon gibbensii* | Gibbens' beardtongue | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 11 mi (18 km) of the study area in Wyoming. |
| *Penstemon harringtonii* | Harrington beardtongue | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 12 mi (19 km) of the study area in Colorado. |
| *Penstemon laricifolius* ssp. *exilifolius* | White beardtongue | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C; | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Penstemon scariosus* var. *garrettii* | Garrett's beardtongue | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia demissa* | Intermountain phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia glandulosa* var. *deserta* | Desert glandular phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Phacelia incana* | Western phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia salina* | Nelson phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia tetramera* | Tiny phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Philadelphus microphyllus* var. *occidentalis* | Little-leaf mock-orange | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox albomarginata* | White-margined phlox | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox pungens* | Beaver Rim phlox | BLM-S; WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences of this species intersect the study area in Wyoming. |
| *Physaria condensata* | Tufted twinpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Township range-level occurrences are within 7 mi (11 km) of the study area in Wyoming. |
| *Physaria dornii* | Dorn's twinpod | BLM-S; WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Possible occurrence in upland habitats of Wyoming study areas. Nearest occurrences are approximately 25 mi (40 km) from the study area in Wyoming. |
| *Physocarpus alternans* | Dwarf ninebark | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Populus deltoides* var. *wislizeni* | Fremont cottonwood | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Potentilla multisecta* | Deep Creek cinquefoil | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Psilocarphus brevissimus* | Dwarf woolly-heads | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Ranunculus flabellaris* | Yellow water-crowfoot | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Rorippa calycina* | Persistent sepal yellowcress | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Sambucus cerulea* | Blue elderberry | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Senecio spartioides* var. *multicapitatus* | Many-headed broom groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Silene douglasii* | Douglas' campion | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Thelesperma caespitosum* | Green River greenthread | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Thelesperma pubescens* | Uinta greenthread | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Townsendia microcephala* | Cedar Mountain Easter-daisy | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish (Cont.)*** | | | | |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S; CO-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gila copei* | Leatherside chub | BLM-S; UT-SC; WY-SC | UT–Duchesne, Emery, Garfield, Wayne; WY–Lincoln, Uinta | **No impact.** This species is not known to occur in the vicinity of any study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Utah. |
| *Gila robusta* | Roundtail chub | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Colorado and the study area in Utah. |
| *Oncorhynchus clarkii utah* | Bonneville cutthroat trout | BLM-S; WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Possible occurrence in aquatic habitats in or near the study areas. Nearest occurrences are approximately 18 mi (29 km) from the study area in Utah. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; CO-E; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–-Carbon, Duchesne, Emery, Garfield, Uintah, Wayne; WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 54,627 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 5 mi (8 km) of the study area in Utah. |
| *Rana luteiventris* | Columbia spotted frog | BLM-S; WY-SC | UT–Utah, Wasatch; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 114 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Utah. |
| *Rana pipiens* | Northern leopard frog | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 27,484 acres of potentially suitable habitat for this species occurs in the study area. Possible occurrence in aquatic and wetland habitats of Colorado, Utah, and Wyoming study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Spea intermontana* | Great basin spadefoot | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,543,840 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| ***Reptiles*** | | | | |
| *Crotalus oreganus concolor* | Midget faded rattlesnake | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sweetwater | **Potential for negative impact.** Approximately 336,446 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado and Wyoming. |
| *Gambelia wislizenii* | Longnose leopard lizard | BLM-S; CO-SC | CO–Garfield | **Potential for negative impact.** Suitable habitat for the species may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Reptiles (Cont.)*** | | | | |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | UT–Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat for the species may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,162,118 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming and Utah. |
| *Aechmophorus clarkii* | Clark's grebe | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 1,295 acres of potentially suitable habitat for this species occurs in the study area. |
| *Aegolius funereus* | Boreal owl | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area and it is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 90 mi (145 km) from the study area in Wyoming. |
| *Ammodramus bairdii* | Baird's sparrow | BLM-S; WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat for the species may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | UT–Duchesne, Uintah, Utah, Wasatch | **Potential for negative impact.** Approximately 993,497 acres of potentially suitable habitat for this species occurs in the study area. |
| *Amphispiza belli* | Sage sparrow | BLM-S | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,734,068 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado, Utah, and Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Aphelocoma californica* | Western scrub-jay | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 907,485 acres of potentially suitable habitat for this species occurs in the study area. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,000,670 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Athene cunicularia* | Burrowing owl | BLM-S; CO-T; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,598,781 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |
| *Baeolophus ridgwayi* | Juniper titmouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 649,692 acres of potentially suitable habitat for this species occurs in the study area. |
| *Botaurus lentiginosus* | American bittern | WY-SC | WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 839,663 acres of potentially suitable habitat for this species occurs in the study area. Suitable habitat may occur in the study area. |
| *Bucephala islandica* | Barrow’s goldeneye | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 140,169 acres of potentially suitable habitat for this species occurs in the study area. Possible occurrence in wetland and aquatic habitats of Colorado study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Buteo regalis* | Ferruginous hawk | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,463,365 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |
| *Calcarius mccownii* | McCown's longspur | WY-SC | WY–Sweetwater | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C; BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,383,474 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah, Colorado, and Wyoming. |
| *Charadrius montanus* | Mountain plover | BLM-S; CO-SC; UT-SC; WY-SC | CO–Rio Blanco; WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 1,035,926 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S; WY-SC | UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Cygnus buccinator* | Trumpeter swan | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 217,257 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cypseloides niger* | Black swift | BLM-S; CO-SC; UT-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Approximately 142 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 12 mi (19 km) of the study area in Colorado. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 97,669 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Falco peregrinus anatum* | American peregrine falcon | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 1,911,571 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado and Wyoming. |
| *Gavia immer* | Common loon | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 5,665 acres of potentially suitable habitat for this species occurs in the study area. |
| *Grus canadensis tabida* | Greater sandhill crane | CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 1,116,401 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 14 mi (23 km) of the study area in Colorado. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; CO-T; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 2,340,562 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado, Utah, and Wyoming. |
| *Icterus parisorum* | Scott's oriole | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 251,915 acres of potentially suitable habitat for this species occurs in the study area. |
| *Lanius ludovicianus* | Loggerhead shrike | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,951,382 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Uinta | **Potential for negative impact.** Approximately 134,462 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Numenius americanus* | Long-billed curlew | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,020,568 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |
| *Oreoscoptes montanus* | Sage thrasher | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,790,019 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | CO–Garfield, UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 999,019 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Picoides arcticus* | Black-backed woodpecker | WY-SC | WY–Lincoln | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Plegadis chihi* | White-faced ibis | BLM-S; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 871,105 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado and Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Psaltriparus minimus* | Bushtit | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,244,002 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sitta pygmaea* | Pygmy nuthatch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 487,888 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sphyrapicus thyroideus* | Williamson's sapsucker | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 15,614 acres of potentially suitable habitat for this species occurs in the study area. |
| *Spizella breweri* | Brewer's sparrow | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,681,334 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Sterna caspia* | Caspian tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 4,868 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sterna forsteri* | Forster's tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 292,166 acres of potentially suitable habitat for this species occurs in the study area. |
| *Tympanuchus phasianellus columbianus* | Columbian sharp-tailed grouse | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat for the species may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| ***Mammals*** | | | | |
| *Antrozous pallidus* | Pallid bat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 1,005,922 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC; WY-SC | UT–Garfield, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 994,977 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 971,264 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,531,315 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 755,032 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Gulo gulo* | Wolverine | CO-E; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 569 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 6 mi (10 km) of the study area in Colorado. |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | UT–Carbon, Emery, Grand, Garfield, San Juan, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the study area. Quad-level occurrences are within 10 mi (16 km) of the study area in Utah. |
| *Microtus richardsoni* | Water vole | WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 9,679 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Myotis evotis* | Long-eared myotis | BLM-S | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,240,116 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sublette | **Potential for negative impact.** Approximately 938,428 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | CO–Garfield; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 825,985 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Peromyscus crinitus* | Canyon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 317,615 acres of potentially suitable habitat for this species occurs in the study area. |
| *Peromyscus truei* | Pinon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 843,307 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sorex preblei* | Preble's shrew | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Tamias dorsalis utahensis* | Cliff chipmunk | WY-SC | WY–Sweetwater | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Thomomys clusius* | Wyoming pocket gopher | BLM-S | WY–Sweetwater | **Potential for negative impact.** Approximately 87,791 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.1-8 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Thomomys idahoensis* | Idaho pocket gopher | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 141,536 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Vulpes macrotis* | Kit fox | BLM-S; CO-E; UT-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Vulpes velox* | Swift fox | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 11,970 acres of potentially suitable habitat for this species occurs in the study area. This species is not known to occur in the vicinity of any study area. Nearest occurrences are approximately 50 mi (80 km) from the study area in Wyoming. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-SC = species of special concern in the state of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 1 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 1 footprint (i.e., study area).

endangered species listed in Table 6.1.1-9 could occur in areas available for application for commercial leasing. This determination is based on records of occurrence in project counties of Colorado, Utah, and Wyoming, species occurrences from state natural heritage programs,[1] and

[1] Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the potential lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.1.1-8 and 6.1.1-9.

**TABLE 6.1.1-9 Potential Effects of Commercial Oil Shale Development under Alternative 1 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Lepidium barnebyanum* | Barneby ridge-cress | ESA-E | UT–Duchesne | **No impact.** Suitable habitat does not occur in the study area. Known distribution is outside of the potential lease areas. |
| *Lesquerella congesta* | Dudley Bluffs bladderpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Penstemon debilis* | Parachute beardtongue | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Phacelia argillacea* | Clay phacelia | ESA-E | UT–Utah, Wasatch | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) of the study area in Utah. |
| *Phacelia scopulina* var. *submutica* | Debeque phacelia | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) of the study area in Colorado. |
| *Physaria obcordata* | Dudley Bluffs twinpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | UT–Uintah | **Potential for negative impact**. Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.1-9 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties with the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | CO–Garfield; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) of the study area in Colorado. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | UT–Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E; CO-T | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Gila elegans* | Bonytail | ESA-E | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E; CO-T | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Colorado and Utah. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E; CO-E | CO–Garfield, Rio Blanco; UT–Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the study area. Quad-level occurrences of this species intersect the study area in Colorado and Utah. |
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 907,570 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.1-9 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties with the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Grus americana* | Whooping crane | ESA-XN; CO-E | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the study area. This species may occur only as a rare migrant in the study area. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | UT–Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 26,004 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T; CO-E; WY-SC | CO–Garfield, Rio Blanco; UT–Emery, Uintah; WY Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 1,167 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN; CO-E | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, San Juan, Uintah; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 133,437 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah and Wyoming. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 1 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 1 footprint (i.e., study area). Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

the presence of potentially suitable habitat.[2] Potential lease areas include about 99 mi of critical habitat for Colorado River endangered fishes in Colorado and Utah; designated critical habitat for the Mexican spotted owl (*Strix occidentalis lucida*) also occurs about 5 mi (8 km) south of potential lease areas in Utah (Figure 6.1.1-4). Greater sage-grouse (*Centrocercus urophasianus*) core habitats and lek sites are shown in Figure 6.1.1-5. Under Alternative 1, potential oil shale lease areas intersect approximately 334,743 and 272,344 acres of core and priority sage-grouse habitat in Utah and Wyoming, respectively. Potential oil shale lease areas under Alternative 1 do not intersect sage-grouse core and priority areas in Colorado (Figure 6.1.1-5). The areas available for application for leasing under Alternative 1 also include more than 382,000 acres for which lease stipulations have been established in existing RMPs to protect federally listed and candidate species, BLM-designated sensitive species, and other special status species.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) by commercial oil shale development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions, contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

Potential impacts on threatened and endangered species (see Section 4.8.1.4) under Alternative 1 are fundamentally similar to or the same as impacts on aquatic resources, plant communities and habitats, and wildlife described in Sections 4.8.1.1, 4.8.1.2, and 4.8.1.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

#### 6.1.1.8 Visual Resources

Under Alternative 1, a total of 2,017,741 acres of public land in Colorado, Utah, and Wyoming are identified as available for application for leasing for commercial development of oil shale. These lands support a wide variety of visual resources (Section 3.8). These resources are not affected by the amendment of land use plans to identify the lands as available for application for commercial leasing. However, visual resources in and around these 2,017,741 acres could be affected by future commercial development of oil shale.

[2] Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the potential lease areas. This quantification is presented in Tables 6.1.1-8 and 6.1.1-9.

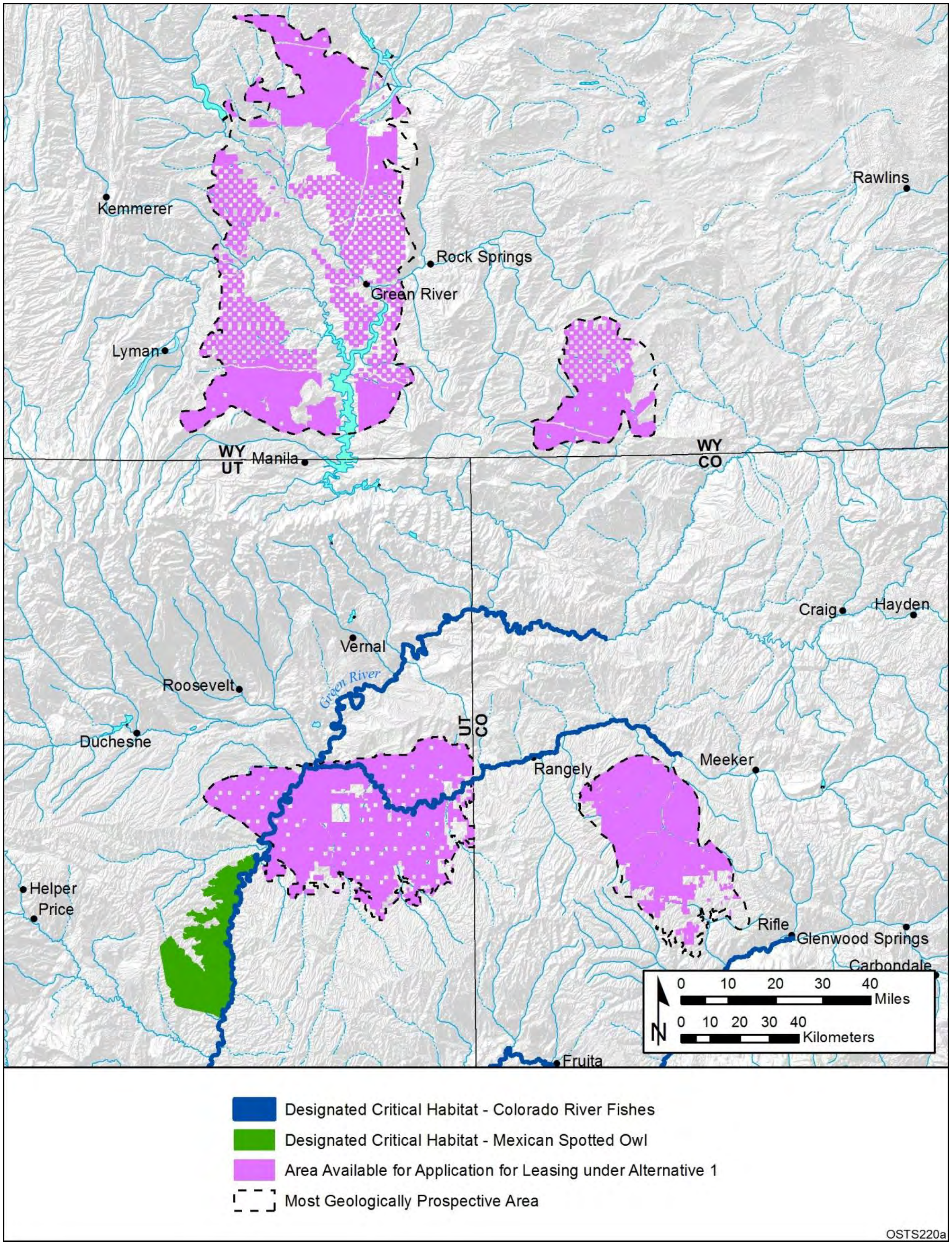


**FIGURE 6.1.1-4 Designated Critical Habitat of Threatened and Endangered Species That Are in or near Lands Available for Application for Leasing under Alternative 1**

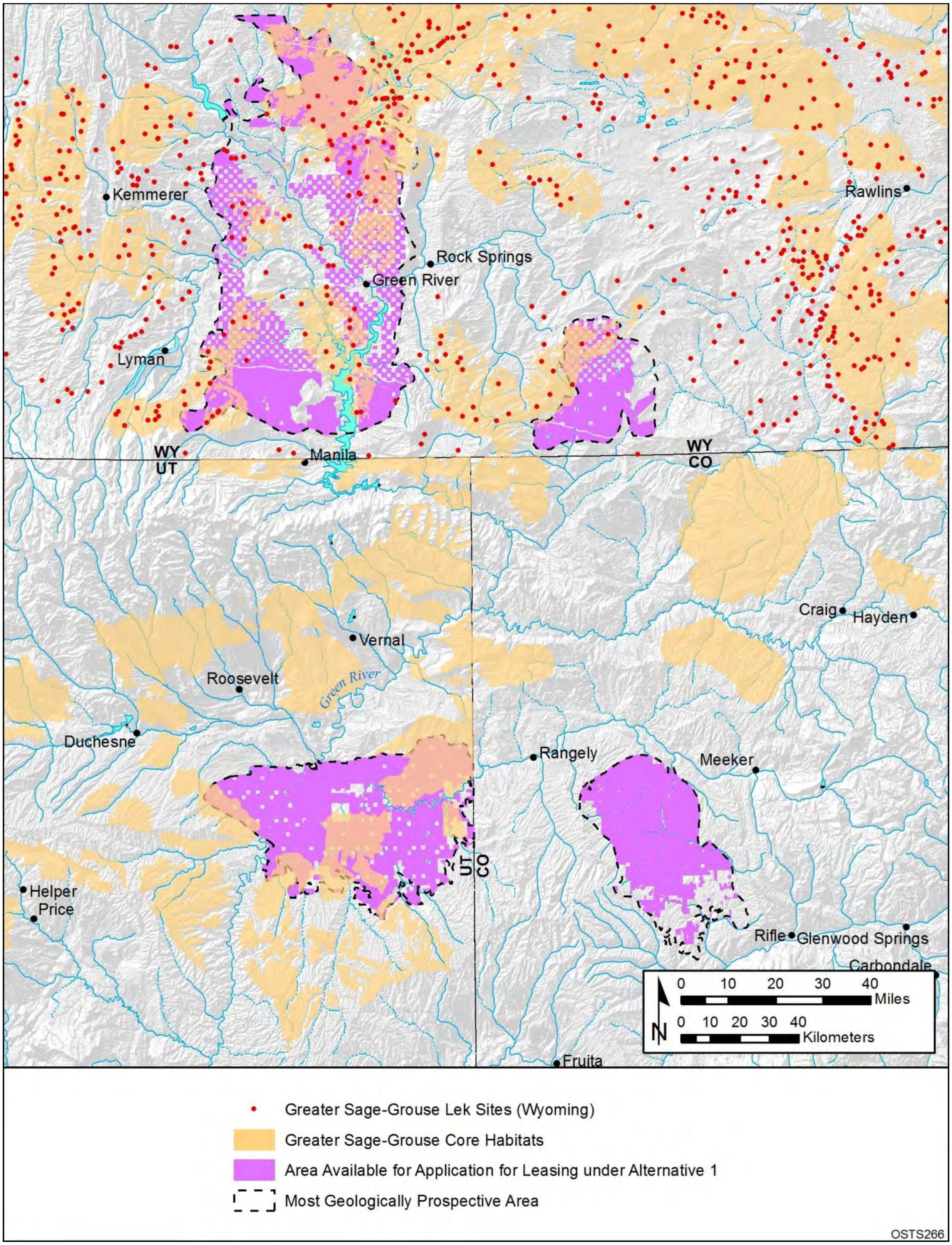


**FIGURE 6.1.1-5 Overlap of Lands Available for Application for Leasing under Alternative 1 with Core Habitat Areas of the Greater Sage-Grouse**

Certain scenic resource areas are located within the lease areas identified under Alternative 1 in Colorado, Utah, and Wyoming (Figures 6.1.1-6, 6.1.1-7, and 6.1.1-8, respectively). These include the following:

- Colorado: Duck Creek, Dudley Bluffs, Ryan Gulch, and East Fork–Parachute Creek ACECs;

- Wyoming: Greater Red Creek, Pine Springs, and Special Status Plant Species ACECs; and Skull Creek Wild & Scenic River;

- Utah: Lower Green River, Nine Mile Canyon, and Pariette ACECs; Blue Mountain, Fantasy Canyon, Nine Mile, Pelican Lake, and White River SRMAs; and segments of the Green River and Lower Green River determined to be eligible for WSR designation.

Additional scenic resource areas are located within 5 or 15 mi of the Alternative 1 proposed lease areas. The 5-mi zone corresponds to the BLM's VRM foreground-middleground distance limit, and the 15-mi zone corresponds to the BLM's background distance limit. Based on the assumption of an unobstructed view of the project, viewers in these areas would be likely to perceive some level of visual impact from a commercial oil shale project; impacts are expected to be greater for resources within the foreground-middleground distance, and lesser for resources within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.1.1-10 lists the scenic resource areas that fall within these zones.

Visual resources could be affected at and near the lease areas where commercial oil shale projects would be developed and operated, and at areas where supporting infrastructure (such as power and utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 4.9.1). Potential impacts could be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components, such as shale-processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

#### 6.1.1.9 Cultural Resources

Under Alternative 1, the amendment of land use plans to identify 2,017,741 acres of public land as available for application for commercial oil shale leasing would not result in impacts on cultural resources. However, cultural resources within these areas could be adversely affected if future leasing and development take place. The lands available under Alternative 1 overlap with lands that have been specifically identified as having cultural resources. Of the public lands that would be available under Alternative 1 for application for leasing, approximately 30% in the Piceance Basin, approximately 28% in the Uinta Basin, and

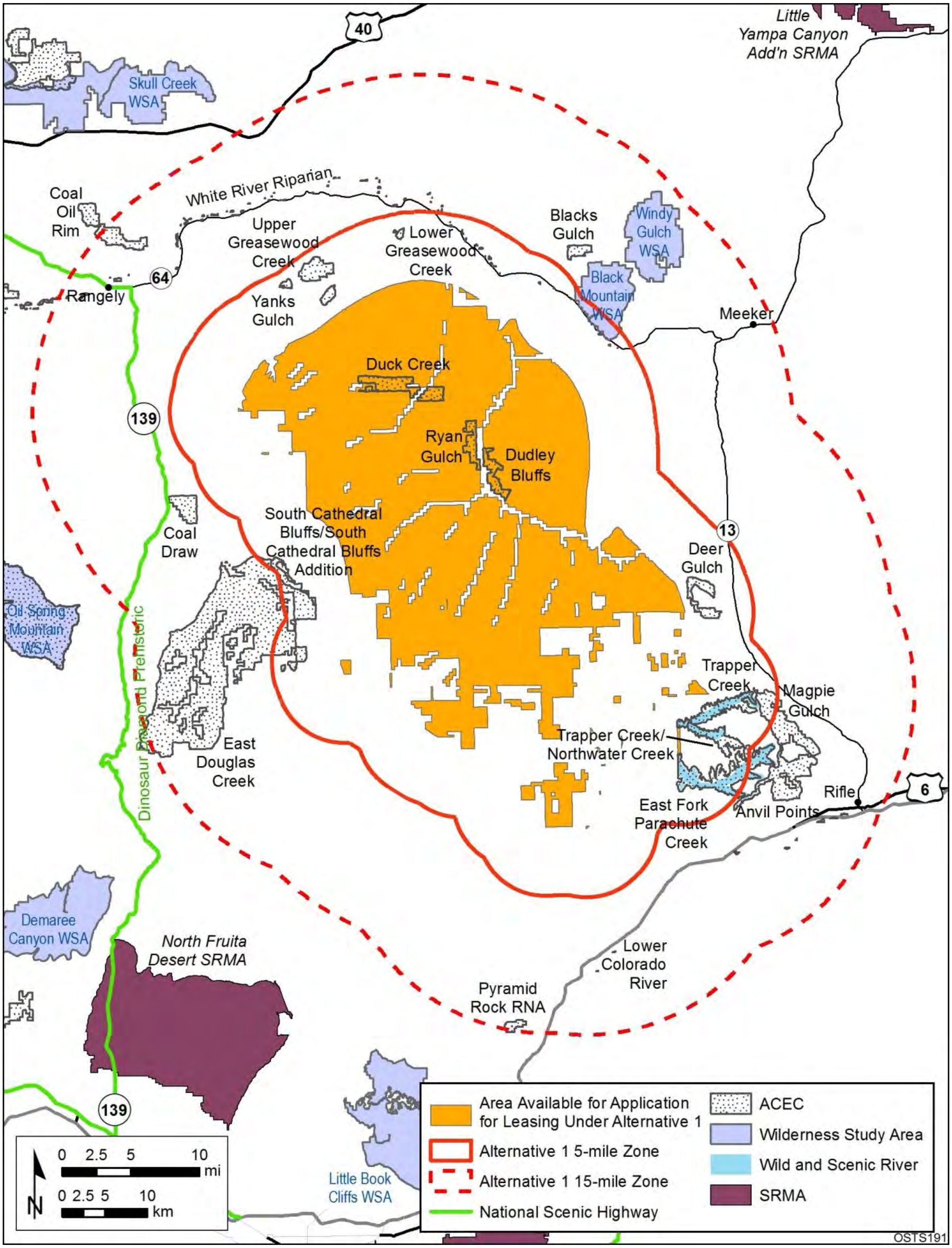


**FIGURE 6.1.1-6 Scenic Resource Areas within the 5-mi and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 in Colorado**

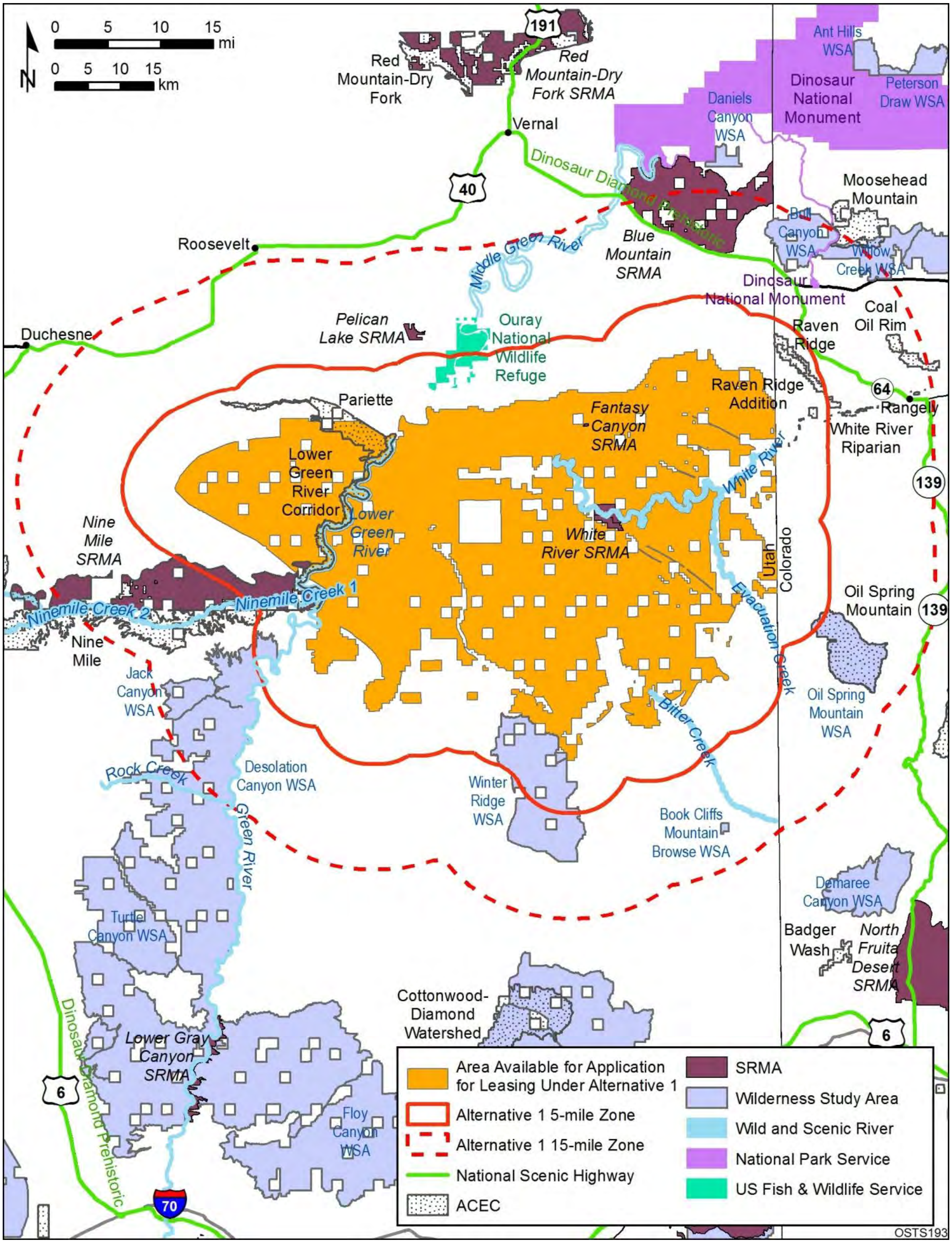


**FIGURE 6.1.1-7 Scenic Resource Areas within the 5-mi and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 in Utah**

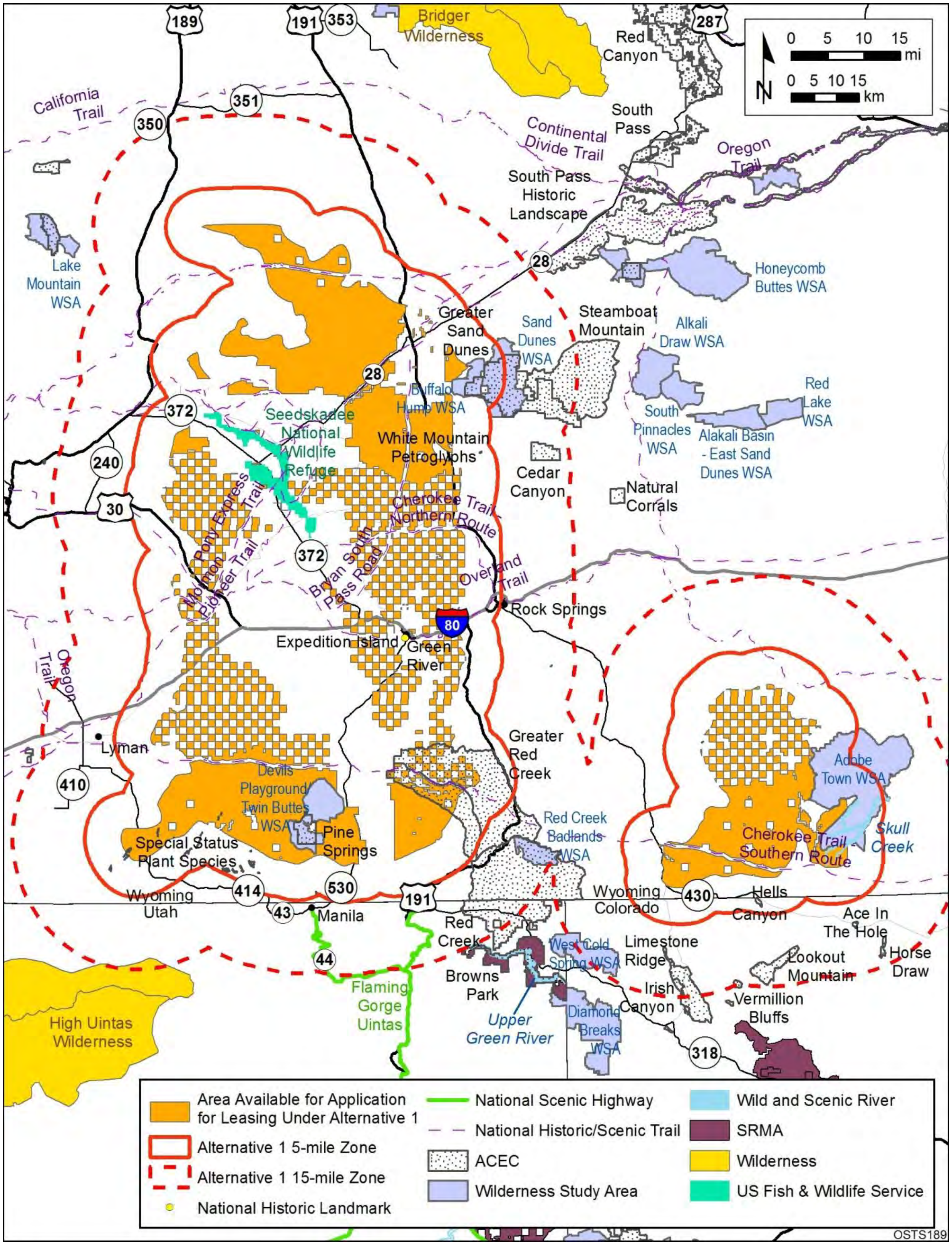


**FIGURE 6.1.1-8 Scenic Resource Areas within the 5-mi and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 in Wyoming**

**TABLE 6.1.1-10 Visually Sensitive Areas That Could Be Affected by Commercial Oil Shale Projects within the Lease Areas Identified under Alternative 1**

| Location | Scenic Resources within 5 mi of Alternative 1 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 1 Lease Areas |
|---|---|---|
| ***Colorado*** | Deer Gulch, Duck Creek, Dudley Bluffs, East Douglas Creek, East Douglas Creek/South Cathedral Bluffs Addition, East Fork Parachute Creek, Lower Greasewood Creek, Magpie Gulch, Ryan Gulch, South Cathedral Bluffs Addition, South Cathedral Bluffs/South Cathedral Bluffs Addition, Trapper Creek, Trapper Creek/Northwater Creek, Upper Greasewood Creek, White River Riparian, and Yanks Gulch ACECs; segments of Trapper Creek, Northwater Creek, and East Fork Parachute Creek determined to be eligible for WSR designation; and Black Mountain WSA. | Anvil Points, Blacks Gulch, Coal Draw, Coal Oil Rim, East Douglas Creek, East Fork Parachute Creek, Lower Colorado River, Magpie Gulch, Pyramid Rock RNA, and White River Riparian ACECs; segments of East Fork Parachute Creek determined to be eligible for WSR designation; Dinosaur Diamond Prehistoric National Scenic Highway; and Black Mountain and Windy Gulch WSAs. |
| ***Utah*** | Lower Green River Corridor, Nine Mile, Oil Spring Mountain, Pariette, Raven Ridge, Raven Ridge Addition, Raven Ridge/Raven Ridge Addition, and White River Riparian ACECs; Ouray NWR; Dinosaur Diamond Prehistoric National Scenic Highway; Ninemile and White River SRMA; and the Desolation Canyon, Oil Spring Mountain, and Winter Ridge WSAs. | Coal Oil Rim, Moosehead Mountain, Nine Mile, Oil Spring Mountain, Raven Ridge, Raven Ridge Addition, and White River Riparian ACECs; Dinosaur National Monument; Ouray NWR; Dinosaur Diamond Prehistoric National Scenic Highway; Nine Mile, Blue Mountain, and Pelican Lake SRMAs; segments of Lower Green River determined to be eligible for WSR designation; and Desolation Canyon, Oil Spring Mountain, Winter Ridge, Book Cliffs Mountain Browse, Bull Canyon, Jack Canyon, and Willow Creek WSAs. |
| ***Wyoming*** | Greater Red Creek, Greater Sand Dunes, Hells Canyon, Pine Springs, Special Status Plant Species, and White Mountain Petroglyphs ACECs; Expedition Island NHL; Bryan South Pass Road, California, Cherokee Trail–Northern Route, Cherokee Trail–Southern Route. Mormon Pioneer, Oregon, Overland, and Pony Express NHTs; Seedskadee NWR; segments of Skull Creek determined to be eligible for WSR designation; and Adobe Town, Buffalo Hump, Devils Playground/Twin Buttes, and Sand Dunes WSAs. | Ace in the Hole, Browns Park, Cedar Canyon, Greater Red Creek, Greater Sand Dunes, Horse Draw, Irish Canyon, Limestone Ridge, Lookout Mountain, Red Creek, Special Status Plant Species, Steamboat Mountain, and Vermillion Bluffs ACECs; Bryan South Pass Road, California, Cherokee Trail–Northern Route, Cherokee Trail–Southern Route. Mormon Pioneer, Oregon, Overland, and Pony Express NHTs; segments of Skull Creek and Upper Green River (Utah) determined to be eligible for WSR designation; Flaming Gorge Uintas Scenic Highway; High Uintas Wilderness; and Adobe Town, Red Creek Badlands, Sand Dunes, and West Cold Spring WSAs. |

approximately 8% in the Green River and Washakie Basins have been surveyed for cultural resources. A total of approximately 7,200 sites[3] have been identified in these surveyed areas. Additional cultural resources are likely to exist in the unsurveyed portions of the proposed lease areas. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), about 210,038 acres (60%) in the Piceance Basin, 583,165 acres (92%) in the Uinta Basin, and 859,666 acres (86%) in the Green River and Washakie Basins within Alternative 1 have been identified as having a medium or high sensitivity for containing cultural resources.

Leasing itself has the potential to have an impact on cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development to cultural properties. Impacts from subsequent development could include the destruction of individual resources present within development footprints, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resource from looting or vandalism to resources as a result of increased human presence/activity in the sensitive areas, and visual degradation of cultural setting (see Section 6.1.1.8). Compliance with all pertinent laws, regulations, and policies at both the leasing and development stages would likely result in lease stipulations and other measures at the project development stage to avoid, minimize, and mitigate impacts on cultural resources, or in the denial of the lease or project.

#### 6.1.1.10 Indian Tribal Concerns

The areas under consideration for oil shale development all have a long history of Native American habitation and use. They are likely to include resources important to Native Americans, including evidence of past life in the area, such as burials, archaeological sites, and rock art panels; landscape features important to their cultural traditions; ceremonial sites; and sources of traditional resources still in use, such as plants for medicine and sustenance, minerals for ceremonial use, and the habitat of culturally important animals. Under Alternative 1, no existing BLM land use plans would be modified. Tribes with traditional ties to the BLM planning areas were contacted and provided the opportunity to consult during the development of these plans. Many Native American concerns have been taken into account in the plans and procedures laid out in these plans. It is estimated that 2,017,741 acres of BLM-administered land would continue to be available for application for commercial leasing, and management prescriptions in existing plans would not be modified. Making land available for application for leasing would not affect resources important to Native Americans. However, leasing and future development could result in adverse impacts. Impacts would vary with the size, location, and technology chosen to develop the lease. Under Alternative 1, surface mining, which has the most potential for adverse impacts, would be allowed in parts of Utah and Wyoming. Surface mining could result in the complete or partial removal of places and resources important to the tribes.

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[3] The archaeological site tools used in the analysis of the alternatives for the PEIS were modified from the raw site tallies supplied by the Colorado, Utah, and Wyoming SHPOs in 2011. The unfiltered site data, and the associated spatial data included with them, serve as the basis for the cultural sensitivity models. However, duplicate site entries were removed prior to generating the numbers used for the alternatives analysis.

Underground mining and associated processing facilities would have less potential for complete destruction, but would include the potential for partial destruction of sites and resources, for an increase in the likelihood of vandalism by introducing more people to the area being developed, and for visual and auditory intrusion on sacred and traditionally important landscapes. Under Alternative 1, split estate parcels in the Hill Creek Extension of the Uintah and Ouray Reservation, where the tribe owns the surface rights and the government owns the subsurface rights, could be leased. This would affect the surface resources of the reservation.

Current BLM land management plans, implemented consistent with such authorities as NAGPRA, AIRFA, NHPA, E.O. 13007, the Energy Policy Act of 2005, and BLM regulations, have mechanisms in place for consultations with tribes with regard to undertakings on BLM-administered lands and show a commitment to coordinating development of the subsurface estate with surface owners. Early and effective consultation can reduce the impacts of oil shale development on resources important to Native Americans through avoidance, facility design, and access provisions procedures such as coordination with tribal surface owners of split estate lands (BLM 2008c). Proactive measures such as conducting the cultural resource surveys required by Section 106 of the NHPA can enhance the consultation process. Land excluded from commercial leasing in the current plans (see Section 3.1), such as ACECs currently closed to mineral development, Wilderness Areas, WSAs, and WSRs, often include surface use restrictions, timing limitations on use, and other stipulations that act to protect resources important to tribes. Under Alternative 1 all the exclusions listed in Table 2.3.2-2, except the MMTA in Wyoming, would reduce impacts on traditional resources important to tribes. Specific lease stipulations developed in consultation with affected tribes at the time of decisionmaking regarding possible leasing and development could reduce the impacts on resources that may be affected by the development of specific parcels.

#### 6.1.1.11 Socioeconomics

Under Alternative 1, a total of 2,017,741 acres of public land in Colorado, Utah, and Wyoming would remain identified as available for application for leasing for commercial development of oil shale. With the possible exception of an impact on property values, there is no socioeconomic impact of this identification. The socioeconomic impacts described in Section 4.12 and summarized in this section are for hypothetical individual commercial oil shale projects. These represent the types of impacts that could occur as a result of commercial development on lands identified as available for commercial leasing. The specific socioeconomic impacts of future commercial oil shale projects would be dependent upon the technologies employed, the project size or production level, and development time lines and mitigation measures.

- Oil shale developments and their associated ancillary facilities might affect property values in ROI communities located nearby. Furthermore, it is possible that there will be property value impacts simply from designating land as available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.12.1.6). Property values might decline in some locations as a result of the anticipated, and, if eventually leased and developed, actual deterioration in aesthetic quality, increases in noise, real or perceived health effects, congestion, or social disruption. In other locations, property values might increase as a result of new access to employment opportunities associated with oil shale developments.

- Under Alternative 1, surface mining with surface retorting could produce about 2,200 total (direct plus indirect) jobs in the three ROIs in the peak year of construction, and 2,900 to 3,000 jobs during operations. Underground mining could create 2,200 to 2,600 jobs during construction, and 2,900 to 3,300 jobs created during the operating period. An in situ processing facility could create 2,300 to 2,900 jobs during construction and 780 to 950 jobs during operations. Income produced by each technology could be $40 million to $169 million during construction and operations in the three ROIs, and peak construction employment could represent an increase of 1.5% to 4.6% over the projected peak year employment in the three ROIs.

- Construction of power plants in association with in situ facilities (if needed) could produce 2,800 to 3,100 total jobs in the three ROIs during the peak construction year and 300 to 330 jobs during operations. The construction and operation of these ancillary power plants could produce $160 million to $220 million in income in the three ROIs, and peak construction employment would represent an increase of 2.4% to 5.6% over the projected ROI employment baseline in the peak year. Ancillary coal mine development in each ROI, also possibly associated with in situ facilities, could produce 200 to 1,300 jobs during construction and 210 to 960 employees during operations. Coal mine construction and operation could produce $12 million to $56 million in income in the three ROIs, and peak construction employment for the coal mines would represent an increase of 0.4% to 2.3% over the projected peak year employment in the three ROIs.

- Construction of housing provided for oil shale workers and their families could create 560 to 620 jobs and $10 million to $15 million in income in the ROIs. Construction of housing for power plant workers and families (associated with in situ facilities only) could create 760 to 820 jobs, while construction of housing for coal mine workers (if needed) could produce 52 to 320 jobs. Income of $14 million to $19 million could be produced during construction of housing for power plant workers and $1 million to $7 million during construction of coal mine worker housing.

- Population increases associated with the construction of an underground mine project would represent an increase of 0.6% to 1.4% over the ROI baseline population during construction and 1% to 3.2% during operations, with similar increases expected for a surface mine. If additional power plants and coal mines are needed in association with in situ facilities, population increases associated with the power plants would represent increases of 0.8%

to 1.7% during construction and 0.1% to 0.3% during operations. Coal mine development would increase ROI population by 0.1% to 0.4% during construction and by 0.2% to 0.3% during operations in each ROI.

- For oil shale facilities, the associated in-migrating population could absorb 2.9% to 6.2% of vacant housing units. For a power plant (if needed), population increases associated with construction could require 3.8% to 6.4% of the vacant housing stock in the ROIs, while coal mine development (if needed) could require 0.5% to 2.9% of vacant units in the ROIs.

- A surface mine facility could require an increase of 1.1% to 1.7% in local expenditures during construction and 2.5% to 3.8% during operations (Table 4.12.1-5). Construction of an underground mine would require an increase in local public service provision of 1.0% to 1.7% in expenditures during construction and 1.8% to 3.9% during operations. Construction of an in situ facility could require an increase in local public service provision of 1.2% to 1.9% in expenditures during construction and 0.5% to 1.1% during operations. A power plant (if needed) could require an increase in local public service provision of 1.1% to 1.9% in expenditures during construction and 0.2% to 0.4% during operations (Table 4.12.1-6). Coal mine development (if needed) could require an increase in local government expenditures of 0.2% to 0.6% during construction and 0.3% to 0.5% during operations.

- The number of new residents from outside the producing regions and the pace of population growth associated with the commercial development of oil shale resources, including large-scale production facilities and ancillary power plants, coal mines, and housing developments, would likely lead to substantial demographic and social change in small rural communities. These communities would likely be required to adapt to a different quality of life—away from a more traditional lifestyle in small, isolated, close-knit, homogenous communities with a strong orientation toward personal and family relationships, toward a more urban lifestyle, with increasing cultural and ethnic diversity and increasing dependence on formal social relationships within the community.

- Substantial changes in access to water by agriculture may or may not occur and could have large impacts on the economy of each ROI, and these would depend on the amount of agricultural production lost, the extent of local employment in agriculture, the reliance of other industries in each ROI on agricultural production, the extent of local procurement of equipment and supplies by agriculture, and the local spending of wage and salaries by farmers, ranchers, and farmworkers. Loss of property tax revenues on agricultural land could also have an impact on local government expenditures and, consequently, on the provision of public services in local communities in each ROI. Changes in agricultural activity could change the character of community life in each ROI, with a movement away from activities that historically represent small rural communities.

- The impact of each oil shale technology on recreational visitation in the Colorado ROI would be the loss of 1,415 jobs if there were a 10% reduction in recreation employment, and 2,830 jobs for a 20% decline in recreation employment. In the Utah ROI, 388 jobs would be lost as a whole as a result of a 10% reduction in recreation employment, and 776 jobs would be lost with a 20% reduction. In the Wyoming ROI, 1,360 jobs would be lost under the 10% scenario, and 2,719 jobs under the 20% scenario. There is no way to be certain whether there will actually be reductions in recreational employment.

The identification of 2,017,741 acres of public land in Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale is expected to have no impacts on transportation systems and infrastructure or on traffic use levels. The identification of these lands does not authorize or approve any ground-disturbing activities that could affect transportation infrastructure or traffic use levels; however, future commercial oil shale development on these lands could have impacts. Any future leasing or development activities would be subject to NEPA analysis, which would assess impacts of the proposed action(s). Transportation impacts would be similar to those described in Section 4.12.1.8.

**6.1.1.11.1 Projections.** As a representation of the impacts of the No Action Alternative, Alternative 1, this section presents projected baseline data for a number of economic and social variables used in the analysis of impacts under each alternative, namely, employment, personal income, population, housing, and fiscal conditions. Included in the employment, population, and public service expenditure projections are the impacts of RD&D projects in Colorado and Utah and the designation of acreage for commercial oil shale leasing and development in the three states. Projections are presented for a base year, 2009, and for 2012, 2016, 2022, 2027, and 2029, the years likely to produce the largest impacts associated with construction and operation of RD&D projects and commercial oil shale facilities.

Although the extent of the impact of the current natural gas and oil development on employment in each ROI over the next 30 years is not known, growth is expected to be rapid, with energy-related employment in northwestern Colorado projected to reach almost 8,900 jobs by 2020 and almost 9,300 by 2035 (BBC Research and Consulting 2008).

***Employment.*** Wage and salary employment projections based on county population forecasts indicate that employment will grow at a relatively modest pace in each ROI from 2009 through 2027 (Table 6.1.1-11). In the Colorado ROI, employment is expected to reach 221,303 by 2029, with an average annual growth rate of 2.5%, while employment in the state is expected to grow at 1.7% over the same period. In the Utah ROI, a growth rate of 1.1% is expected over the 2009 through 2029 period, with growth in state employment higher at 2.2%. At these rates, by 2029, employment is expected to reach approximately 74,898 in the Utah ROI. Employment is expected to stand at about 59,618 in the Wyoming ROI in 2029, with a growth rate of 0.7% in the ROI and 0.6% in the state.

**TABLE 6.1.1-11 Total Employment[a] for Each ROI and State**

| | Number of Employees | | | | | |
|---|---|---|---|---|---|---|
| Parameter | 2009 | 2012 | 2016 | 2022 | 2027 | 2029 |
| ***Colorado*** | | | | | | |
| ROI | 134,964 | 147,309 | 163,464 | 192,313 | 213,754 | 221,303 |
| Colorado | 2,407,098 | 2,526,961 | 2,717,818 | 3,029,476 | 3,273,764 | 3,366,474 |
| ***Utah*** | | | | | | |
| ROI | 59,537 | 61,706 | 65,781 | 70,976 | 73,777 | 74,898 |
| State | 1,285,134 | 1,418,075 | 1,551,898 | 1,753,591 | 1,923,265 | 1,991,134 |
| ***Wyoming*** | | | | | | |
| ROI | 51,702 | 53,697 | 55,535 | 57,851 | 59,064 | 59,618 |
| State | 275,607 | 277,688 | 285,572 | 296,885 | 307,418 | 312,051 |

[a] Projections are based on forecasted growth rates in population for each ROI and state.

Sources: U.S. Department of Labor (2011); Colorado State Demography Office (2011); Utah Governor's Office of Planning and Budget (2011); Wyoming Department of Administration and Information (2011).

Forecasts recently completed for the Associated Governments of Northwest Colorado, which include some level of oil shale development, indicate that employment is likely to grow from 110,683 in 2005 to 184,978 in 2025, at an average annual rate of 2.6%, in the four-county area comprising Garfield, Mesa, Moffat, and Rio Blanco Counties (BBC Research and Consulting 2008).

***Population.*** County and state projections indicate that population will grow at a relatively modest rate in the Colorado and Utah ROIs between 2009 and 2029. In the Colorado ROI, at an average annual growth rate of 2.5%, population is expected to reach 416,860 by 2029, while in the Utah ROI, at an annual rate of 1.1% population is expected to reach 140,052 by 2029. In Wyoming, relatively low annual growth rates are expected in the ROI (0.7%) between 2009 and 2029, with population expected to stand at 109,550 in 2029. Fairly rapid annual population growth is expected in Utah as a whole (2.2%), with lower annual rates of growth expected for Colorado (1.7%) and Wyoming (0.6%) (Table 6.1.1-12).

Forecasts recently completed for the Associated Governments of Northwest Colorado indicate that the population is likely to grow from 200,835 in 2005 to 345,699 by 2025, at an average annual rate of 2.8%, in the four-county area comprising Garfield, Mesa, Moffat, and Rio Blanco Counties (BBC Research and Consulting 2008).

**TABLE 6.1.1-12 Total Population[a] for Each ROI and State**

| Parameter | Population 2009 | 2012 | 2016 | 2022 | 2027 | 2029 |
|---|---|---|---|---|---|---|
| ***Colorado*** | | | | | | |
| ROI | 254,227 | 277,480 | 307,911 | 363,383 | 402,641 | 416,860 |
| State | 5,074,567 | 5,327,259 | 5,729,618 | 6,386,646 | 6,901,645 | 7,097,093 |
| ***Utah*** | | | | | | |
| ROI | 112,037 | 115,948 | 123,313 | 132,760 | 137,969 | 140,052 |
| State | 2,784,572 | 3,072,624 | 3,362,585 | 3,799,604 | 4,167,246 | 4,314,303 |
| ***Wyoming*** | | | | | | |
| ROI | 94,868 | 98,550 | 101,940 | 106,230 | 108,510 | 109,550 |
| State | 544,270 | 548,380 | 563,370 | 586,290 | 607,090 | 616,240 |

[a] Projections are based on forecasted growth rates in population for each ROI and state.

Sources: U.S. Census Bureau (2006a); Colorado State Demography Office (2011); Utah Governor's Office of Planning and Budget (2011); Wyoming Department of Administration and Information (2011).

***Fiscal Conditions.*** In the Colorado ROI, public service expenditures are expected to reach $751.4 million by 2027 at an average annual growth rate of 2.6%, while in the Utah ROI public service expenditures are expected to reach $264.3 million by 2027, growing at an annual rate of 0.9% over the period 2000 through 2027. In Wyoming, relatively low annual growth rates are expected in the ROI (0.8%) between 2000 and 2027, with expenditures expected to stand at $319.0 million in 2027. Fairly rapid public service expenditure growth is expected in Utah as a whole (3.0%), with lower annual rates of growth expected for Colorado (1.7%) and Wyoming (0.8%) (Table 6.1.1-13).

**6.1.1.11.2 Impacts Common to All Alternatives.** Construction and operation of RD&D oil shale facilities and the associated temporary housing will impact the economies of each ROI. On the basis of employment numbers presented in the EAs and the IMPLAN model results (Minnesota IMPLAN Group, Inc. 2007; see discussion of the socioeconomic assessment methodology in Section 4.12), the five current and three pending in situ RD&D projects will create 2,059 jobs (1,080 direct jobs at oil shale facilities and 979 indirect jobs in the remainder of the local economy) in the Colorado ROI and $123.3 million in income during the peak year of construction and 1,355 additional jobs (713 direct and 641 indirect jobs) during operations, thus producing $80.6 million in income (Table 6.1.1-14). In situ construction employment represents an increase of 1.4% over the projected ROI employment baseline for 2012 (see Section 3.11.2). The underground mining and surface retort projects in Utah will create 360 jobs (240 direct and 120 indirect jobs) and $18.4 million in income during the peak construction year, and 362 jobs (240 direct and 122 indirect) and $18.4 million in income during the first year of operation.

**TABLE 6.1.1-13 Annual State and ROI Public Service Expenditures Comparing Each ROI and State[a]**

| | Public Service Expenditures ($ million 2005) | | | | | |
|---|---|---|---|---|---|---|
| Parameter | 2005 | 2009 | 2012 | 2016 | 2022 | 2027 |
| ***Colorado*** | | | | | | |
| ROI | 416.8 | 461.9 | 504.2 | 568.1 | 699.0 | 751.4 |
| State | 39,481 | 42,720 | 45,267 | 48.783 | 54.073 | 58,483 |
| ***Utah*** | | | | | | |
| ROI | 215.4 | 219.1 | 224.8 | 234.6 | 250.3 | 264.3 |
| State | 19,455 | 21,307 | 23,682 | 27,685 | 33,250 | 38,255 |
| ***Wyoming*** | | | | | | |
| ROI | 268.8 | 285.8 | 293.2 | 299.8 | 309.8 | 319.0 |
| State | 5,638 | 5,919 | 6,068 | 6,240 | 6,501 | 6,732 |

[a] Projections are based on forecasted growth rates in population for each ROI and state.

Sources:

*Colorado*: City of Craig (2003); City of Delta (2004); City of Fruita (2005); City of Glenwood Springs (2004); City of Grand Junction (2004); City of Rifle (2004); Colorado State Demography Office (2007); Delta County (2005); Garfield County (2004); Mesa County (2003); Moffat County (2005); Rio Blanco County (2005); Town of Meeker (2005); Town of Parachute (2005); Town of Rangely (2004); Town of Silt (2005).

*Utah:* Carbon County (2004); City of Moab (2006); Duchesne County (2004); Emery County (2004); Garfield County (2004); Grand County (2004); Price Municipal Corporation (2005); Roosevelt City Corporation (2005); San Juan County (2004); Uintah County (2004); Utah Governor's Office of Planning and Budget (2006); Vernal City Corporation (2005); Wayne County (2004).

*Wyoming*: Carbon County (2006); City of Evanston (2005); City of Green River (2004); City of Kemmerer (2005); City of Rawlins (2005); City of Rock Springs (2005); Lincoln County (2006); Sweetwater County (2005); Uinta County (2005); Wyoming Department of Administration and Information (2006).

*Overall*: Standard and Poor's (2006); U.S. Census Bureau (2006a,b).

### 6.1.1.12 Environmental Justice

The potential environmental justice impacts described in Section 4.13 and summarized in this section are for hypothetical individual commercial oil shale projects. These represent the types of impacts that could occur as a result of development on lands identified as available for application for commercial leasing under Alternative 1.

Since oil shale development projects and ancillary power plant and housing developments would lead to rapid population growth in many of the communities in each ROI, it is possible that social disruption could occur, leading to the undermining of local community

**TABLE 6.1.1-14 Estimated ROI Economic Impacts of RD&D Oil Shale Development Projects Common to All Alternatives[a]**

| | Housing Construction | | Oil Shale Development | | | |
|---|---|---|---|---|---|---|
| | | | Construction | | Operation | |
| Parameter | Employment (number of jobs) | Income ($ million) | Employment (number of jobs) | Income ($ million) | Employment (number of jobs) | Income ($ million) |
| ***Colorado*** | | | | | | |
| In situ processing (5 RD&D projects) | | | | | | |
| Direct | 343 | 8.2 | 1,080 | 97.2 | 713 | 64.3 |
| Indirect | 113 | 3.2 | 979 | 26.1 | 641 | 16.3 |
| Total | 456 | 11.5 | 2,059 | 123.3 | 1,355 | 80.6 |
| ***Utah*** | | | | | | |
| Underground mining with surface retorting (1 RD&D project) | | | | | | |
| Direct | 32 | 0.6 | 240 | 16.0 | 240 | 16.0 |
| Indirect | 8 | 0.2 | 120 | 2.4 | 122 | 2.4 |
| Total | 40 | 0.8 | 360 | 18.4 | 362 | 18.4 |

[a] Totals may be off due to rounding. The direct employment data presented in this table for the construction and operation of the RD&D projects are based on information contained in the final EAs prepared for the six RD&D projects. Direct employment numbers and multiplier data from the IMPLAN model (Minnesota IMPLAN Group, Inc. 2007) were used to calculate indirect employment numbers for each ROI. The direct employment numbers for the construction of the in situ projects are based on the assumption that only three projects will be under construction simultaneously (American Shale Oil [AMSO], Chevron, and one Shell project). For operation of the in situ projects, it is assumed that all five projects will be under operation simultaneously.

social structures with contrasting beliefs and value systems among the local population and in-migrants and, consequently, to a range of changes in social and community life, including increases in crime, alcoholism, drug use, and so forth. Impacts on property values of property owned by minority and low-income individuals would depend on the range of alternate uses of specific land parcels, current property values, and the perceived value of costs (traffic congestion; noise and dust pollution; and visual, air quality, and EMF effects) and benefits (infrastructure upgrades, employment opportunities, and local tax revenues) associated with proximity to oil shale–related facilities.

Each technology would produce surface disturbance, fugitive dust, vehicle emissions, and visible activity that could generate visual impacts. Emissions associated with construction activities would consist primarily of particulate matter ($PM_{2.5}$ and $PM_{10}$), criteria pollutants, VOCs, $CO_2$, and certain HAPs released from heavy construction equipment and vehicle exhaust.

Because of the limited availability of surface water and groundwater, the amount of water needed in commercial oil shale projects, power plants and coal mines (if needed), and associated population growth would mean that additional water resources would be needed. Oil shale facilities might impact certain animals or vegetation types that may be of cultural or religious significance to certain population groups or that form the basis for subsistence agriculture. Similarly, land used for these facilities that has additional economic uses might affect access to resources by low-income and minority population groups.

Given the location of environmental justice populations in each state, construction and operation of oil shale facilities, power plants and coal mines (if needed), and employer-provided housing could produce impacts that could be experienced disproportionately by minority and low-income populations. Of particular importance would be social disruption impacts of large increases in population on small rural communities, the undermining of local community social structures, and the resulting deterioration in quality of life. The impacts of facility operations on air and water quality and on the demand for water in the region could also be important. Land use and visual impacts might be significant depending on the location of land parcels for oil shale projects and the associated power plant and housing facilities, their importance for subsistence, their cultural and religious significance, and alternate economic uses. Depending on the locations of low-income and minority populations, impacts could also occur with the development of transmission lines associated with power development and the supply of power to oil shale facilities in each state.

#### 6.1.1.13 Hazardous Materials and Waste Management

Under Alternative 1, a total of 2,017,741 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. There would not be any hazardous material or waste management concerns associated with the identification of the availability of this land for this use. Impacts related to hazardous materials and wastes could occur during future development of commercial oil shale projects within areas identified in Alternative 1 as available for application for commercial leasing. Such impacts are generally independent of location but would be unique to the technology combinations used for oil shale development. However, hazardous materials and wastes are similar for some of the ancillary support activities that would be required for development of any oil shale facility regardless of the technology used. These include the impacts from development or expansion of support facilities such as employer-provided housing, transmission or transportation infrastructure, and power plants.

Hazardous materials and wastes could be used and generated during both the construction and operation of commercial oil shale facilities and supporting infrastructure (e.g., power plants). Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, and corrosion control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites, and other wastes typically associated with construction, none of which are expected to be hazardous (Section 4.14.1).

During project operations, hazardous materials could be utilized, and a variety of wastes (some hazardous) could be generated. Hazardous materials used include fuels, solvents, corrosion control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations will depend on the specific design of the commercial oil shale project (surface or subsurface mining, surface retorting, in situ processes). Waste materials produced during operations may include spent shale, waste engine fuels and lubricants, pyrolysis water, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 4.14.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial oil shale project, it is not possible to quantify project-related impacts of these materials. Under Alternative 1, individual facilities could be located anywhere within the area identified as available for leasing, pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Section 4.15) at locations where the individual projects are sited within the Alternative 1 potential lease areas.

#### 6.1.1.14 Health and Safety

The identification of 2,017,741 acres of public land as being available for application for leasing and the amendment of land use plans to identify these areas does not result in any direct health and safety concerns. However, a number of health and safety concerns would be associated with the commercial development of oil shale projects within the areas in Alternative 1 identified as available for commercial leasing. The level of health and safety impacts would be mainly dependent on the extent of oil shale development, the extent of health and safety precautions imposed by the operators, and the design of each project (as related to the level of air and water emissions associated with a facility).

Potential health and safety impacts from the construction and operation of commercial oil shale projects could be associated with the following activities: (1) constructing project facilities and associated infrastructure, (2) mining (if processing is not in situ) the oil shale; (3) obtaining and upgrading the crude oil, either through surface retorting or in situ processing; (4) transporting construction and raw materials to the upgrading facility and transporting product from the facility; and (5) exposing the general public to water and air contamination associated with oil shale development. Hazards from oil shale development (summarized in Table 4.15-1) could include physical injury from construction, oil shale processing, and vehicle transportation accidents and exposure to fugitive dust and hazardous materials, such as retort emissions and industrial chemicals (Section 4.15). Health and safety impacts would be largely restricted to the immediate workforce of each facility. Accidents could also affect members of the general public who could be present in the immediate vicinity of an accident (e.g., project-related truck accident on a public road, recreational users in areas adjacent to the project lease area).

Workers could be exposed to different hazards depending on the type of jobs they do. Workers at all types of oil shale development facilities could be exposed to high noise levels, resulting in hearing loss. The health and safety of miners could be impacted by injuries or deaths due to accidents (e.g., highwall bank failures or cave-ins, uncontrolled explosions, accidents involving heavy machinery), or heat exposures. Workers operating surface retorts also could be injured or die due to accidental explosions, heat stress, or accidents involving heavy machinery. Physical hazards from well-drilling, the use of explosives, and the operation of heavy equipment would be present for in situ workers.

Serious and often fatal lung disease in miners has been associated with inhalation of particulates and volatile compounds containing carcinogenic PAHs; such exposures could be limited by adherence to applicable occupational health and safety standards. Lung disease caused by inhalation of emissions from the retorting process would also be of concern for retort operators, although these exposures are generally lower than those associated with mining. For workers at facilities using in situ recovery techniques, hazards associated with inhalation of emissions would also be expected to be lower than those associated with mining.

Estimates of expected injuries and fatalities can be made on the basis of numbers of employees and the type of work. Based on the numbers of employees projected to be needed for construction and operation of oil shale facilities, there would statistically be less than 1 death and about 125 injuries per year expected per facility during construction activities, and less than 1 death and less than 100 injuries per year expected per facility during operations (NSC 2006). A comprehensive facility health and safety plan and worker safety training will be required as part of the plan of development for every proposed commercial oil shale project.

Health and safety concerns are largely independent of the location of oil shale development facilities. However, the health and safety impacts on the general public from emissions from these facilities would depend both on the specific characteristics and level of emissions, and on the distance of the emissions source from population centers. The level of air and water emissions would be regulated under required permits. Potential impacts on the general public from emissions would be assessed in future site-specific NEPA and permitting documentation.

### 6.1.2 Impacts of Alternative 2, Conservation Focus

Under Alternative 2, the BLM would amend eight BLM land use plans to designate only 461,965 acres of public land as available for application for leasing for commercial development of oil shale within the most geologically prospective oil shale areas in Colorado, Utah, and Wyoming (see Figures 2.3.3-1, 2.3.3-2, and 2.3.3-3, respectively). (See Section 2.3.3.1 for a complete description of Alternative 2.) These lands include 35,308 acres in Colorado, 252,181 acres in Utah, and 174,476 acres in Wyoming (Table 2.3.3-1). These public lands comprise 445,678 acres of BLM-administered lands and 16,287 acres of split estate lands. Specific land use plan amendments are provided in Appendix C.

Lands other than those 461,965 acres to be designated as available for application for leasing for commercial development of oil shale under Alternative 2 that are currently open would be closed to such leasing and development, that is, the difference between 2,017,741 and

461,965 acres. As described below, the potential impacts on lands currently available for application for leasing for commercial development but considered in Alternative 2 for closure to such leasing and development would not be adverse, because no leasing or development would take place and, unless otherwise discussed, any benefit would accrue in proportion to the number of acres closed.

The eight land use plans that would be amended are as follows:

- Colorado
  - Glenwood Springs RMP (BLM 1988, as amended by the 2006 Roan Plateau Plan Amendment [BLM 2006i, 2007c, 2008a])
  - Grand Junction RMP (BLM 1987)
  - White River RMP (BLM 1997a, as amended by the 2006 Roan Plateau Plan Amendment [BLM 2006i, 2007c, 2008a])

- Utah
  - Price RMP (BLM 2008d)
  - Vernal RMP (BLM 2008e)

- Wyoming
  - Green River RMP (BLM 1997a, as amended by the Jack Morrow Hills Coordinated Activity Plan [BLM 2006a])
  - Kemmerer RMP (BLM 2010d)
  - Rawlins RMP (BLM 2008f)

As discussed in Section 2.3.3.1, these land use plans would be amended under Alternative 2 specifically to (1) designate lands within these most geologically prospective areas as available or not available for application for leasing and (2) identify any technology restrictions. Specific land use plan amendments are provided in Appendix C. On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with amending land use plans to make lands available or not available for application for commercial leasing in the three-state study area, but there may be impacts on land values. However, the development of commercial oil shale projects on lands available for application for commercial leasing by these land use plan amendments would have impacts on these resources. In addition, Alternative 2 could include the same level of development of the RD&D projects as described in Section 6.1.1 for Alternative 1. The effects of the RD&Ds under this alternative would be the same as those under Alternative 3 (Section 6.1.3). The following sections describe the impacts of Alternative 2 on the environment and the socioeconomic setting of the areas identified as available for application for leasing under this alternative. The impacts described would not be expected to occur with respect to the lands identified as not available for application for commercial oil shale leasing, apart from possible indirect impacts on such lands, from activities that might occur on lands identified as available.

In general, potential impacts of future commercial development on specific resources located within the 461,965 acres cannot be quantified at this time, because key information about the location of projects, the technologies employed, the project size or production level, and development time lines are unknown. While it is not possible to quantify the impacts of future project development, it is possible to make observations and draw conclusions on the basis of certain lands being available for application for leasing and their overlap with specific resources. The following sections identify the potential impacts that could accompany subsequent commercial oil shale leasing, many of which might be successfully avoided or mitigated depending on site- and project-specific factors and future regulations that would guide leasing actions.

#### 6.1.2.1 Land Use

Alternative 2 would amend eight land use plans and would identify 461,965 acres of public land in Colorado, Utah, and Wyoming as available for application for leasing for commercial development of oil shale. The amendment of the land use plans is expected to have no direct impacts on land uses, although there may be some impact on land values. The identification of these lands does not authorize or approve any ground-disturbing activities that could affect existing land uses. Existing land uses could, however, be adversely affected by future commercial oil shale development on these lands.

The nature of the impacts of Alternative 2 on land uses would be the same as those listed under Alternative 1 above, with exceptions listed below. Alternative 2 removes from consideration for leasing lands with sensitive resources that have been identified in current BLM land use plans, including all existing ACECs.

The following are areas in which the impacts of Alternative 2 could differ from those described for Alternative 1 in Section 6.1.1.1:

- In the Piceance Basin, Alternative 2 would have less of an impact on oil and gas operations because considerably fewer acres of potentially valuable oil and gas deposits in a rapidly developing area would be available for application for commercial oil shale development.

- Alternative 2 removes from application for leasing core or priority sage-grouse habitat and approximately 44,000 acres of land identified as designated ACECs that are not closed to mineral entry (Table 6.1.1-1). No acreage in currently recommended ACECs lies within Alternative 2.

- Lands available for application for leasing under Alternative 1 contain all or portions of areas that have been recognized by the BLM in Colorado, Utah, and Wyoming as LWC. Table 6.1.1-2 lists these areas. Alternative 2 excludes all of the approximately 221,000 acres of these LWC that are available for application for leasing under Alternative 1, that is, all LWC in the study area.

- Approximately 6,612 acres of the land within the PRLAs established for the five Colorado RD&D projects and the Enefit RD&D project in Utah would be available for application for leasing under Alternative 2 by applicants other than the existing RD&D leaseholders (see Table 2.3.3-1). Approximately 24,000 acres would be excluded in order to protect the resources described in Section 2.3.3.1. Specifically, portions of the areas associated with the Chevron, American Shale Oil, and Shell Site 2 RD&D projects would be excluded. In addition, the entire PRLAs for Shell Sites 1 and 3 would be excluded. As with Alternative 1, a portion of the land within the PRLA established for the Enefit RD&D project also will not be available for lease to any successor applicants unless a land use plan amendment is completed to designate the area as available for leasing.

- Under the terms of the RD&D program, the federal government has a commitment to grant the RD&D companies leases for commercial development within the PRLAs, provided all conditions of the program are met (see Section 23 of the RD&D leases, which allows conversion of the RD&D leases to commercial leases, including the PRLAs, if the BLM determines that commercial operations can be conducted without unacceptable environmental consequences). As a result, all lands within the PRLAs would be available for issuance of commercial leases to the RD&D companies under Alternative 2 if they meet all conditions of the program. The federal government is not under an obligation to grant leases for commercial development within these areas to any other applicants.

- Under this alternative, of the 30,720 acres included in the existing RD&D leases, if current leaseholders relinquished those leases, only 6,612 acres would be available for future leasing under the resource exclusions that define Alternative 2. The 6,612 acres that would be available are those identified within the RD&D lease boundaries in Figures 2.3.3-4 and 2.3.3-5.

#### 6.1.2.2 Soil and Geologic Resources

Under Alternative 2, land use plans in Colorado, Utah, and Wyoming would be amended to designate 461,965 acres available for commercial oil shale leasing (Section 2.3.3.1). Soil and geologic resources could be affected by future commercial oil shale development on these lands.

Construction-related activities could directly disturb surface and subsurface soils during clearing and grading activities and construction of project facilities and infrastructure. This disturbance could include soil disturbance, removal, and compaction, and disturbed areas would be more susceptible to the effects of precipitation and wind-driven erosion (see Section 4.3.1). Surface and subsurface mining activities during project operations would directly disturb geologic resources. Erosion of exposed soils could lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust. Soils in project areas would remain susceptible to erosion until completion of construction, mining, and oil shale–processing activities, and site stabilization and reclamation (e.g., revegetation of pipeline ROWs, surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as areas in which associated off-lease infrastructure (such as access roads, utility ROWs, and power plants) would be located. For any project, the erosion potential of the soils will be a direct function of the lease and project location and of the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

Under Alternative 2, project-related impacts could occur wherever individual projects are located within the 461,965 acres identified for application for leasing under this alternative. Utah would have the most land (252,181 acres) and Colorado the least land (35,308 acres) where commercial oil shale development could affect soil and geologic resources.

#### 6.1.2.3 Paleontological Resources

Under Alternative 2, land use plans in Colorado, Utah, and Wyoming would be amended to designate 461,965 acres available for commercial oil shale leasing (Section 2.3.3.1). Paleontological resources within these areas could be adversely affected if leasing and subsequent commercial development occur. Of the acreage designated under Alternative 2, a total of 423,292 acres (about 92% of the 461,965 acres that would remain available under Alternative 2) have been identified as overlying geologic formations having a high potential to contain important paleontological resources (Murphey and Daitch 2007). Approximately 34,405 of these acres are in the Piceance Basin; 232,239 acres are in the Uinta Basin; and 156,648 acres are in the Green River and Washakie Basins. All existing ACECs, some of which have been identified for their paleontological values, would not be available for application for leasing under this alternative, and therefore the paleontological resources in these areas would not be affected under this alternative.

Impacts from oil shale development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development areas, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. However, oil shale development could also result in scientifically beneficial discoveries that may not have otherwise been made. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 4.4.

#### 6.1.2.4 Water Resources

Under Alternative 2, land use plans in Colorado, Utah, and Wyoming would be amended to designate something less than 461,965 acres as available for commercial oil shale leasing (Section 2.3.3.1). The acreage available for application for leasing in this alternative specifically excludes lands identified in BLM land use plans as sensitive for numerous different resources (see Table 2.3.3-1). Excluding these lands from application for leasing would provide protection from direct impacts from oil shale development on water resources found on these lands. However, indirect effects are still possible. In those areas that are available for application for leasing in both Alternatives 1 and 2, the potential impacts would be the same as described for Alternative 1 (Section 6.1.1.4).

The total stream miles within the four oil shale basins is approximately 753 mi. Alternative 2 contains approximately 386 mi of these perennial streams (see Table 6.1.1-3).

The assessment of impacts on water resources under Alternative 2 has the same limitations as those referenced under Alternative 1 (Table 6.1.1-4). Without site-specific information regarding location and type of technology to be employed, it is not possible to assess the overall impacts of this alternative.

#### 6.1.2.5 Air Quality

Under Alternative 2, a total of 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale (Section 2.3.3.1). Of the acreage designated under Alternative 2, about 35,308 acres are in the Piceance Basin, Colorado; 252,181 acres in the Uinta Basin, Utah; and 174,476 acres in the Green River and Washakie Basins, Wyoming. Air resources in the three states would not be affected by this land use plan amendment. Air resources in and around these areas could, however, be affected by potential future commercial oil shale development within the basin areas. Under Alternative 2, local, short-term air quality impacts could be incurred as a result of (1) PM releases (fugitive dust, diesel exhaust) during construction activities such as site clearing and grading in preparation for facility construction, and (2) exhaust emissions ($NO_X$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 4.6). These potential impacts would be of short duration and largely limited to specific project locations and the immediately adjacent areas. Similar short-term impacts could also occur in other areas in which project-related electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the oil shale. Processing activities could also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, which could extend beyond the lease areas identified under Alternative 2. These regional impacts would be associated with operational releases of $NO_X$, CO, PM, and other pollutants (VOCs and $SO_2$) during oil shale processing (Section 4.6). In addition, ozone precursors of $NO_X$ and VOC from oil shale development could exacerbate wintertime high-ozone occurrences already prevalent in the study area. Operational releases of certain HAPs (e.g., benzene, toluene, and formaldehyde) as well as diesel PM could also affect on-site workers and nearby residences, but these impacts would be localized to the immediate project location and subject to further analysis prior to project implementation.

During all phases of oil shale development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustion sources could contribute to climate change to some extent.

If development of oil shale requires expansion of capacity of existing electric power plants, or the construction and operation of new electric power plants off-lease, those would also have longer term impacts on regional air quality. Table 6.1.6-3 presents a summary of the emissions from coal-fired electric power plants.

#### 6.1.2.6 Noise

Under Alternative 2, approximately 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. Ambient noise levels would not be affected by this action. However, ambient noise levels could be affected by future commercial development of oil shale. Under Alternative 2, local, short-term changes in ambient noise levels could be incurred during the construction, operation, and reclamation of oil shale projects (see Section 4.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Noise impacts on wildlife and recreational users are discussed in Sections 4.8.1.3 and 4.2.1.4, respectively.

Increased noise levels could result from the operation of construction equipment (graders, excavators, and haul trucks) and from any blasting activities that might occur. Increases in noise levels during operations could be associated with mining and oil shale–processing activities and could be more long-term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could increase in the immediate vicinity of any pipeline pump stations and be affected by project-related vehicular traffic at the project site and related locations (such as access roads to the site).

Construction-related noise levels could exceed EPA guidelines and/or Colorado regulations at some distances from the construction sites (there are currently no state guidelines/regulations for Utah or Wyoming; however, local jurisdictions have noise controls pertaining to construction).Similarly, operational noise associated with mining and retort activities could, in the absence of mitigation, exceed EPA guidelines and/or Colorado regulations at some project locations. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline and/or Colorado regulation levels, except for short durations and in areas close to roads or traffic.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes in ambient noise levels due to project development could occur wherever a project is located within the 461,965 acres identified for application for leasing under Alternative 2.

#### 6.1.2.7 Ecological Resources

Under Alternative 2, approximately 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. These lands support a wide variety of biota and their habitats (Section 3.7). Ecological resources in these areas would not be affected by the identification of lands available for application for leasing or by amendment of land use plans to incorporate these lease areas. However, ecological resources in and around these areas could be affected by future commercial development of oil shale in these areas. The following sections describe the potential impacts on ecological resources that may result from commercial oil shale development within the areas identified as available for application for commercial leasing under Alternative 2.

The magnitude of the impact on specific ecological resources that could be affected by commercial oil shale development in areas identified as available for application for commercial leasing in Alternative 2 would depend on the specific location of the commercial oil shale projects as well as on specific project design.

**6.1.2.7.1 Aquatic Resources.** Under Alternative 2, approximately 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. There are no impacts on aquatic habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

Potential impacts on aquatic resources from oil shale development could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 4.8.1.1. As described in Section 4.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals are occurring. Consequently, the analysis here considers the potential for impacts in waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities become more distant from waterways, the potential for negative effects on aquatic resources is reduced. For the analysis of potential impacts on each of the alternatives considered in the PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increases.

Under Alternative 2, 14 perennial streams and about 41 mi of perennial stream habitat within the Piceance, Uinta, and Washakie Basins are directly overlain by areas that would be potentially available for oil shale development. There are no perennial streams in the Green River Basin that are directly overlain by areas that would be potentially available for oil shale development. When an additional 2-mi zone surrounding these areas is considered, there are 37 perennial streams and about 386 mi of perennial stream habitat that could be affected by future development activities (Table 6.1.1-4). The development of commercial oil shale projects in the areas identified under Alternative 2 could affect aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 4.8.1.1, impacts from water quality degradation and water depletions could affect resources not only in areas within or immediately adjacent to leased areas but also in areas farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the Piceance, Uinta, Green River, and Washakie Basins are described in Section 3.7.1, and some of these aquatic habitats could contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. However, because most of the areas within the oil shale basins that contain known sensitive aquatic habitats and species would be excluded from consideration for leasing via land use plan amendments under this alternative, the potential impacts on aquatic resources are likely to be considerably smaller under Alternative 2 than under Alternative 1. Specific impacts would depend greatly upon the locations selected, methods of extraction used, and mitigation measures implemented by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing (including conversion from any RD&D to a commercial lease) and development decisions to evaluate potential impacts in greater detail.

**6.1.2.7.2 Plant Communities and Habitats.** Under Alternative 2, approximately 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. There would be no impacts on plant communities and habitats associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

Areas identified as available for application for commercial leasing under Alternative 2 support a wide variety of plant communities and habitats (see Section 3.7.2). Areas that are currently identified in BLM land use plans for the protection of wetlands, riparian habitats, and floodplains are excluded under this alternative. Direct and indirect impacts on plant communities and habitats could be incurred in available areas during project construction and operation, extending over a period of several decades (especially within facility and infrastructure footprints) (see Section 4.8.1.2). Some impacts, such as habitat loss, may continue beyond the termination of shale oil production.

Direct impacts would include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities, such as access roads, pipelines, transmission lines, employer-provided housing, and new power plants, would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be localized (occurring within construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction and facilities would occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The areas identified as available for application for commercial leasing under Alternative 2 potentially include locations outside of ACECs that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of oil shale development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

No ACECs are included in the lands available under this alternative. Therefore direct impacts on sensitive plant species and plant communities within ACECs would not occur. However, three ACECs are located adjacent to the Alternative 2 footprint: the Duck Creek ACEC located within the Piceance Basin and the Pariette Wetlands and Lower Green River ACECs located within the Uinta Basin. Each of these ACECs includes rare plant species and/or rare or important plant communities. Indirect impacts on these species and communities could occur.

Seventeen ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) the Alternative 2 footprint: Upper Greasewood Creek (3.7 mi), Lower Greasewood Creek (4.9 mi), South Cathedral Bluffs (4.5 mi), Dudley Bluffs (0.7 mi), Ryan Gulch (1.3 mi), East Douglas Creek (4.4 mi), Magpie Gulch (3.9 mi), Deer Gulch (1.8 mi), White River Riparian (3.6 mi), Trapper Creek/Northwater Creek (1.3 mi), East Fork Parachute Creek (4.9 mi), all near the Piceance Basin; Raven Ridge (4.3 mi), Oil Spring Mountain (4.4 mi), Nine Mile Canyon (2.7 mi), and White River Riparian (0.6 mi), all near the Uinta Basin; Special Status Plant Species (0.4 mi) and Greater Red Creek (3.9 mi), both near the Green River Basin; and Special Status Plant Species (4.2 mi) and Hells Canyon (3.8 mi), both near the Washakie

Basin. Indirect impacts on the sensitive species or communities within these ACECs could occur. Impacts would generally decrease with increasing distance.

**6.1.2.7.3 Wildlife.** Under Alternative 2, approximately 461,965 acres of public land would be made available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. While no impacts on wildlife species associated with the identification of lands as available for application for commercial leasing are expected, impacts could result from post-lease construction and operation as described in Section 4.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects. The areas available for application for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Alternative 2 excludes lands that were excluded under Alternative C in the 2008 OSTS PEIS on the basis of oil and gas stipulations at the time. Various stipulations included in the BLM RMPs provide protection for different wildlife species. These stipulations include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) TL (where the BLM may allow specified activities but not during certain sensitive seasons such as when raptors are nesting or when big game are on their winter ranges). No additional acreage of protected habitat has resulted from updates to oil and gas stipulations since the preparation of the 2008 OSTS PEIS in areas available for application for oil shale leasing in Alternative 2.

Areas identified in Alternative 2 as available for application for commercial leasing overlap with areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.1.2-1 and 6.1.2-2, respectively). Table 6.1.2-1 presents the acreage of these habitats (as identified by state resource agencies) that occur in the Alternative 2 lease areas and that could be impacted by future commercial oil shale development.

Several wild horse HMAs overlap with the lands identified as available for application for commercial leasing, including the Piceance–East Douglas Creek HMA in Colorado 6,585 acres); the Hill Creek HMA in Utah (5,064 acres); and the Adobe Town (161 acres), Little Colorado (50,653 acres), Salt Wells Creek (20,497 acres), and White Mountain (29,891 acres) HMAs in Wyoming (Figure 6.1.2-3). Any oil shale development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Impacts on wildlife from commercial oil shale projects (see Section 4.8.1.3) in Alternative 2 potential lease areas could occur in a number of ways and would be related to (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of biota; (3) mortality; (4) exposure to hazardous materials; and (5) increase in human access. These could result in changes in species distribution and abundance; changes in habitat use; changes in

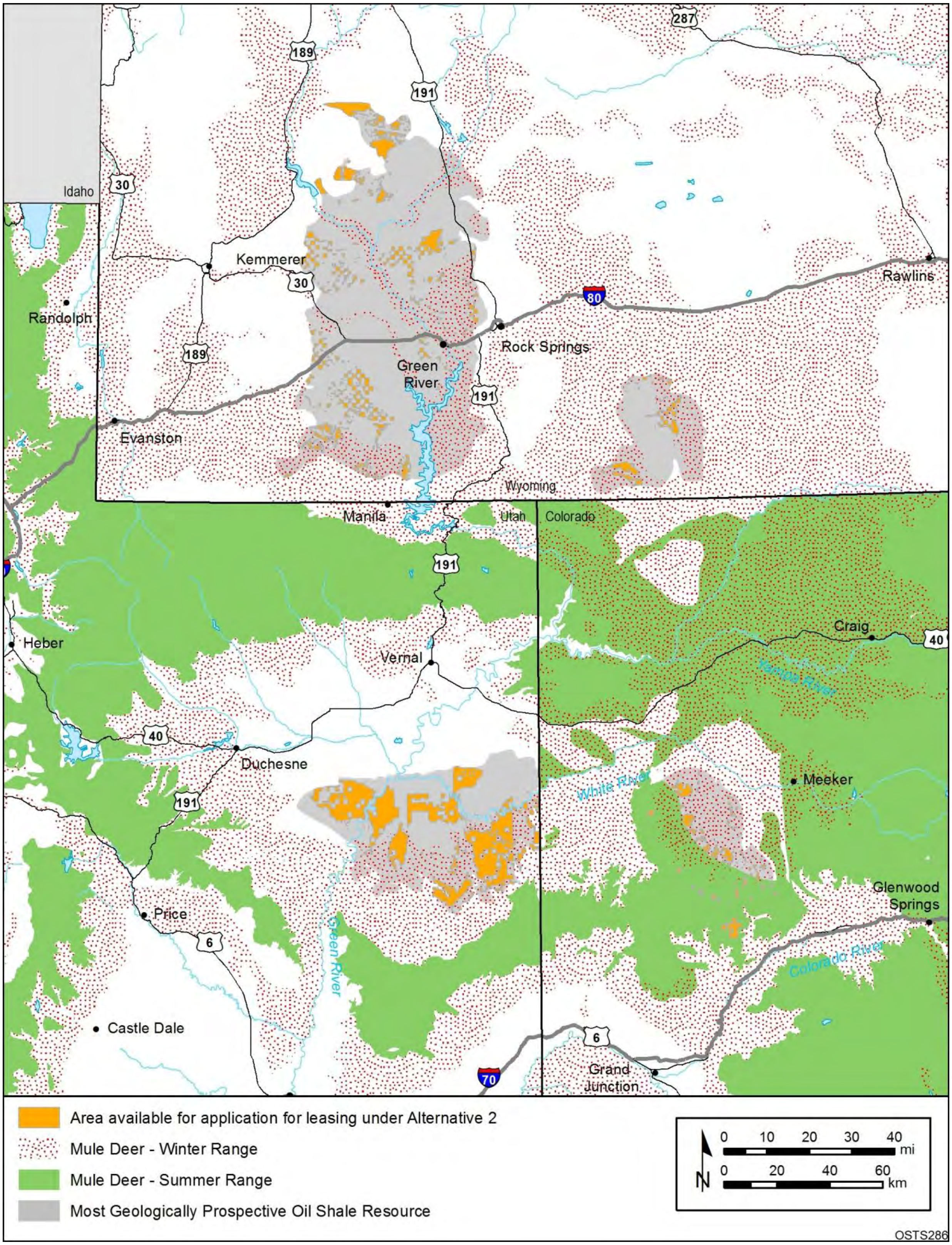


**FIGURE 6.1.2-1 Lands Available for Application for Oil Shale Leasing under Alternative 2 in Relation to the Summer and Winter Ranges of the Mule Deer**

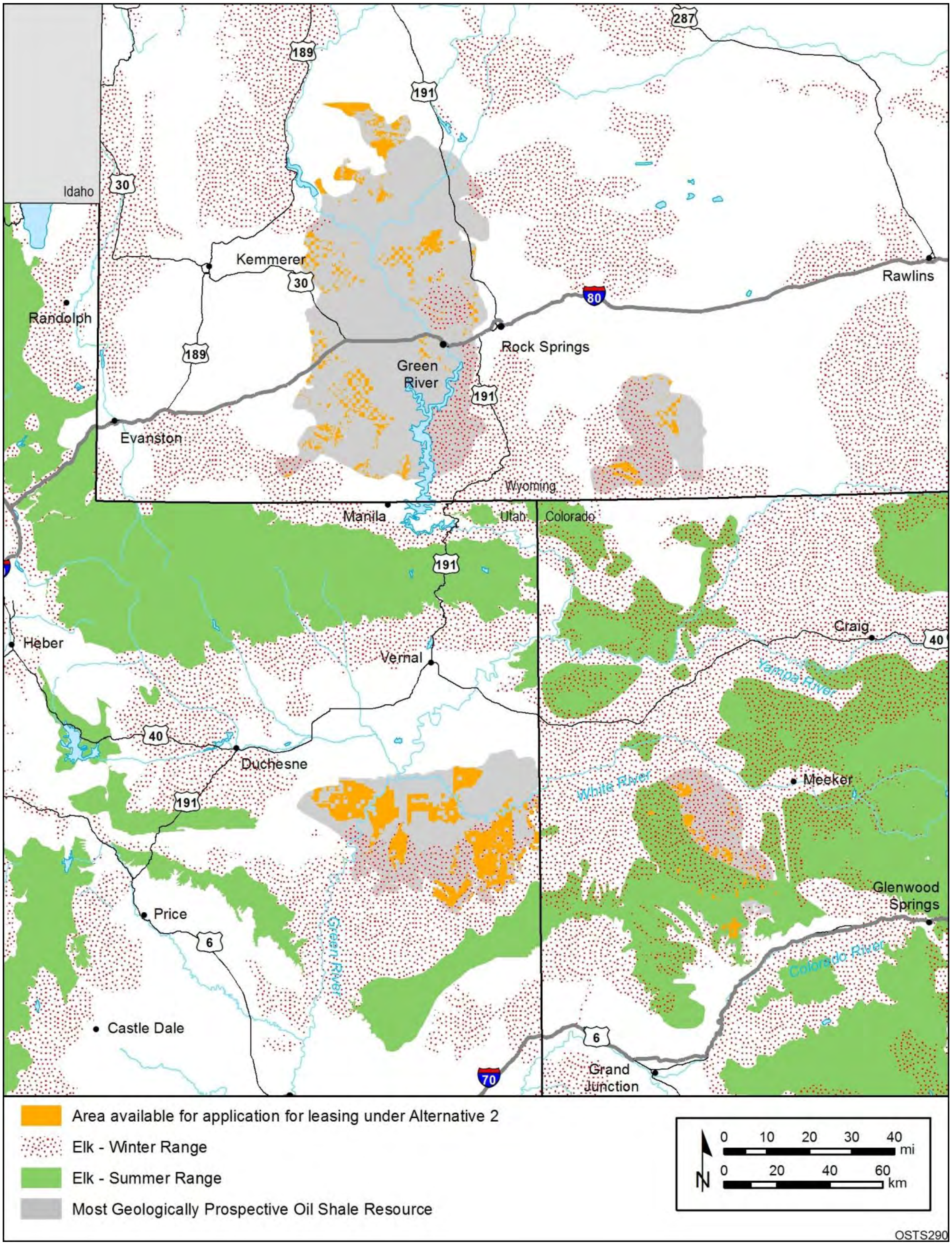


**FIGURE 6.1.2-2 Lands Available for Application for Oil Shale Leasing under Alternative 2 in Relation to the Summer and Winter Ranges of the Elk**

**TABLE 6.1.2-1 State-Identified Elk and Mule Deer Habitat Present in the Alternative 2 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Colorado | Utah | Wyoming | Total |
| ***Mule deer*** | | | | |
| Winter habitat | 23,104 | 111,388 | 37,847 | 172,339 |
| Summer habitat | 11,470 | 0 | NA[a] | 11,470 |
| ***Elk*** | | | | |
| Winter habitat | 26,645 | 119,750 | 12,810 | 159,205 |
| Summer habitat | 11,465 | 0 | NA | 11,465 |

[a] NA = data not available.

behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with the oil shale project or its workforce but instead associated with the increased access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads could lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, (2) an increase in the incidence of fires, and (3) increased runoff that could adversely affect riparian or other wetland areas important to wildlife.

The potential for impacts on wildlife and their habitats from commercial oil shale development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. Their magnitude is also considered to be proportional to the amount of land disturbance.

**6.1.2.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 2, approximately 461,965 acres of public land would be available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. Under this alternative, oil shale development would be excluded from core or priority habitats for the greater sage-grouse (*Centrocercus urophasianus*) as defined by the guidance set forth in the BLM's sage-grouse interim policy (BLM 2005i). There would be no impacts on threatened and endangered species associated with identifying lands as available for application for commercial

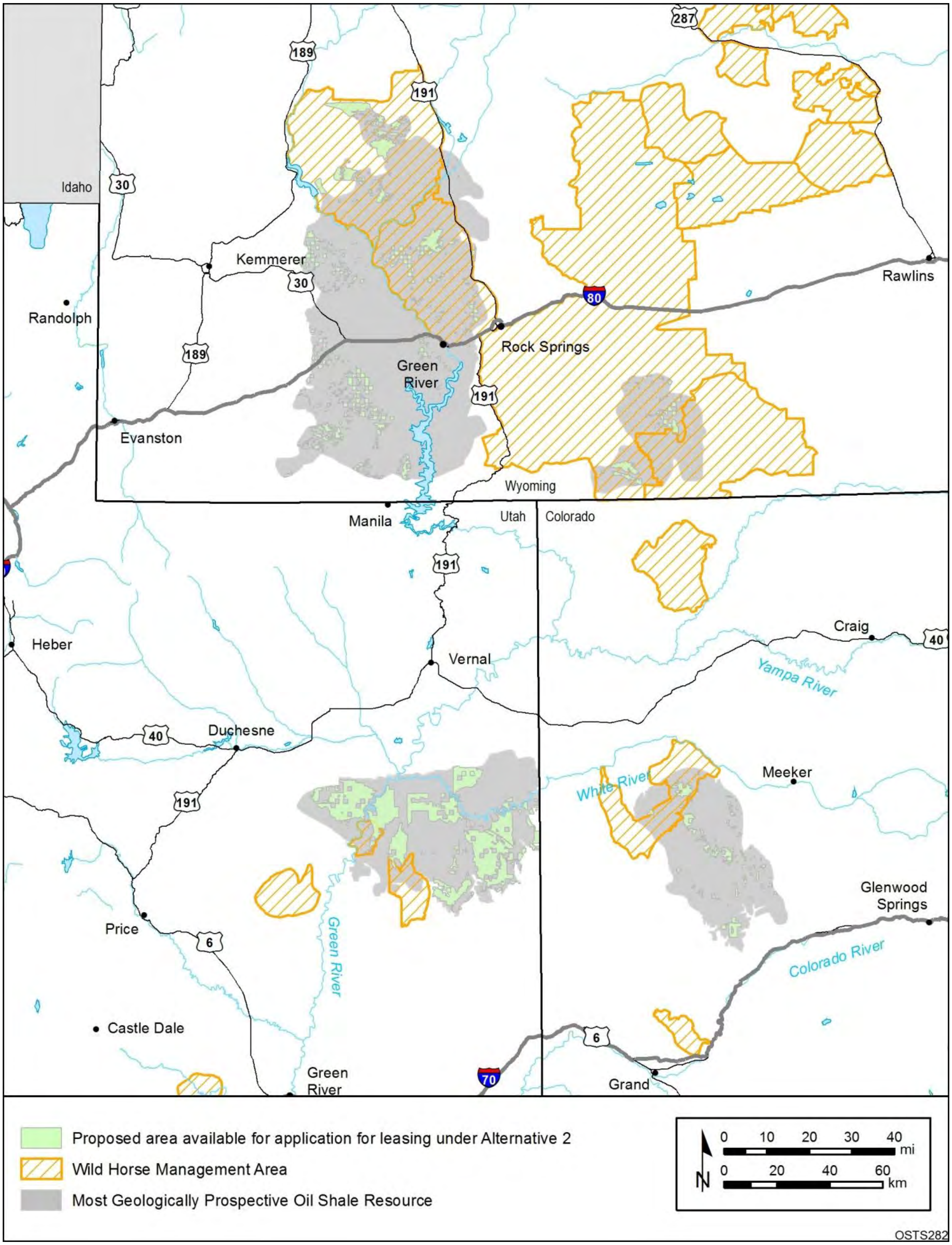


**FIGURE 6.1.2-3 Lands Available for Application for Oil Shale Leasing under Alternative 2 in Relation to Wild Horse and Burro Herd Management Areas**

leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.4. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

Under Alternative 2, 164 of the 185 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.1.2-2 and 14 of the 16 federally listed threatened or endangered species listed in Table 6.1.2-3 could occur in areas that are available for application for leasing. This determination is based on records of occurrence in project counties of Colorado, Utah, and Wyoming, species occurrences from state natural heritage programs,[4] and the presence of potentially suitable habitat.[5] Under this alternative, there are no critical habitats for species listed under the ESA in the potential lease areas. However, critical habitat for Colorado River endangered fishes and the Mexican spotted owl (*Strix occidentalis lucida*) occur within 5 mi (8 km) from potential lease areas (Figure 6.1.2-4). Areas including greater sage-grouse habitat and lek sites are shown in Figure 6.1.2-5. Although greater sage-grouse core and priority habitats are excluded from oil shale development under this alternative, core and priority habitats may occur in close proximity (<1 mi [1.6 km]) to proposed lease areas. In addition, three current and historic sage-grouse leks have been identified in Wyoming in areas overlapped by the Alternative 2 lease areas in that state (Figure 6.1.2-5). Those areas for which lease stipulations have been established in existing RMPs to protect federally listed and candidate species, BLM-designated sensitive species, and other special status species would not be available for lease application under Alternative 2.

The potential impacts on threatened, endangered, and sensitive species (and their habitats) by commercial oil shale development are directly related to the amount of land disturbance that could occur with a commercial project (including ancillary facilities such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface water or groundwater depletions, contamination, and disturbance and harassment of animal species, would be proportional to the amount of land disturbance.

Potential impacts on threatened, endangered, and sensitive species under Alternative 2 are similar to or the same as impacts on aquatic resources; plant communities and habitats; and wildlife described in Sections 6.1.2.7.1, 6.1.2.7.2, and 6.1.2.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population

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4 Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the potential lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.1.2-2 and 6.1.2-3.

5 Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the potential lease areas. This quantification is presented in Tables 6.1.2-2 and 6.1.2-3.

**TABLE 6.1.2-2 Potential Effects of Commercial Oil Shale Development under Alternative 2 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | State and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Abies concolor* | White fir | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Achnatherum swallenii* | Swallen mountain-ricegrass | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Amsonia jonesii* | Jones blue star | BLM-S | UT–Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat does not exist in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Utah. |
| *Androstephium breviflorum* | Purple funnel-lily | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Antennaria arcuata* | Meadow pussytoes | BLM-S; WY-SC | WY–Sublette | **No impact.** Suitable habitat does not exist in the study area. Nearest occurrences are approximately 35 mi (56 km) from the study area in Wyoming. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | UT–Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Artemisia biennis* var. *diffusa* | Mystery wormwood | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus bisulcatus* var. *haydenianus* | Hayden's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus calycosus* var. *calycosus* | King's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus coltonii* var. *moabensis* | Moab milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus debequaeus* | Debeque milkvetch | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 7 mi (11 km) from the study area in Colorado. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact. S**uitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus lentiginosus* var. *salinus* | Sodaville milkvetch | WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | CO–Garfield; UT–Emery, Garfield, Grand, Wayne | **No impact.** Suitable habitat does not exist in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | CO–Garfield; UT–San Juan | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 8 mi (13 km) from the study area in Colorado. |
| *Astragalus paysonii* | Payson's milkvetch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus proimanthus* | Precocious milkvetch | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Astragalus racemosus* var. *treleasei* | Trelease's racemose milkvetch | BLM-S; WY-SC | WY–Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 6 mi (10 km) from the study area in Wyoming. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Atriplex falcata* | Sickle saltbush | WY-SC | WY–Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Atriplex wolfii* | Wolf's orache | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera crandallii* | Crandall's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera selbyi* | Selby's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Bolophyta ligulata* | Ligulate feverfew | BLM-S | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 6 mi (10 km) from the study area in Utah. |
| *Brickellia microphylla* var. *scabra* | Little-leaved brickell-bush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Ceanothus martinii* | Utah mountain lilac | WY-SC | WY–Lincoln, Sweetwater | **No impact.** This species is not known to occur in the vicinity of the study areas. Nearest occurrences are approximately 70 mi (113 km) from the study area in Wyoming. |
| *Cercocarpus ledifolius* var. *intricatus* | Dwarf mountain mahogany | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chamaechaen-actis scaposa* | Fullstem | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chrysothamnus greenei* | Greene rabbitbrush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cirsium aridum* | Cedar Rim thistle | BLM-S; WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S; WY-SC | UT–Uintah; WY Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium perplexans* | Adobe thistle | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Collomia grandiflora* | Large-flower collomia | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Cryptantha gracilis* | Slender cryptantha | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S; WY-SC | CO–Rio Blanco; UT–Duchesne, San Raphael, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 10 mi (16 km) from the study area in Utah. |
| *Descurainia pinnata* var. *paysonii* | Payson's tansy mustard | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Descurainia torulosa* | Wyoming tansymustard | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Downingia laeta* | Great Basin downingia | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Draba juniperina* | Uinta draba | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Elymus simplex* var. *luxurians* | Long-awned alkali wild-rye | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Wyoming. |
| *Ephedra viridis* var. *viridis* | Green Mormon tea | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriastrum wilcoxii* | Wilcox eriastrum | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Erigeron compactus* var. *consimilis* | San Rafael daisy | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | CO–Garfield; UT-Grand | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Eriogonum corymbosum* var. *corymbosum* | Crisp-leaf wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum divaricatum* | Divergent wild buckwheat | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Eriogonum hookeri* | Hooker wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Galium coloradoense* | Colorado bedstraw | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Gentianella tortuosa* | Utah gentian | BLM-S | CO–Rio Blanco; UT–Duchesne, Emery, Garfield, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 8 mi (13 km) from the study area in Colorado. |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Glossopetalon spinescens* var. *meionandrum* | Utah greasebush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lathyrus lanszwertii* var. *lanszwertii* | Nevada sweetpea | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium integrifolium* var. *integrifolium* | Entire-leaved peppergrass | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |
| *Lesquerella macrocarpa* | Large-fruited bladderpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 9 mi (14 km) from the study area in Wyoming. |
| *Lesquerella multiceps* | Western bladderpod | BLM-S; WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lesquerella parviflora* | Piceance bladderpod | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Lesquerella parvula* | Narrow-leaved bladderpod | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Lesquerella prostrata* | Prostrate bladderpod | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Wyoming. |
| *Listera borealis* | Northern twayblade | BLM-S | CO–Garfield; UT–Duchesne, San Juan; WY–Sublette | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |
| *Lomatium triternatum* var. *anomalum* | Ternate desert-parsley | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia goodrichii* | Goodrich's blazingstar | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia rhizomata* | Roan Cliffs blazingstar | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | UT–Duchesne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Monolepis pusilla* | Red poverty-weed | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *juniperina* | Juniper prickly-pear | WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *rufispina* | Rufous-spine prickly-pear | WY-SC | WY–Lincoln, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Oxytheca dendroidea* | Tree-like oxytheca | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Oxytropis besseyi* var. *obnapiformis* | Maybell locoweed | WY-SC | WY–Sweetwater, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the WY study areas. Nearest occurrences are approximately 85 mi (137 km) from the study area in Wyoming. |
| *Packera crocata* | Saffron groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | CO–Rio Blanco; UT–Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon acaulis* var. *acaulis* | Stemless beardtongue | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 4 mi (6 km) from the study area in Wyoming. |
| *Penstemon gibbensii* | Gibbens' beardtongue | BLM-S; WY-SC | WY–Sweetwater | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Wyoming. |
| *Penstemon harringtonii* | Harrington beardtongue | BLM-S | CO–Garfield | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Penstemon laricifolius* ssp. *exilifolius* | White beardtongue | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C; | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Penstemon scariosus* var. *garrettii* | Garrett's beardtongue | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Phacelia demissa* | Intermountain phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia glandulosa* var. *deserta* | Desert glandular phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia incana* | Western phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia salina* | Nelson phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia tetramera* | Tiny phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Philadelphus microphyllus* var. *occidentalis* | Little-leaf mock-orange | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox albomarginata* | White-margined phlox | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox pungens* | Beaver Rim phlox | BLM-S; WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Physaria condensata* | Tufted twinpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 7 mi (11 km) from the study area in Wyoming. |
| *Physaria dornii* | Dorn's twinpod | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 25 mi (40 km) from the study area in Wyoming. |
| *Physocarpus alternans* | Dwarf ninebark | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Populus deltoides* var. *wislizeni* | Fremont cottonwood | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Potentilla multisecta* | Deep Creek cinquefoil | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Psilocarphus brevissimus* | Dwarf woolly-heads | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Ranunculus flabellaris* | Yellow water-crowfoot | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Rorippa calycina* | Persistent sepal yellowcress | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 6 mi (10 km) from the study area in Wyoming. |
| *Sambucus cerulea* | Blue elderberry | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Senecio spartioides* var. *multicapitatus* | Many-headed broom groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Silene douglasii* | Douglas' campion | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Thelesperma caespitosum* | Green River greenthread | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Thelesperma pubescens* | Uinta greenthread | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Townsendia microcephala* | Cedar Mountain Easter-daisy | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Invertebrates* | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur near the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur near the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S; CO-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gila copei* | Leatherside chub | BLM-S; UT-SC; WY-SC | UT–Duchesne, Emery, Garfield, Wayne; WY–Lincoln, Uinta | **Potential for negative impact.** Suitable habitat may occur near the study area. |
| *Gila robusta* | Roundtail chub | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur near the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Uintah, Wayne; WY– Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur near the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Oncorhynchus clarkii utah* | Bonneville cutthroat trout | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; CO-E; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Uintah, Wayne; WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 7,216 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Wyoming. |
| *Rana luteiventris* | Columbia spotted frog | BLM-S; WY-SC | UT–Utah, Wasatch; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 100 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 35 mi (56 km) from the study area in Wyoming. |
| *Rana pipiens* | Northern leopard frog | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,267 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Spea intermontana* | Great basin spadefoot | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 372,058 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| ***Reptiles*** | | | | |
| *Crotalus oreganus concolor* | Midget faded rattlesnake | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sweetwater | **Potential for negative impact.** Approximately 54,755 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Gambelia wislizenii* | Longnose leopard lizard | BLM-S; CO-SC | CO–Garfield | **No impact.** Suitable habitat for this species does not occur in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Reptiles (Cont.)*** | | | | |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | UT–Carbon, Duchesne, Grand, San Juan, Uintah | **No impact.** Suitable habitat for this species does not occur in the study area and it is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Utah. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 213,343 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Wyoming, and Utah. |
| *Aechmophorus clarkii* | Clark's grebe | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 28 acres of potentially suitable habitat for this species occurs in the study area. |
| *Aegolius funereus* | Boreal owl | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area and it is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 100 mi (161 km) from the study area in Wyoming. |
| *Ammodramus bairdii* | Baird's sparrow | BLM-S; WY-SC | WY–Uinta | **Potential for negative impact.** Approximately 2,867,364 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | UT–Duchesne, Uintah, Utah, Wasatch | **Potential for negative impact.** Approximately 172,820 acres of potentially suitable habitat for this species occurs in the study area. |
| *Amphispiza belli* | Sage sparrow | BLM-S | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 409,705 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Aphelocoma californica* | Western scrub-jay | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 152,225 acres of potentially suitable habitat for this species occurs in the study area. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 173,888 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Athene cunicularia* | Burrowing owl | BLM-S; CO-T; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 386,092 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Wyoming, and Utah. |
| *Baeolophus ridgwayi* | Juniper titmouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 112,286 acres of potentially suitable habitat for this species occurs in the study area. |
| *Botaurus lentiginosus* | American bittern | WY-SC | WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 153,079 acres of potentially suitable habitat for this species occurs in the study area. |
| *Bucephala islandica* | Barrow's goldeneye | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 21,421 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |
| *Buteo regalis* | Ferruginous hawk | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 287,057 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Wyoming, and Utah. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Calcarius mccownii* | McCown's longspur | WY-SC | WY–Sweetwater | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C, BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 269,479 acres of potentially suitable habitat for this species occurs in the study area. Study areas do not intersect any core or priority habitat areas for this species. Quad-level occurrences of this species intersect the study areas in Colorado, Wyoming, and Utah. |
| *Charadrius montanus* | Mountain plover | BLM-S; CO-SC; UT-SC; WY-SC | CO–Rio Blanco; WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 209,884 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Wyoming, and Utah. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S; WY-SC | UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Species may occur in riparian habitats near the study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Utah. |
| *Cygnus buccinator* | Trumpeter swan | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 60,591 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cypseloides niger* | Black swift | BLM-S; CO-SC; UT-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Approximately 28 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Colorado. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 21,506 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 14 mi (23 km) from the study area in Utah. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Falco peregrinus anatum* | American peregrine falcon | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 427,283 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Gavia immer* | Common loon | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 142 acres of potentially suitable habitat for this species occurs in the study area. |
| *Grus canadensis tabida* | Greater sandhill crane | CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 186,897 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; CO-T; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 437,787 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |
| *Icterus parisorum* | Scott's oriole | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 74,611 acres of potentially suitable habitat for this species occurs in the study area. |
| *Lanius ludovicianus* | Loggerhead shrike | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 440,292 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Uinta | **Potential for negative impact.** Approximately 13,023 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 14 mi (23 km) from the study area in Utah. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Numenius americanus* | Long-billed curlew | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 177,162 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |
| *Oreoscoptes montanus* | Sage thrasher | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 381,195 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | CO–Garfield, UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 160,480 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Picoides arcticus* | Black-backed woodpecker | WY-SC | WY–Lincoln | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Plegadis chihi* | White-faced ibis | BLM-S; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 143,614 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Psaltriparus minimus* | Bushtit | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Approximately 249,310 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sitta pygmaea* | Pygmy nuthatch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 99,035 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Sphyrapicus thyroideus* | Williamson's sapsucker | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 4,825 acres of potentially suitable habitat for this species occurs in the study area. |
| *Spizella breweri* | Brewer's sparrow | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 393,151 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Sterna caspia* | Caspian tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 185 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sterna forsteri* | Forster's tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 30,274 acres of potentially suitable habitat for this species occurs in the study area. |
| *Tympanuchus phasianellus columbianus* | Columbian sharp-tailed grouse | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat does not occur in the study area. Quad-level occurrences are within 7 mi (11 km) of the study area in Colorado. |
| ***Mammals*** | | | | |
| *Antrozous pallidus* | Pallid bat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 254,107 acres of potentially suitable habitat for this species occurs in the study area. |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC; WY-SC | UT–Garfield, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 173,375 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 282,474 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 9 mi (14 km) from the study area in Utah. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 337,642 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 219,064 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Utah. |
| *Gulo gulo* | Wolverine | CO-E; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 100 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 6 mi (10 km) from the study area in Wyoming. |
| *Microtus richardsoni* | Water vole | WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 655 acres of potentially suitable habitat for this species occurs in the study area. |
| *Myotis evotis* | Long-eared myotis | BLM-S | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 232,301 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sublette | **Potential for negative impact.** Approximately 262,035 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | CO–Garfield; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 210,752 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |

**TABLE 6.1.2-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Counties in Study area Where Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Peromyscus crinitus* | Canyon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 118,848 acres of potentially suitable habitat for this species occurs in the study area. |
| *Peromyscus truei* | Pinon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 246,463 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sorex preblei* | Preble's shrew | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Tamias dorsalis utahensis* | Cliff chipmunk | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 224,331 acres of potentially suitable habitat for this species occurs in the study area. |
| *Thomomys clusius* | Wyoming pocket gopher | BLM-S | WY–Sweetwater | **Potential for negative impact.** Approximately 11,159 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Thomomys idahoensis* | Idaho pocket gopher | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 13,749 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Vulpes macrotis* | Kit fox | BLM-S; CO-E; UT-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Vulpes velox* | Swift fox | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 3,644 acres of potentially suitable habitat for this species occurs in the study area. |

**Footnotes on next page.**

**TABLE 6.1.2-2 (Cont.)**

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[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-SC = species of special concern in the state of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 2 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 2 footprint (i.e., study area).

sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

#### 6.1.2.8 Visual Resources

The lands available for application for leasing under Alternative 2, approximately 461,965 acres support a wide variety of visual resources (Section 3.8). These resources would not be affected by the amendment of land use plans or by the identification of these lands as available for application for commercial leasing. Visual resources in and around these potential lease areas, however, could be affected by subsequent commercial development of oil shale.

Two scenic resource areas are located in Utah within the area that would be available for application for commercial leasing under Alternative 2. Specifically, these areas (shown in Figures 6.1.2-6, 6.1.2-7, and 6.1.2-8) are Fantasy Canyon SRMA and Green River Wild & Scenic River.

Scenic resource areas are also located within 5 or 15 mi of the areas that would be made available for application for commercial leasing under Alternative 2 (Figures 6.1.2-6, 6.1.2-7, and 6.1.2-8). These 5- and 15-mi zones correspond to the BLM's VRM foreground-middleground and background distance limits, respectively. Based on the assumption of an unobstructed view of a commercial oil shale project, viewers in these areas would be likely to perceive some level of visual impact from a commercial oil shale project; impacts would be expected to be greater for resources within the foreground-middleground distance and lesser for those areas within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.1.2-4 identifies the scenic resource areas that would fall within these zones under Alternative 2.

**TABLE 6.1.2-3 Potential Effects of Commercial Oil Shale Development under Alternative 2 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Lepidium barnebyanum* | Barneby ridge-cress | ESA-E | UT–Duchesne | **No impact.** Suitable habitat is not likely to occur in the study area. Nearest quad-level occurrences are approximately 13 mi (21 km) from the study areas in Utah. |
| *Lesquerella congesta* | Dudley Bluffs bladderpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Penstemon debilis* | Parachute beardtongue | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Penstemon grahamii* | Graham’s beardtongue | ESA-PT; BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Phacelia argillacea* | Clay phacelia | ESA-E | UT–Utah, Wasatch | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 50 mi (80 km) from the study area in Utah. |
| *Phacelia scopulina* var. *submutica* | Debeque phacelia | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Physaria obcordata* | Dudley Bluffs twinpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |

**TABLE 6.1.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | CO–Garfield; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | UT–Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Utah. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E; CO-T | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the study area. Designated critical habitat occurs within 5 mi (8 km) from study areas in Utah. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Gila elegans* | Bonytail | ESA-E | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the study area. Designated critical habitat occurs within 5 mi (8 km) from study areas in Utah. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E; CO-T | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the study area. Designated critical habitat occurs within 1 mi (1.6 m) from study areas in Utah. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E; CO-E | CO–Garfield, Rio Blanco; UT–Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the study area. Designated critical habitat occurs within 1 mi (1.6 km) from study areas in Utah. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |

**TABLE 6.1.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 164,124 acres of potentially suitable habitat for this species occurs in the study area. |
| *Grus americana* | Whooping crane | ESA-XN; CO-E | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the study area. This species may only occur as a rare migrant through Colorado. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | UT–Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 9,593 acres of potentially suitable habitat for this species occurs in the study area. Critical habitat for this species occurs within 5 mi (8 km) from study areas in Utah. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T; CO-E; WY-SC | CO–Garfield, Rio Blanco; UT–Emery, Uintah; WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 925 acres of potentially suitable habitat for this species occurs in the study area. Designated critical habitat does not occur in the vicinity of the study areas. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN; CO-E | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, San Juan, Uintah; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 34,401 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 2 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 2 footprint (i.e., study area). Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

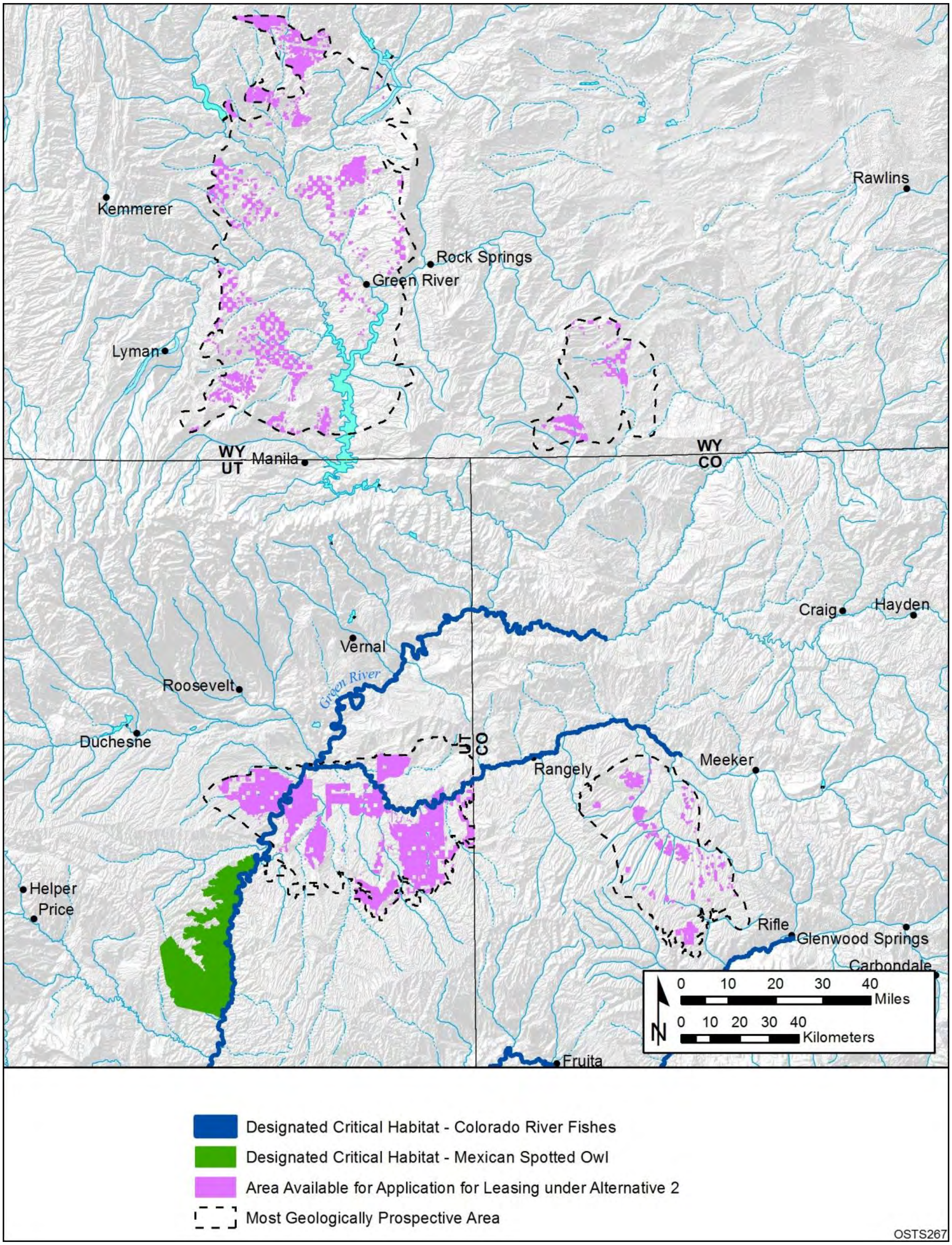


**FIGURE 6.1.2-4 Designated Critical Habitat of Threatened and Endangered Species near Lands Available for Application for Leasing for Oil Shale under Alternative 2**

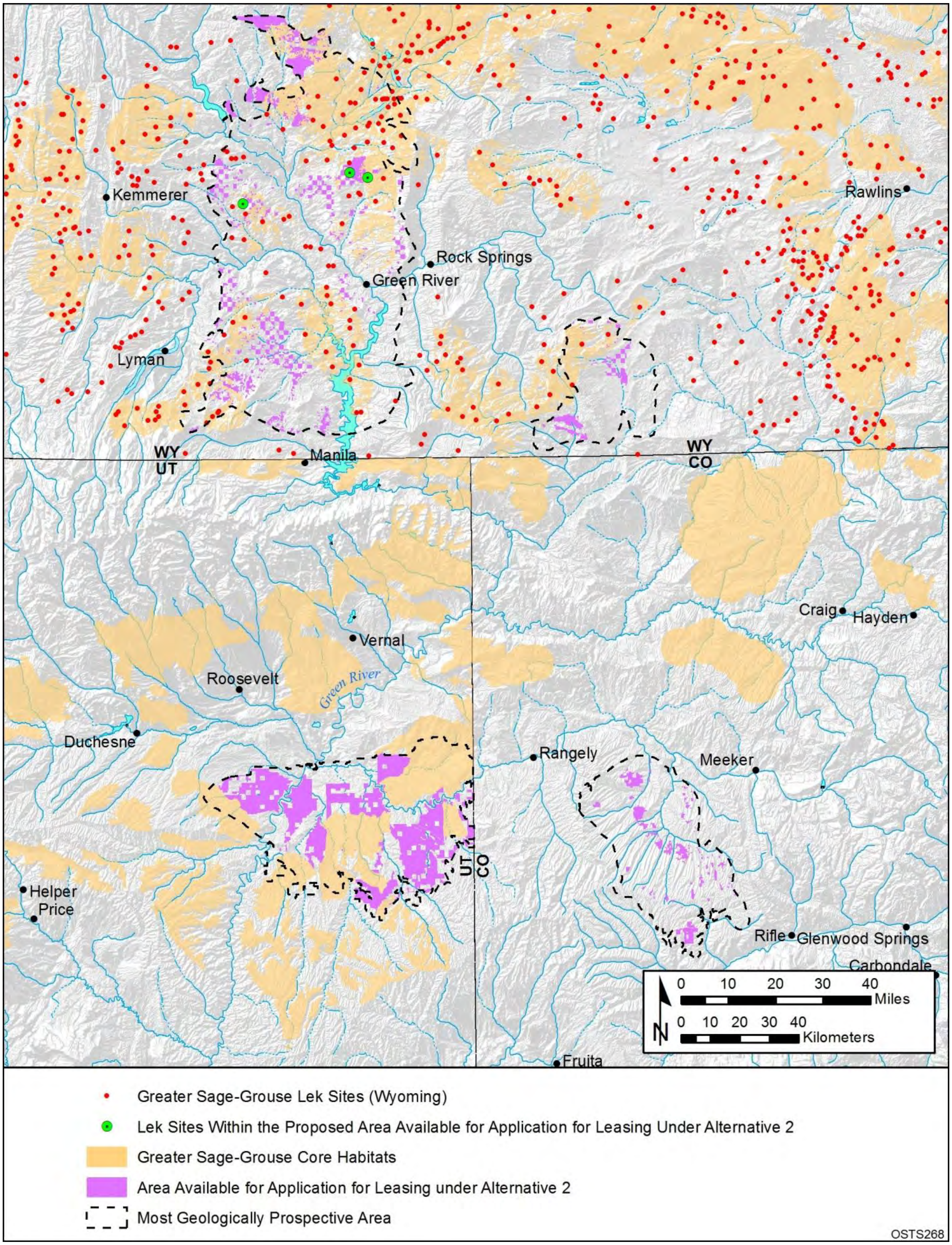


**FIGURE 6.1.2-5 Distribution of Core and Priority Habitat Areas and Lek Sites for Greater Sage-Grouse near Lands Available for Application for Leasing for Oil Shale under Alternative 2**

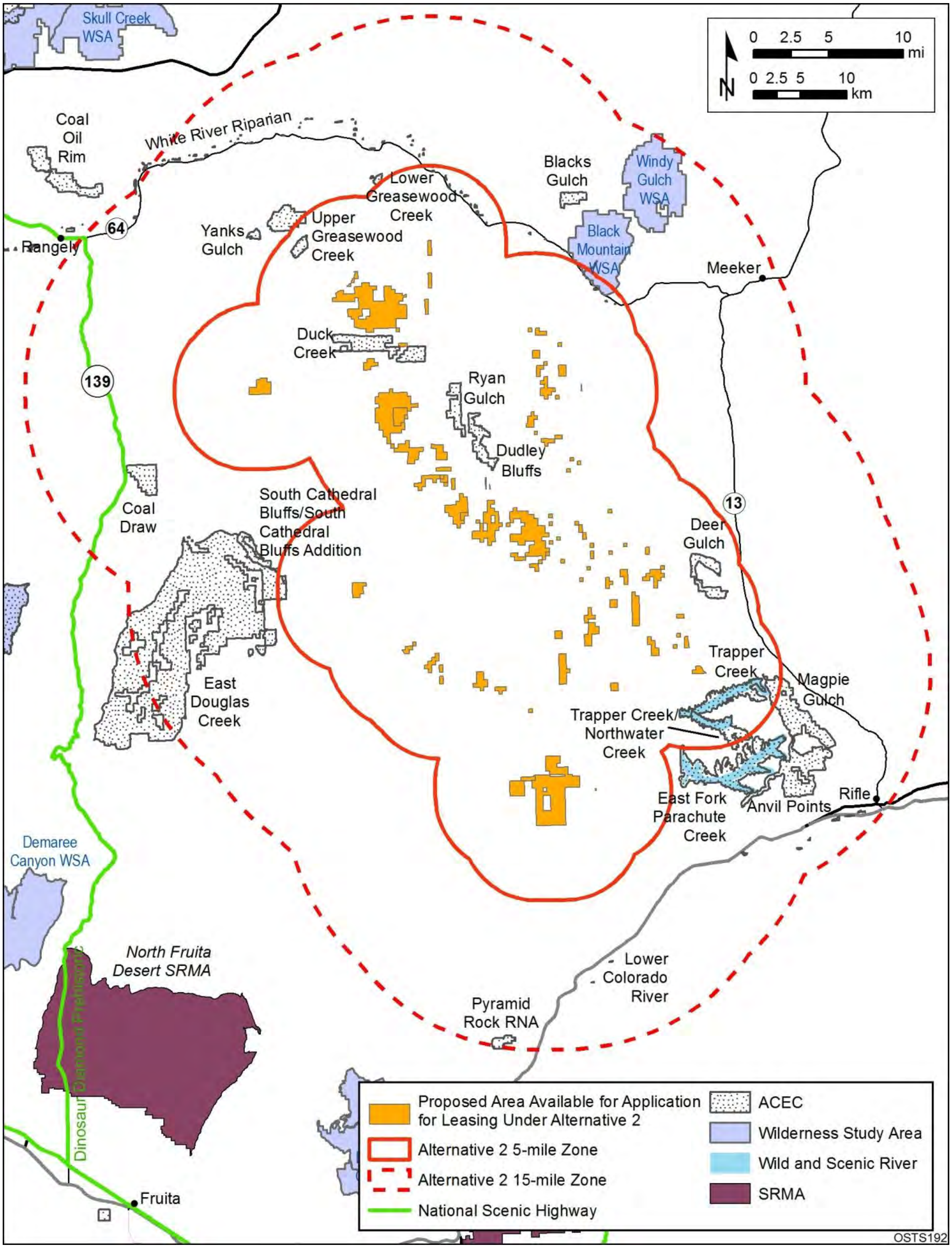


**FIGURE 6.1.2-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 in Colorado**

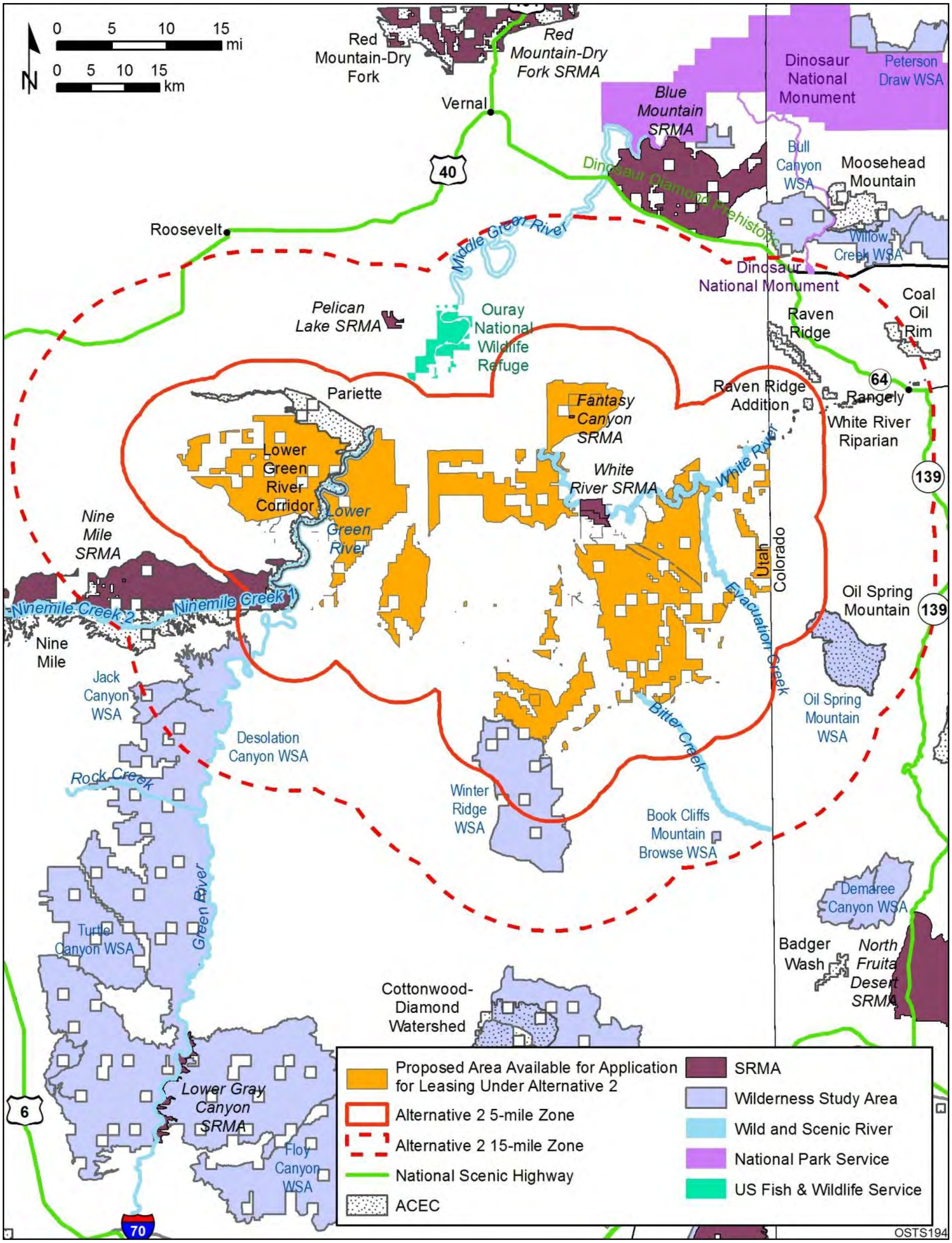


**FIGURE 6.1.2-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 in Utah**

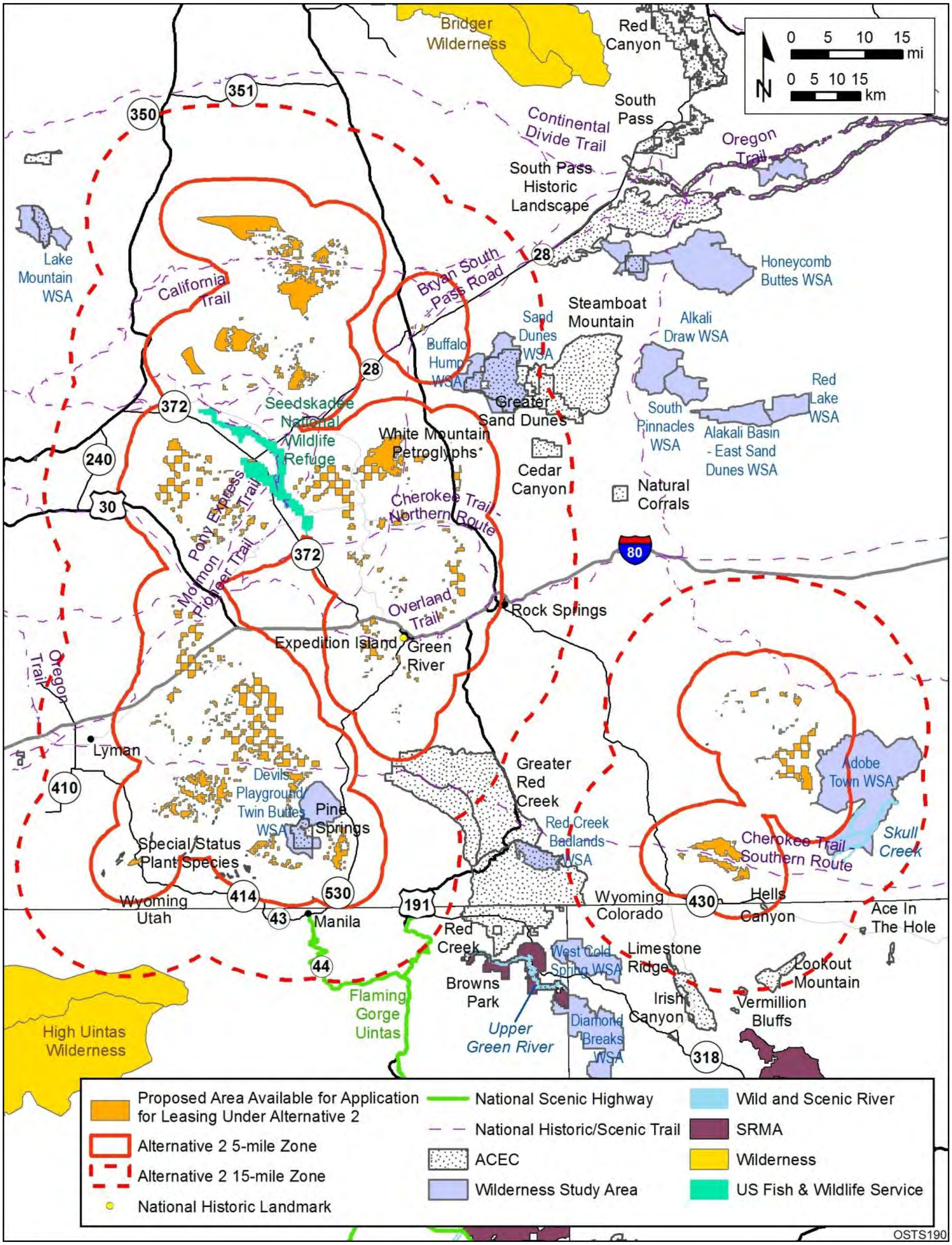


**FIGURE 6.1.2-8 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 in Wyoming**

**TABLE 6.1.2-4 Visually Sensitive Areas That Could Be Affected by Commercial Oil Shale Projects Developed in the Alternative 2 Lease Areas**

| Location | Scenic Resources within 5 mi of Alternative 2 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 2 Lease Areas |
|---|---|---|
| ***Colorado*** | Deer Gulch, Duck Creek, Dudley Bluffs, East Douglas Creek, East Douglas Creek/South Cathedral Bluffs Addition, East Fork Parachute Creek, Lower Greasewood Creek, Magpie Gulch, Ryan Gulch, Trapper Creek, Trapper Creek/Northwater Creek, Upper Greasewood Creek, and White River Riparian ACECs; segments of Trapper Creek, and Northwater Creek determined to be eligible for WSR designation; and Black Mountain WSA. | Anvil Points, Blacks Gulch, Coal Draw, Lower Colorado River, Pyramid Rock RNA, South Cathedral Bluffs/South Cathedral Bluffs Addition, South Cathedral Bluffs Addition, Trapper Creek/Northwater Creek, Upper Greasewood Creek, White River Riparian, and Yanks Gulch ACECs; Dinosaur Diamond Prehistoric Scenic Highway; segments of East Fork Parachute Creek determined to be eligible for WSR designation; and Black Mountain and Windy Gulch WSAs. |
| ***Utah*** | Nine Mile, Oil Spring Mountain, Raven Ridge, Raven Ridge Addition, White River Riparian, Lower Green River Corridor, Pariette, and Raven Ridge/Raven Ridge Addition ACECs; Ouray NWR; Dinosaur Diamond Prehistoric National Scenic Highway; Nine Mile and White River SRMAs; and Desolation Canyon, Oil Spring Mountain, and Winter Ridge WSAs. | Coal Oil Rim, Moosehead Mountain, Nine Mile, Oil Spring Mountain, Raven Ridge, Raven Ridge Addition, and White River Riparian ACECs; Dinosaur National Monument; Ouray NWR; Dinosaur Diamond Prehistoric National Scenic Highway; Nine Mile, Blue Mountain, and Pelican Lake SRMAs; Desolation Canyon, Oil Spring Mountain, Winter Ridge, Book Cliffs Mountain Browse, Bull Canyon, Jack Canyon, and Willow Creek WSAs. |
| ***Wyoming*** | Greater Red Creek, Hells Canyon, Pine Springs, Special Status Plant Species, and White Mountain Petroglyphs ACECs; Expedition Island NHL; Bryan South Pass Road, California, Cherokee Trail–Northern Route, Cherokee Trail–Southern Route. Mormon Pioneer, Oregon, Overland, and Pony Express NHTs; Seedskadee NWR; and Adobe Town, Buffalo Hump, and Devils Playground/Twin Buttes WSAs. | Greater Red Creek, Hells Canyon, Special Status Plant Species, Cedar Canyon, Greater Sand Dunes, Irish Canyon, Limestone Ridge, Lookout Mountain, Steamboat Mountain, and Vermillion Bluffs ACECs; Bryan South Pass Road, California, Cherokee Trail–Northern Route, Cherokee Trail–Southern Route. Mormon Pioneer, Oregon, Overland, and Pony Express NHTs; Flaming Gorge Uintas Scenic Highway; segments of Skull Creek and Upper Green River (Utah) determined to be eligible for WSR designation; High Uintas Wilderness; and Adobe Town and Buffalo Hump WSAs. |

Visual resources could be affected at and near the Alternative 2 lease areas where commercial oil shale projects are developed and operated, and at areas where supporting infrastructure (e.g., plants and utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 4.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components, such as shale-processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

#### 6.1.2.9 Cultural Resources

Under Alternative 2, the amendment of land use plans to identify 461,965 acres of public land as available for commercial oil shale development would not result in impacts on cultural resources. Existing ACECs, some of which have been identified for their cultural values, including about 7,300 acres in Wyoming (the West Sand Dunes Archaeological District), will be excluded from potential application for leasing under this alternative, and, therefore, the cultural resources present in these areas would not be directly impacted under this alternative. The remaining lands made available for application for leasing overlap with some lands identified as having cultural resources present. Of the public lands that would be made available for application for leasing under Alternative 2, approximately 33% in the Piceance Basin, approximately 21% in the Uinta Basin, and approximately 10% in the Green River and Washakie Basins have been surveyed for cultural resources. In these areas that have been surveyed, an approximate total of 1,820 sites have been identified. Additional resources are likely in unsurveyed portions of the study area. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), 20,917 acres (59%) of the Piceance Basin, 221,316 acres (88%) of the Uinta Basin, and 164,425 acres (94%) of the Green River and Washakie Basins Alternative 2 footprints have been identified as having a medium or high sensitivity for containing cultural resources.

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to have an impact on cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts of development could include the destruction of individual resources present within development footprints, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resources from looting or vandalism as a result of increased human presence/activity in the sensitive areas, and visual degradation of cultural setting (see Section 6.1.2.8). Any future leasing and development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts or to denial of the lease or project. Development can also lead to scientifically beneficial discoveries of cultural resources that would otherwise have remained unknown.

#### 6.1.2.10 Indian Tribal Concerns

Alternative 2 (Conservation Focus) differs from Alternative 1 in that the land management plans for areas of oil shale development in Utah, Wyoming, and Colorado, while carrying forward those exclusions from oil shale leasing and development established in 2008 and reflected in Alternative 1, would be amended to incorporate (1) all land exclusions in Alternative 1; (2) all ACECs analyzed in the 2008 OSTS PEIS plus additional ACEC areas resulting from recently completed planning efforts in Utah and Wyoming; (3) all areas that the BLM has identified or may identify as containing wilderness characteristics; (4) Adobe Town, a "Very Rare or Uncommon Area" in Wyoming; and (5) core or priority sage-grouse habitat as defined in BLM guidance. As a result, the acreage made available for application for commercial lease under Alternative 2 (461,965 acres) would be less than a quarter of that available under Alternative 1. As with Alternative 1, making parcels available for application for commercial leasing will not in and of itself have adverse effects on traditional properties and other resources of concern to Native Americans. The leasing and development of the parcels, however, would increase the potential for adverse impacts. Since less land is available for commercial leasing, it is likely that fewer traditional properties and other resources important to Native Americans would be affected under Alternative 2. However, the reduction in impacts would not be precisely proportional to the reduction in acreage, because the nature and scope of the impacts of development depend on the location of the development facility and the steps taken to mitigate impacts. Legally required project-specific cultural resource surveys, NEPA analyses, and consultation with interested tribes are important steps in avoiding or mitigating adverse effects on tribal resources. This is particularly true for split estate lands in the Uintah and Ouray Reservation where the tribe owns the surface estate and the federal government the subsurface estate. Specific lease stipulations developed in consultation with affected tribes could reduce the impacts on resources that may be impacted by the development of specific parcels.

#### 6.1.2.11 Socioeconomics

Socioeconomic and transportation impacts of Alternative 2 would be dependent on the exact locations of future development. The types of impacts that could occur would be the same as those described in Section 4.12 and summarized in Section 6.1.1.11 for Alternative 1, but would be lesser in scale because of the reduced acreage available for development. The specific impacts would be dependent upon the technologies employed, the project size or production level, development time lines, mitigation measures, and the location of employee housing.

Under Alternative 2, it is possible that there will be property value impacts simply from designating land as available or not available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.12.1.6).

#### 6.1.2.12 Environmental Justice

Although the environmental justice impacts of Alternative 2 would be dependent on the exact locations of specific developments, the types of impacts that could occur as a result of development on lands identified as available for application for leasing under Alternative 2 would be the same as those described in Section 4.13 and summarized in Section 6.1.1.12.

#### 6.1.2.13 Hazardous Materials and Waste Management

The amendment of land use plans under Alternative 2 to identify 461,965 acres of land as available for application for leasing for commercial oil shale development would not result in any hazardous material or waste management concerns. Impacts related to hazardous materials and wastes could occur during future development of commercial oil shale projects within the areas identified in Alternative 2 as available for application for commercial leasing. Such impacts are generally independent of location and would be unique to the technology combinations used for oil shale development. However, impacts from hazardous materials and wastes are similar for some of the ancillary support activities that would be required for development of any oil shale facility regardless of the technology used. These include the impacts from development or expansions of support facilities, such as employer-provided housing and power plants.

Hazardous materials and wastes would be used and generated during both the construction and operation of commercial oil shale facilities and supporting infrastructure (e.g., power plants). Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, and corrosion control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites and other wastes typically associated with construction, none of which are expected to be hazardous (Section 4.14.1).

During project operations, hazardous materials would be utilized, and a variety of wastes (some hazardous) would be generated. Hazardous materials would include fuels, solvents, corrosion-control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations will depend on the specific design of the commercial oil shale project (surface or subsurface mining, surface retorting, in situ processes). Waste materials produced during operations may include spent shale, waste engine fuels and lubricants, pyrolysis water, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 4.14.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial oil shale project, it is not possible to quantify project-related impacts of these materials. Under Alternative 2, individual facilities could be located anywhere within the area identified as available for leasing pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Sections 4.15 and 6.1.2.14) at locations wherever the individual projects are sited within the Alternative 2 lease areas.

#### 6.1.2.14 Health and Safety

The amendment of land use plans to identify 461,965 acres of land as available for application for leasing for commercial oil shale development would not result in any direct health and safety concerns. A number of health and safety concerns, however, would be associated with the commercial development of oil shale projects within the areas in Alternative 2 identified as available for application for commercial leasing. For commercial oil shale development in Alternative 2, potential health and safety impacts from the construction and operation of commercial oil shale projects would be associated with the following activities: (1) constructing project facilities and associated infrastructure, (2) mining (if processing is not in situ) the oil shale; (3) obtaining and upgrading the crude oil, either through surface retorting or in situ processing; (4) transporting construction and raw materials to the upgrading facility and transporting product from the facility; and (5) exposing the general public to water and air contamination associated with oil shale development. Hazards from oil shale development (summarized in Table 4.15-1) could include physical injury from construction, oil shale processing, and vehicle transportation accidents and exposure to fugitive dust and hazardous materials, such as retort emissions and industrial chemicals (Section 4.15). Health and safety impacts would be largely restricted to the immediate workforce of each facility. Accidents could also affect members of the general public who could be present in the immediate vicinity of an accident (e.g., project-related truck accident on a public road, recreational users in areas adjacent to the project lease area).

Hazards for workers at oil shale development facilities include risks of accidental injuries or fatalities, lung disease caused by inhalation of particulates and other hazardous substances, and hearing loss. Estimates of expected injuries and fatalities can be made on the basis of numbers of employees and the type of work. Based on the numbers of employees projected to be needed for construction and operation of oil shale facilities, statistically there would be less than 1 death and about 125 injuries per year expected per facility during construction activities, and less than 1 death and less than 100 injuries per year expected per facility during operations (NSC 2006). As a measure to decrease worker injuries, a comprehensive facility health and safety plan and worker safety training could be recommended to be included in the plans of development for proposed commercial oil shale projects.

Health and safety concerns are largely independent of the location of oil shale development facilities. However, the health and safety impacts on the general public from emissions from these facilities would depend both on the specific characteristics and level of emissions and on the distance of the emissions source from population centers. The level of air and water emissions would be regulated under required permits. Potential impacts on the general public from emissions would be assessed in future site-specific NEPA and permitting documentation.

### 6.1.3 Impacts of Alternative 3, Research Lands Focus

Under Alternative 3, the BLM would amend the same eight BLM land use plans that would be amended under Alternative 2 (Section 6.1.2), but would designate only 32,640 acres of public land as available for application for leasing for commercial development of oil shale in Colorado and Utah. (See Section 2.3.3.2 for a complete description of Alternative 3.) Specific proposed land use plan amendments are provided in Appendix C.

Lands other than these 32,640 acres to be designated as available for application for leasing for commercial development of oil shale under Alternative 3 that are currently open would be closed to such leasing and development, that is, the difference between 2,017,741 and 32,640 acres. As described below, the potential impacts on lands currently available for application for leasing for commercial development but considered in Alternative 3 for closure to such leasing and development would not be adverse, because no leasing or development would take place and, unless otherwise discussed, any benefit would accrue in proportion to the number of acres closed.

The proposed development in this alternative area includes the six 160-acre RD&D projects leased by the BLM in 2007 and three potential new RD&D leases, two in Rio Blanco County near the existing RD&D leases and one in Uintah County. The five existing projects in Rio Blanco County, Colorado, are evaluating in situ processes, and the one existing project in Uintah County, Utah, is evaluating underground mining with surface retort (see Figure 2.3-2). A total of 960 acres is currently involved in the six projects. The six current RD&D leases contain terms and conditions that could allow commercial development of the original leases and the associated PRLA totaling 30,720 acres. The three potential new RD&D leases are currently undergoing NEPA analysis. Maximum acreage of these three leases, if approved, would be 1,920 acres, bringing the total acreage among all existing and potential RD&D projects to 32,640 acres as available for potential oil shale leasing under this alternative.

The BLM evaluated the environmental and socioeconomic impacts of the RD&D activities on the six leases prior to issuance of the leases through the preparation of EAs. Four separate EAs were prepared, and Findings of No Significant Impact (FONSIs) were issued for each project. These include separate documents for the Chevron project (BLM 2006a,b), EGL (now American Shale Oil [AMSO]) project (BLM 2006c,d), three Shell projects (BLM 2006e–h), and Enefit project (BLM 2007a,b). These EAs assess only the RD&D activities at each project site and do not examine the potential impacts of future commercial development on the associated PRLAs. The new potential RD&D projects are currently undergoing site-specific NEPA review separate from this PEIS. The impacts described would not be expected to occur with respect to the lands identified as not available for application for commercial oil shale leasing, apart from possible indirect impacts on such lands from activities that might occur on the RD&D and PRLA lands identified as available.

This section contains a summary of the impacts associated with the RD&D activities at each of the six project sites (including the impacts associated with the establishment of their utility ROWs for electric transmission lines and pipelines and the construction of access roads). As described in Section 2.3 of this PEIS, the RD&D leases are prior existing rights and are common to all four alternatives. To avoid unnecessary duplication, the impacts of the RD&Ds are not repeated in Sections 6.1.1, 6.1.2, and 6.1.4, but the effects of the RD&Ds under each of these alternatives would be the same as under Alternative 3. Unless otherwise noted, the information on the RD&Ds is summarized from the individual EAs, and more detailed information is contained in the EAs. The EAs and FONSIs identify a number of terms, conditions, and stipulations that will be applied to mitigate the potential impacts of the RD&D projects. The potential impacts of the new RD&Ds that are being considered likely will be similar and proportionate to the impacts of the existing RD&D projects. While any conversion of these RD&D leaseholds to commercial use would require separate NEPA analysis, this analysis presents a description of possible impacts of development on the acres that would be available for leasing and development under Alternative 3, which includes only those acres currently covered by the RD&D leases (existing and under review) and their respective PRLA. Although these impacts would occur in Alternatives 1, 2, and 4, because Alternative 3 would leave *only* these acres available for leasing and development they are emphasized here. In the event that the NEPA and other reviews for the three pending RD&D leases are completed prior to preparation of the final version of this PEIS, the BLM anticipates including any relevant information from those review processes in the Final PEIS.

As noted, this information is not provided in order to serve as the NEPA compliance that supports issuance of these leases themselves. That has been done (for the existing leases), or is underway in a separate process (for the pending leases). Rather, the information is provided not only for its own sake (to disclose what is happening under all of the alternatives), but primarily to illustrate the kinds of impacts that might be expected from such type of development, in order to inform this allocation decisionmaking. In the event that the NEPA and other reviews for the three pending RD&D leases are completed prior to preparation of the final version of this PEIS, the BLM anticipates including any relevant information from those review processes in the Final PEIS.

#### 6.1.3.1 Land Use

In the Piceance Basin area, the five existing Colorado RD&D lease areas are located within 15 mi of each other in Rio Blanco County. They are all located between 25 and 30 mi southwest of the town of Meeker and 20 to 30 mi southeast of the town of Rangely. The region in which these lease areas are located is rural and relatively undeveloped. Existing land uses include open rangeland; ranching; oil and gas development; utility corridors; historic nahcolite and oil shale mining, as well as more recent sodium solution mining; seasonal recreation, including big-game hunting; and wild horse herd management (primarily at Shell Sites 1 and 3, within the Piceance–East Douglas Creek HMA). Land use on adjacent parcels of land should be largely unaffected by the RD&D activities, except that noise and human activity could alter the quality of hunting and other recreational experiences in the area and impact wild horses (see Section 6.1.1.7.3 for more information about the impact on wild horses under Alternative 3). Land use along the new utility ROWs and access roads will be impacted during the construction phases, but these impacts will be largely short term. Although these lease areas are located in the same general area and will be undergoing RD&D activities during the same period of time, they are dispersed enough so that cumulatively, their impacts on land use will be relatively minor.

One of the five Colorado lease areas, Shell Site 2, is located within the Multimineral Zone. The Shell Site 2 RD&D activities are focused on evaluating the practicability of combining already developed nahcolite extraction methods with Shell's in situ hydrocarbon extraction technology. Although the Chevron RD&D lease area is outside the Multimineral Zone, this project also will include an assessment of the development potential for nahcolite and dawsonite in the project area and the potential conflicts between oil shale development using Chevron's in situ technology and the development of these resources.

By the terms of the existing RD&D leases, the operations could convert into commercial facilities (see Section 1.4.1 for a description of the terms and conditions). Within the Piceance Basin, this could lead to a relatively dense development complex of approximately 25,000 acres, which could dramatically affect existing land uses within the area.

The Enefit RD&D project is located at the White River Mine site in Uintah County, Utah. This 160-acre lease area is located within the Ua Tract of the 1974 Federal Prototype Oil Shale Leasing Program. Current land use within the RD&D lease and on adjacent lands includes oil and gas development, gilsonite mining, wildlife habitat, recreational use, and livestock grazing. The project site does not coincide with any wild horse or burro HMA. Enefit plans to conduct RD&D activities in three phases. On-site construction activities will not begin until Phase 2, and construction of the utility ROWs will not begin until Phase 3. Because this project is located at an existing mine site, the RD&D activities will not substantively change the existing land use within the leased area. Land use on adjacent parcels of land should be largely unaffected by the RD&D activities, except that noise and human activity could alter the quality of hunting and other recreational experiences. These impacts will not occur until the start of Phase 2 activities. Land use along the new infrastructure ROWs will be impacted during the construction phases, but these impacts will be largely short term.

Impacts could result from construction and operation of oil shale facilities that could occur following future approval of commercial leases and development on the 32,640 acres composing this alternative, including PRLA lands. Impacts of that leasing and subsequent development action would be considered in project-specific NEPA analyses prior to approval of any commercial leases and/or development. The specific impacts on land use and the magnitude of those impacts are generally similar for all the projects testing in situ methods but vary slightly depending on project location; project size, technology employed, and scale of operations; and proximity to roads, transmission lines, and pipelines. Impacts associated with the Enefit project are different from the in situ projects because it involves underground mining with a surface retort facility. Impacts on various land uses that could be caused by commercial development of oil shale are discussed in Section 4.2 and are summarized below:

- Commercial oil shale development, using any technology, is largely incompatible with other mineral development activities (with the obvious exception of when nacohlite production is incorporated into a lease) because each dominates the lease area in which it is located. Oil and gas development is ongoing in many parts of the study area, and conflict between oil shale projects and oil and gas projects may occur. Oil and gas leases issued between 1968 and 1989 contained a stipulation that drilling of wells will occur only if the oil and gas lessee can establish that such drilling will not interfere with the mining and recovery of oil shale deposits. Oil and gas leases issued after January 27, 1989, do not contain this stipulation. Although it is possible that undeveloped portions of an oil shale lease area could be available for other mineral development, such development would be unlikely to occur on a widespread basis, except possibly in areas where a single company is developing multiple resources. A possible exception is being investigated as part of two of the RD&D projects in which nacholite mining is being conducted in advance of oil shale production. Existing leases for oil and gas or other mineral development may preclude oil shale development for some period of time.

- In the Vernal RMP area, the two oil shale areas totaling 6,000 acres classified for in situ development overlap with the P.R. Spring STSA. Although no development of either oil shale or tar sands resources has occurred in this area, it is possible that at some point development of these resources may conflict with one another.

- Where existing agricultural water rights are acquired to support oil shale development, existing irrigation-based agricultural uses of the land from which the water is acquired would be modified to support lower value dry land use of the lands and/or may result in a complete loss of agricultural uses. Some areas could be converted to nonfarm uses, depending upon local zoning decisions.

- Grazing activities could be precluded by commercial oil shale development in those portions of the lease area that were (1) undergoing active development; (2) being prepared for a future development phase; (3) undergoing restoration after development; or (4) occupied by long-term surface facilities, such as production facilities, office buildings, laboratories, retorts, and parking lots. Depending on conditions unique to the individual grazing allotment, temporary reductions in authorized grazing use may be necessary because of loss of a portion of the forage base. It is possible, depending upon how commercial leases would be developed, that grazing uses might be accommodated on parts of the leases during the lease period.

  The level of impact of the removal of acreage from individual grazing leases would be dependent upon site-specific factors regarding the grazing allotment(s) affected. There is a large variation in size and productivity of BLM grazing allotments across the PEIS study area, and the loss of up to 5,120 acres for individual oil shale leases from larger allotments would not be as significant as that from smaller allotments. Some allotments could become completely unavailable for use. Others would lose varying percentages of grazing area that might affect their overall economic viability.

- Commercial oil shale development activities are largely incompatible with recreational land use (e.g., hiking, biking, fishing, hunting, bird-watching, OHV use, and camping). Recreational uses, including OHV use, would be precluded from those portions of commercial lease areas involved in ongoing development and restoration activities. Impacts on vegetation, development of roads, and displacement of big game could degrade the recreational experiences and hunting opportunities near commercial oil shale projects. The impact of displacement of recreation uses from oil shale development lease areas would be highly dependent upon site-specific factors, especially the nature of existing uses on the site.

- No specially designated areas would be directly affected by this alternative.

- No ACECs are directly affected in this alternative. In Colorado three ACECs are close enough that they could incur indirect impacts (e.g., dust and degraded viewshed) resulting from commercial oil shale development on adjacent lands or on areas within the general vicinity.

- No lands classified as available for oil shale leasing in this alternative would directly affect lands that have been recognized by the BLM in Utah or Colorado as having one or more characteristics of wilderness.

#### 6.1.3.2 Soil and Geologic Resources

Under Alternative 3, the six current RD&D oil shale leases with PRLA lands in Colorado and Utah, totaling 30,720 acres, and three potential new RD&D leases (two in Colorado and one in Utah), totaling 1,920 acres, would be available for oil shale leasing (Section 2.3.3.2). In combination, the six current RD&D projects are expected to result in up to 960 acres of disturbed land at the lease sites, plus additional disturbed land for access roads and utilities. Soil erosion impacts, including potential related impacts on surface water salinity and overall water quality (see Section 6.1.1.4), are of concern. The erosion hazard of the soils at each of the sites is variable. The Chevron site is composed of soil with moderate to very high erosion potential (BLM 2006a). The erosion potential at the AMSO site ranges from moderate to very high for water erosion and slight to moderate for wind erosion; the revegetation potential is fair to very poor for site soils (BLM 2006c).

Shell Site 1 is mostly moderately to highly erodible, but some areas are severely erodible by water and wind. At Shell Site 2, a small portion of the site is slightly erodible, but the bulk of it is moderately to highly erodible, including some severely erodible areas. Shell Site 3 has a wide range of erosion hazard levels, from slight to high, and also includes a portion that is severely erodible. At the Enefit RD&D site, the soils are slightly to moderately erodible by water, but have wind erodibility ranging from none to moderate. Phase 3 of the Enefit project will involve construction of a ROW to the site, which will add to the overall amount of disturbed land. Along this ROW, many soil types are present, ranging in water erodibility from none to very severe and ranging in wind erodibility from none to high (BLM 2007a).

Each of the Colorado RD&D projects will entail extensive drilling activities. Proper management of drill cuttings is important because they can be susceptible to water and wind erosion and may have a subsequent effect on water quality. At the Chevron site, drilling cuttings will be generated at approximately 5 injection or production wells, 20 groundwater monitoring wells, and 20 to 25 boreholes for tiltmeters, for collection of fracture data. At the AMSO site, drill cuttings will be produced by approximately 4 to 8 dewatering wells, 2 water injection wells, 5 boreholes for heating, 4 producer wells, and additional groundwater monitoring wells. Anticipated drilling waste from each of the Shell sites will include cuttings from approximately 150 boreholes for freeze-wall construction, 10 producer boreholes, 30 heater boreholes, and additional boreholes for groundwater monitoring wells.

Each of the RD&D projects will have impacts on other mineral development activities. Chevron's in situ combustion technique could lead to the loss of other mineral resources, such as any economically extractable nahcolite or dawsonite, in or near the treated area. Because of the flammability of natural gas, gas wells will not be allowed within some distance of an in situ combustion site, likely including any directionally drilled wells targeting gas beneath the oil shale treatment zone. Producing gas wells are within 0.1 mi of the Chevron lease boundary. This site is located in the KSLA of the Piceance Basin. The nahcolite and dawsonite content beneath the site is to be determined through a drilling program. Coal is too deep to be technologically accessible.

The AMSO site also is within the KSLA, although the EA does not describe the sodium minerals present at the site. The AMSO site targets a zone above nahcolite, presumably leaving this mineral resource unaffected. The heating process could potentially lead to heaving and subsidence, with possible effects on nearby gas or oil wells. A producing gas well is within 0.4 mi of the AMSO lease boundary.

As part of the RD&D activities, nahcolite solution mining will occur at Shell Site 2, which is located in the Multimineral Zone. The naturally occurring nahcolite at Sites 1 and 3 has been leached away by naturally circulating groundwater. Dawsonite, which is not soluble in groundwater, is present at Site 2 at an average of 5% by weight and at Site 3 at an average of 4% by weight across certain intervals. Natural gas wells, including producing wells and permitted locations awaiting drilling, are within 5 mi of Sites 1 and 3, and several are within 0.5 mi of Site 2. Directional drilling will be necessary for accessing gas beneath the RD&D sites, although technological constraints may prevent this. Coal is present at technologically infeasible depths.

Tar sands resources are not present on the Enefit RD&D site, although they do occur 10 mi to the south. Coal bed $CH_4$ is present in the region, though no production takes place near the RD&D site. Coal is too deep to be minable, and no other minerals are present at the site. Two gilsonite veins are present along the intended ROW. Enefit will coordinate ROW construction with the gilsonite mining company. Natural gas leases are present at the site; Enefit will also coordinate with the oil and gas lessees.

Soil impacts, occurring during construction and reclamation, are expected to be local in extent. Overall impacts will be minimized through a series of conditions identified in the EAs and FONSIs. To mitigate impacts on nahcolite and dawsonite, the proposed actions for the Colorado sites call for avoiding oil shale zones with substantial deposits of sodium minerals, recovering the nahcolite before recovering the oil resources, or isolating the formations to avoid destruction of the nahcolite and dawsonite. The proposed actions will not adversely affect the future recovery of oil shale outside the retorted zones or of other minerals in the study area.

Under Alternative 3, impacts on soil and geologic resources as described in Section 4.3 could occur wherever individual projects are located within the 32,640 acres identified as available for application for leasing in the two existing land use plans.

#### 6.1.3.3 Paleontological Resources

Under Alternative 3, the six current RD&D oil shale leases with PRLA lands in Colorado and Utah, totaling 30,720 acres, and three potential new RD&D leases (two in Colorado and one in Utah), totaling 1,920 acres, would be available for oil shale leasing (Section 2.3.3.2). There is a potential for impacts on paleontological resources at all nine RD&D oil shale lease areas, consistent with the common impacts discussed in Section 4.4 for commercial oil shale operations. All seven RD&D lease areas in the Piceance Basin near Meeker, Colorado (five current sites: Chevron, AMSO, and Shell Sites 1, 2, and 3; and two potential new sites: Natural Soda and ExxonMobil) are underlain by the Uinta Formation. The Uinta Formation is categorized as a Condition 1 and PFYC 4/5 unit in which significant paleontological resources are known to occur (Table 3.3-2). The two lease areas in the Uinta Basin in northeastern Utah (one current site, Enefit, and one potential new site, Aurasource) are underlain by the Uinta and Green River Formations, both of which are categorized as Condition 1 and PFYC 4/5 units (Table 3.3-2). Of the new acreage designated under Alternative 3, a total of 1,456 acres (about 76% of the 1,920 acres that would be available in the new RD&D leases under Alternative 3) has been identified as overlying geologic formations having a high potential to contain important paleontological resources (Murphey and Daitch 2007). Approximately 1,121 of these acres are in the Piceance Basin and 335 acres are in the Uinta Basin.

At the Chevron and AMSO sites, there were no bedrock exposures from which paleontological resource potential could be directly assessed (BLM 2006a,c). Impacts on paleontological resources were determined to be possible at both sites, especially during drilling of test wells, clearing for construction of site facilities, drilling and installation of heating and production wells, and excavating for construction research facilities (e.g., reserve pits, access roads, and ROWs for power and communication lines and natural gas pipelines). To mitigate possible damage during such activities, the EAs (BLM 2006a,c) indicated that a BLM paleontological monitor would be present to identify paleontological resources during ground-disturbing activities and to spot-check areas during surface-clearing activities associated with facility construction. The monitor would modify or halt activities as needed to mitigate impacts on paleontological resources. As fossil materials are uncovered, the operator would contact the BLM authorized officer. The authorized officer would evaluate the materials and inform the operator as to whether the materials are of scientific significance and specify what mitigation measures (including relocation) are to be undertaken before site activities can resume. The authorized officer would be responsible for the stabilization and recordation of exposed materials and would provide technical and procedural guidelines for mitigation measures undertaken. Once mitigation has been completed, the authorized officer would authorize activities to resume. The

EAs also indicated that Chevron and AMSO would train construction and operation personnel that collection of fossil specimens is prohibited.

Shell Sites 1 and 3 have been surveyed for paleontological resources (BLM 2006e). No paleontological resources were found during the survey at Site 1; however, the EA indicated that a BLM paleontologist would be notified prior to any excavation into the underlying rock formations. Significant fossil plants were encountered in an unnamed tongue of the Uinta Formation exposed in incised drainages on Site 3 (vertebrate fossils were not found); therefore impacts on significant paleontological resources are considered probable at Site 3 (BLM 2006e). Shell Site 2 has not been surveyed; therefore, the potential for significant paleontological resources to be present at the site is not known (although a cultural survey by Darnell 2006 recorded a paleontological site; see Section 6.1.3.9). The EAs for the Shell sites include the following mitigation measures: site avoidance, quarrying to recover a sampling of fossils present at the site (such as Site 3), and monitoring by the operator and authorized officer, as needed (similar to that described above for AMSO and Chevron).

Surveys have not been completed for the Natural Soda and ExxonMobil potential new lease areas; however, EAs are currently under way for these two sites.

No significant fossils were found in existing shale ore stockpiles at the Enefit lease area; however, known Condition 1 sites have been documented within 1 mi of the site (BLM 2007a). Land disturbance and construction activities along proposed utility ROWs have the potential to affect paleontological resources. Construction of power lines and pipelines in support of the RD&D project is less likely to affect paleontological resources because of the limited areas of bedrock near the construction location for the proposed pipeline and the limited amounts of ground disturbance associated with power pole placement. Possible mitigation presented in the EA to reduce adverse impacts includes developing standard procedures for managing the discovery of fossils, including stop work and notification procedures if fossils are encountered during construction activities. The operator would prepare a project-specific unanticipated discovery and monitoring plan (in consultation with the BLM) and ground disturbance within Condition 1 and Condition 2 areas, and shale ore stockpiles would be evaluated periodically by a qualified paleontologist. The operator would also inform construction and operation personnel that collection of fossil specimens is prohibited.

A survey has not been completed for the Aurasource potential new lease area; however, an EA is currently under way for this site.

Under Alternative 3, all the RD&D lease areas in Colorado and Utah (covering a total of 32,640 acres) have a high potential for containing significant paleontological resources because they overlie stratigraphic units that are categorized as Condition 1 and PFYC of 4/5. Mitigation measures, as outlined in the respective EAs, would be followed to avoid or minimize adverse impacts.

### 6.1.3.4 Water Resources

Under Alternative 3, the six current RD&D oil shale leases with PRLA lands in Colorado and Utah, totaling 30,720 acres, and three potential new RD&D leases (two in Colorado and one in Utah), totaling 1,920 acres, would be available for oil shale leasing (Section 2.3.3.2). Impacts on water resources in leased areas can be divided into water quality and water quantity issues. The former are particularly important to surface water, in keeping with the federal Colorado River Water Quality Improvement Program (CRWQIP) (P.L. 92-500) to maintain Lower Colorado Basin water salinity at or below certain levels. Water quantity issues are related to the water allocation under the Upper Colorado River Basin Compact, stream and river flows, and their effect on sediment erosion and deposition in channels. The water quality in the Upper Colorado River Basin, where the RD&D sites are located, is closely related to stream and river flows. Because water will not be withdrawn from surface water bodies near the sites and wastewater will be shipped off-site for disposal under this alternative, the impacts on surface water quantity and quality originate primarily from surface runoff, including potential spills. For the groundwater, potential impacts come from groundwater dewatering, reinjection (if used), permeability enhancement in oil shale productive zones, and release of contaminants in the subsurface. Natural groundwater discharge from seeps and springs in stream valleys will also be affected. Mitigation measures identified in the EAs and FONSIs focus extensively on limiting impacts on water resources.

During the construction phase for the RD&D sites, most of the surface water impacts are related to soil and vegetation disturbance that will occur as a result of clearing, excavating, and grading activities. These activities occur at project sites, along utility line ROWs, newly constructed stormwater drainage systems, spent shale disposal areas, and access roads, and will result in temporary increases in sediment load carried to nearby surface water bodies by surface runoff. Because the soils and underlying sedimentary rocks near the RD&D sites have a high salt content, increased surface runoff also is likely to produce higher dissolved salts in the surface runoff. Construction activities may cause some natural drainages to be diverted or modified, and new drainage channels may be created near access roads and other specific sites. These changes could result in increased runoff velocity and increased peak discharge. An indirect consequence of drainage changes could be increased rates of surface soil erosion, especially in sloped areas. If drill cuttings are not contained or otherwise managed properly, they could represent another source of increased sediment and salinity loads to surface water. The impacts on surface water during the construction phase can be mitigated by many of the actions identified in the EAs for the projects.

At the Enefit site, mitigation of impacts from runoff and treated process water from retorting will likely be through collection in ponds or behind a retention dam. Depending on the quality of the water and the permeability of the soil underneath the retention dam area, water infiltrated to the subsurface could migrate to nearby surface water bodies and impact the surface water. At other RD&D sites, lined ponds will be used to hold and evaporate stormwater and process water; infiltrated water from the ponds will be withheld, resulting in insignificant impacts on the water resources.

During development of the five RD&D facilities employing in situ technologies, single or multiple zones of oil shale will be fractured by using different fracturing technologies (e.g., water, steam, $CO_2$, or thermal) to enhance the extraction of hydrocarbon products during in situ retorting (such as at the Chevron and AMSO sites). The fractures could permanently increase the permeability of the source rock in the productive zones. At the Chevron RD&D site, where horizontal fracturing will be conducted, the fracturing will be limited to individual production zones. The groundwater aquifers below and above the production zone will be closely monitored to detect inadvertent vertical fracturing. If cross-flows between the two aquifers are detected, fracturing intervals will be adjusted or other measures implemented to correct this problem. Similarly, at the AMSO site, a zone of oil shale adjacent to an aquifer will be preserved, allowing the production zone to remain hydraulically isolated from the aquifer.

In the case of the Shell ICP sites, fractures could also form vertically in rocks within the freeze wall, resulting in cross-flow between aquifers after the freeze wall is allowed to dissipate. The permeability in the retorted zone likely will be increased, allowing for greater groundwater flow, and could become a groundwater discharge zone for the shallower aquifers and a groundwater recharge zone for the deeper aquifers. Increased porosity (and permeability) will occur where kerogen, nahcolite, and other soluble minerals are removed from the rock. Such alteration of permeability will promote vertical as well as horizontal flow and transport of groundwater, as well as any residual hydrocarbons, chemicals used to enhance the hydrocarbon extraction, salts, and metals.

The withdrawal of groundwater will lower the water table and potentiometric surface of the affected aquifers. During RD&D operations, the activities that will result in groundwater withdrawal include (1) dewatering operations in mines or in retorted zones to prevent groundwater from entering work areas or production zones, and (2) drilling operations that could create conduits between aquifers if precautions and appropriate drilling technologies are not used. The withdrawals will create a cone of depression of the potentiometric surface or water table around each pumping well. If existing water supply wells were within the cone of depression, the yield of the wells could decline or the wells could go dry. In the Piceance Basin where the five in situ sites are located, the upper and lower aquifers (totaling 1,100 ft in thickness) are present above and below the Mahogany Zone of the Parachute Creek Member. The drawdown of water levels in the upper Parachute Creek Unit could reduce the streamflows in Yellow or Piceance Creeks. According to a modeling study presented in the EA for the Shell projects, 1 ft of groundwater drawdown could extend up to 2 mi from a dewatering well. At the Enefit site, the dewatering involves the Bird’s Nest Aquifer (about 115 ft thick), which is above the target oil shale (the Parachute Creek Member). At the Shell ICP sites, drawdown of water levels will be limited inside the freeze wall, and impacts of the withdrawal on local surface water will be minimized. At the Enefit site, the dewatering could reduce the flows of springs in Bitter Creek that receive groundwater discharge from the connected Bird’s Nest Aquifer.

Groundwater injection may have the opposite effect on hydrologically connected surface water bodies, if underground injection is used to dispose of formation water or wastewater. Injection will raise the groundwater level of the recharged aquifer near recharge wells and, depending on the target depth of the injection wells, may increase the flows of the seeps and springs or create new seeps and springs in valleys that are hydrologically connected to the affected aquifer. At the RD&D sites, the injected fluids will originate from different activities, including disposal of formation water from the production zone and injection of water to create fractures (hydrofracturing) in oil shale layers. The hot-water injection to recover dawsonite and nahcolite (used in the Shell two-step ICP) is accompanied by extraction wells and is less likely to cause a rise of water levels outside the production zone.

Impacts from groundwater–surface water interaction are primarily attributed to groundwater-related activities, including groundwater withdrawal and injection. Surface water bodies that are connected to and replenished by surficial and confined aquifers could consequently be affected. Because of the connectivity of the aquifer and the surface water bodies, the lowering of the water table could reduce or prevent the replenishment of the water bodies by the aquifers, thereby reducing the flow of the affected seeps, springs, and streams. The magnitude and the areal extent of the impact will depend on the drop or rise of the water level, the areal extent of the zone of influence, and seasonal factors. During low-flow periods, many seeps, springs, and streams in the study areas rely on groundwater discharge.

The surface water quality near an injection well may be adversely affected if the injection zone is hydraulically connected to a surface water body. During the dewatering operations, water from the lower aquifer will be mixed with the water from the upper aquifer. Because the water quality of the deeper aquifer is typically lower than that of the upper aquifer, the mixed water will result in decreased water quality compared with the water of the upper aquifer as well as the surface water bodies. The reinjection could therefore decrease the quality of hydraulically connected surface water through groundwater discharge at seeps and springs.

Once RD&D activities end at the in situ project sites and engineering controls such as the freeze wall are suspended, groundwater will reenter and flow through the retorted zone. Because the porosity of the source rock in the retorted zone (and the nahcolite and dawsonite mining zone, for the cases in which they are mined) will have been increased by the in situ retorting process, residual hydrocarbons and salts in the source rock may be readily leached and moved by the groundwater. The retorted zone is likely to become a potential subsurface contamination source for hydrocarbons, various kinds of salts, and metals. Any downgradient groundwater users could therefore have decreased water quality. If the contaminated groundwater is discharged to surface water bodies directly or through seeps and springs, the quality of the surface water will be adversely affected. If the underground injection method is used to dispose of "rinse" water from the retorted zones (e.g., the AMSO site or the Shell ICP sites in Colorado), the injection will cause environmental impacts similar to those described above. The magnitude of the impacts on groundwater and surface water will depend on the injection rate, locations of the injection wells, quality of injected water, and the target geologic formation. Reinjection of groundwater and treated process water will be done under permits managed by the affected states. Both the standards for treatment for reinjected water and/or designation of the aquifer into which injection will be permitted could minimize the potential for adverse effects on uses downgradient from the reinjection sites.

Retention ponds will be used in all RD&D sites to capture runoff from the sites and to minimize sediment input to surface streams. Discharge of captured runoff to surface water bodies will be managed through stormwater management plans and NPDES permits. The impacts of the discharge on the surface water quality should be minor.

The water sources for the six RD&D sites vary. At the Chevron and AMSO sites, water use will be limited because of the in situ combustion technologies. Water will be trucked in or derived from on-site groundwater sources. Process wastewater will be trucked off-site or placed in evaporation ponds for disposal. The water use is not likely to cause a significant impact on water resources. At the Shell ICP sites, water for drilling, dust control, soil compaction, and drinking will be trucked in. During the operation and reclamation phase, groundwater and treated process water will be used. The amount of water to be consumed is unlikely to affect the groundwater resource. At the Enefit site, water used in Phases 1 and 2 will be trucked in. In Phase 3, groundwater from the alluvial aquifer connected to the White River is likely to be used. The amount of water to be withdrawn is small relative to the streamflow of the river so that the impact on the White River will be insignificant.

Under Alternative 3, about 23 mi of perennial streams (or about 12% of the total perennial streams in the Piceance Basin, including a 2-mi buffer) are within the areas identified for oil shale leasing in Colorado. In Utah, about 5 mi of perennial streams (or about 2% of the total streams in the Uinta Basin) are within Alternative 3 areas. If the technologies tested at RD&D sites could be commercialized and would not pose any environmental or social risks unacceptable to the BLM, oil shale could be developed in these areas. The streams and associated floodplains, wetlands, and riparian areas still could be affected. Depending on the technologies that are tested to be successful and restrictions on existing management plans, the oil shale development could use underground mining, surface mining, or in situ processing to obtain the oil shale. The mining and oil shale processing operations and the construction of supportive infrastructures could impact the water quality and streamflows in the vicinity of project sites, primarily through surface disturbance; drainage modification; surface water and/or groundwater withdrawals; construction of ponds or reservoirs; leaching of overburden material, mine tailings, and spent shale; traffic dust; unwanted-water discharges (may be treated before the discharges); alteration of the hydrologic properties of affected subsurface bedrock; and modification of the interaction between groundwater and surface water. These types of impacts are discussed in Section 4.5.1 and are not repeated here.

#### 6.1.3.5 Air Quality

Under Alternative 3, the six current RD&D oil shale leases with PRLA lands in Colorado and Utah, totaling 30,720 acres, and three potential new RD&D leases (two in Colorado and one in Utah), totaling 1,920 acres and bringing the total acreage to 32,640 acres, would be available for oil shale leasing (Section 2.3.3.2). Construction and operation activities associated with each of the nine RD&D projects have the potential to affect local air quality as a result of (1) PM releases generated during construction activities (e.g., clearing and grading of facility areas, shale excavation, operation of graders and dump trucks) and (2) exhaust emissions ($NO_X$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 4.6). Operational releases (e.g., smokestack emissions from processing activities) have the potential to affect regional air quality and AQRVs, such as visibility and acid deposition. In addition, ozone precursors of $NO_X$

and VOC from oil shale development could exacerbate wintertime high-ozone occurrences already prevalent in the area.

During all phases of oil shale development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustion sources could contribute to climate change to some extent

The EAs prepared for the RD&D projects (BLM 2006a,c,e; 2007a) identified proposed construction and operations activities, quantified potential air pollutant emissions levels, predicted potential air quality impacts using atmospheric dispersion modeling methods, and compared potential impacts with appropriate significance threshold levels. The air quality analyses presented in the EAs indicate that no significant adverse, direct, or cumulative air quality impacts are likely to occur. Individual RD&D lessees may also apply to convert their 160-acre leases (plus 4,960 adjacent acres) to a 20-year commercial-scale lease once specific requirements are met.

#### 6.1.3.6 Noise

Ambient noise levels may be affected as a result of RD&D activities at the nine project sites during the construction and operations phases. The EAs prepared for the RD&D projects (BLM 2006a,c,e; 2007a) provide some quantification of the expected noise levels and, along with the FONSIs, identify measures that will be taken to mitigate noise impacts. Specifically, at the five in situ projects in Colorado, noise impacts could occur as a result of construction activities (e.g., clearing, excavation, grading, paving, and building construction); drilling wells; use of pumps, generators, and transformers; flaring; vehicular traffic; and, at the AMSO project site, use of a steam boiler. No sensitive human receptors are located within 0.5 mi of the Chevron and Shell project sites and 1 mi of the AMSO project site.

At Enefit's underground mine and surface retort project in Utah, noise impacts could occur as a result of construction activities; mining activities; use of a crusher and conveyor belt system; operation of a horizontal rotary kiln; use of pumps, generators, and transformers; and vehicular traffic. Noise impacts elsewhere in the 32,640 acres currently available for leasing would be the same as those described in Section 4.7, and their effects would be highly location dependent.

#### 6.1.3.7 Ecological Resources

Under Alternative 3, a total of 32,640 acres of public land would be made available within Colorado and Utah for application for leasing for commercial development of oil shale. These lands support a wide variety of biota and their habitats (Section 3.7). Ecological resources in these areas would not be affected by the identification of future lands available for application for leasing or by amendment of land use plans to incorporate these lease areas. However, ecological resources in and around these areas could be affected by future commercial development of oil shale in these areas. The following sections describe the potential impacts on ecological resources that may result from commercial oil shale development within the areas identified as available for application for commercial leasing under Alternative 3.

The magnitude of the impact on specific ecological resources that could be affected by commercial oil shale development in areas identified as available for application for commercial leasing in Alternative 3 would depend on the specific location of the commercial oil shale projects as well as on specific project design.

**6.1.3.7.1 Aquatic Resources.** Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. There are no impacts on aquatic habitats associated with this land use designation. However, as described in Section 4.8.1.1, impacts could result from post-lease construction and operation on RD&D and PRLA lands if the RD&D projects are converted to commercial operations. These impacts will be considered in project-specific NEPA analyses that will be conducted prior to the leasing (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects.

Potential impacts on aquatic resources from oil shale development on RD&D and PRLA lands could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 4.8.1.1. As described in Section 4.8.1.1, there is a potential for activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals are occurring. Consequently, the analysis here considers the potential for impacts on waterways up to 2 mi beyond the boundary of the lands that could be allocated for potential leasing under this alternative. However, as project development activities become more distant from waterways, the potential for negative effects on aquatic resources are reduced. For the analysis of potential impacts under each of the alternatives considered in the PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that could be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increase.

Under Alternative 3, there is no perennial stream habitat within the Piceance and Uinta Basins that is directly overlain by areas that are potentially available for oil shale development. When an additional 2-mi zone surrounding these areas is considered, there are 7 perennial streams and about 28 mi of perennial stream habitat that could be affected by future development activities (Table 6.1.1-4). Because there are no existing or under review RD&D leases in the Green River or Washakie Oil Shale Basins of Wyoming, aquatic resources within those areas would not be affected by oil shale development under this alternative, because such areas would be excluded from application for commercial oil shale leasing and development. The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the Piceance and Uinta Basins are described in Section 3.7.1, although specific impacts would depend upon the locations and methods of extraction. Project-specific NEPA analyses would be conducted prior to any future leasing decisions (including, but not limited to, conversion from RD&D to commercial lease).

Six RD&D projects that have already been initiated within the Piceance and Uinta Basins would continue to operate under this alternative. Potential impacts on aquatic resources from those projects, derived from information provided in previously prepared NEPA documents (BLM 2006a,c,e; 2007a), are summarized here. It is anticipated that impacts from the three potential RD&D leases currently undergoing environmental review would be similar to those of the six existing RD&D leases. The potential impacts on aquatic resources discussed in Section 4.8.1.1 potentially could occur at each of the RD&D project sites, although the magnitude of the impacts would be less than those discussed for full-scale commercial operations. No perennial streams occur immediately within the 160-acre tracts where the RD&D projects are sited. Within the Uinta Basin, the White River (perennial) and Evacuation Creek (intermittent tributary of the White River) are located more than 0.75 mi from the Enefit project area. The five RD&D projects planned within the Piceance Basin are located 0.25 mi or more from the nearest perennial water bodies (Hunter Creek, Black Sulphur Creek, Corral Gulch, Ryan Gulch, and Willow Creek). A combined ROW for a power line, communication lines, and a natural gas pipeline will be constructed across Hunter Creek as part of the Chevron RD&D project, but no such stream crossings are included as part of the remaining RD&D projects within the Piceance Basin. While portions of Black Sulphur Creek may have habitat suitable for cutthroat trout, such areas are located upstream from the proposed RD&D sites, and no erosion or sedimentation impacts on cutthroat trout habitats are anticipated under Alternative 3. The use of mitigation measures identified in the EAs and FONSIs, including erosion control practices, dust suppression techniques, limiting of the length of time for completing stream crossings, use of horizontal directional drilling to install pipelines under perennial streambeds, and restoration of disturbed areas upon project completion, will greatly reduce or eliminate the potential for effects on aquatic habitats and species from erosion or sedimentation. A relatively small amount of land surface would be affected by the RD&D projects (160 acres per project), which would limit the potential for large amounts of erosion or sedimentation to occur in specific watersheds. However, the amount of land affected could increase to up to 32,640 acres as PRLAs are developed during conversion to a commercial operation.

Any changes in the elevation of the water table or in the quality of discharged groundwater that occur as a result of RD&D operations could negatively affect nearby aquatic habitats and the species they support. Dewatering activities could result in drawdown of surrounding water tables, while reinjection of water could result in localized increases in the elevation of the water table. Preliminary groundwater modeling results for the Shell RD&D sites indicate that up to 1 ft of aquifer drawdown could extend for up to 2 mi from the dewatering well locations in the Piceance Basin. It is anticipated that such a drawdown will have a relatively minor effect on water quantity in nearby perennial streams. Very small amounts of depletion are expected (about 19 ac ft/yr at each of the three Shell test sites), and during some phases of operations an increase in flow may be realized. No depletions are expected for the AMSO or Chevron projects. It is anticipated that dewatering or recharge at well sites associated with the RD&D projects (existing and pending) under Alternative 3 will have minor effects on water quantity in perennial stream habitats. However, the conversion of RD&D projects to commercial developments may increase impacts on aquatic biota in perennial streams.

Dewatering and reinjection wells have a potential to inadvertently allow connection between aquifers with differing water quality parameters (Section 4.5). In addition, groundwater passing through the retorted zone associated with in situ oil shale operations could pick up residual hydrocarbons, various salts, and metals and discharge this contaminated water into nearby stream systems (Section 4.5). Depending upon the level of changes to water quality or the concentrations of specific contaminants, aquatic organisms in receiving streams could be adversely affected. The potential for impacts from contaminated groundwater could be mitigated, in some cases, by pumping water out of the retorted zone and treating it before reinjecting it into the portion of the aquifer located downgradient of the retorted zone. This approach is proposed for the AMSO RD&D site in the Piceance Basin, and impacts on aquatic organisms are expected to be minor, based on the assumption that well locations, treatment procedures, and withdrawal and reinjection rates are properly selected. Similar treatment operations have not been proposed for the remaining RD&D sites in the Piceance Basin, and it is anticipated that some impacts on aquatic organisms could occur at these remaining locations. In situ retorting will not occur in the Uinta Oil Shale Basin under Alternative 3. Rather, surface retorting will be implemented, and spent oil shale will be disposed of either off-site or in an engineered surface impoundment that will be designed to prevent off-site discharge of contaminated runoff. Contaminated water will be temporarily stored in aboveground storage tanks prior to being sent off-site for treatment and disposal.

A potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into waterways during construction and maintenance activities or as the result of leaks or spills from pipelines and on-site fuel and material storage areas. The mitigation measures identified in the EAs and FONSIs will effectively minimize the risk for such releases and resulting impacts.

In addition to the potential for the direct impacts identified above, indirect impacts on fisheries could occur as a result of increased public access to remote areas via newly constructed access roads and utility corridors. However, as described in Section 4.8.1.1, it is anticipated that impacts on fishery resources from increased access associated with oil shale development would be minor.

**6.1.3.7.2 Plant Communities and Habitats.** Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. There are no impacts on plant communities and habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects. The three potential new RD&D leases are currently undergoing NEPA analysis.

Land areas allocated for commercial oil shale development under Alternative 3 support a wide variety of plant communities and habitats (see Section 3.7.2). These areas include approximately 39 acres that are currently identified in BLM land use plans for the protection of sensitive plant species and remnant vegetation associations. Direct and indirect impacts could be incurred during project construction and operation, extending over a period of several decades (especially within facility and infrastructure footprints) (see Section 4.8.1.2). Some impacts, such as habitat loss, could continue beyond the termination of oil shale production.

Direct impacts could include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities such as access roads, pipelines, transmission lines, employer-provided housing, and new power plants would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure, and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well as the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be localized (occurring within the construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction occurs and where facilities are located, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The area available for lease application under Alternative 3 includes locations that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of oil shale development activities. The establishment and long-term survival of these species on reclaimed land may be difficult.

No ACECs are included within the Alternative 3 RD&D footprint, including PRLAs; however, several ACECs that support rare plant species and remnant vegetation associations are located within 5 mi of the RD&D footprint: Duck Creek (0.8 mi), Dudley Bluffs (1.3 mi), and Ryan Gulch (1.0 mi). Although direct impacts within these ACECs would not occur, indirect impacts, such as those associated with fugitive dust or hydrologic changes, could potentially occur. Impacts would generally decrease with increasing distance.

Within the area available for lease application under Alternative 3, the six RD&D project sites encompass a total of 960 currently leased acres, 800 acres in the Piceance Basin (the Chevron, AMSO, and three Shell sites) and 160 acres in the Uinta Basin (the Enefit site). Also included under this alternative are the three proposed RD&D project sites, two in the Piceance

Basin and one in the Uinta Basin, each totaling 160 acres. The PRLAs associated with each of the RD&D sites could potentially be available, and potentially developed, under any of the alternatives.

Impacts on vegetation, wetlands and riparian areas, and ephemeral streams will vary among the RD&D project sites. On the Chevron site, about 100 acres of sagebrush steppe community will be cleared. The sagebrush steppe at this site comprises Wyoming big sagebrush and associated shrubs, herbaceous species, and scattered pinyon pine and juniper. The impacts will extend throughout the duration of the project, with the cleared area remaining unvegetated for up to 10 years. Following site reclamation, herbaceous vegetation will likely become reestablished in 1 to 2 years, while sagebrush will take about 20 years to return and pinyon at least 50 years. Indirect impacts could include increased soil erosion and the invasion of noxious weeds or non-native species, which could reduce restoration success, introduce invasive species into nearby undisturbed areas, and reduce biodiversity, with the decline and possible eventual replacement of native species by non-natives. In addition, the replacement of native species by noxious weeds could result in an increase in the intensity and frequency of fires and a change in soil nutrient regimes. Plant community structure could also be impacted by creating, eliminating, or changing the density of vegetation layers or canopy cover. No wetlands or riparian areas occur on the Chevron RD&D project site. However, the ROW for the electric transmission line, communications lines, and natural gas pipeline will cross approximately 0.1 mi of Hunter Creek, a perennial stream, resulting in disturbance of the wetland and riparian vegetation communities along Hunter Creek, including mature pinyon-juniper woodland. Herbaceous species will likely become reestablished in 1 to 3 years; however, the loss of pinyon-juniper woodland will be a long-term impact. Indirect impacts could include lower recruitment of native species resulting from mixing of topsoil and subsoil, alteration of the hydrology of the wetland and riparian areas, inhibition of seed germination, and an increase in the potential for siltation because of soil compaction and rutting.

At the AMSO RD&D project site, up to 35 acres will be cleared of vegetation, with an additional acre cleared along the utility ROW. A total of 28 acres of sagebrush shrubland and 8 acres of pinyon-juniper woodland will be removed. Some vegetation, primarily grasses and small shrub species, will be allowed to reestablish on portions of the site during operations. Pinyon-juniper woodland, however, will be lost until reclamation of the site is completed. Restoration of vegetation communities similar to those existing on the sites will likely require 1 to 2 years for herbaceous vegetation, 20 to 75 years for big sagebrush communities, and 100 to 300 years for pinyon-juniper woodland. Potential indirect impacts from vegetation removal could include increased soil erosion and the invasion of noxious weeds and non-native plant species. Effects of the invasion of noxious weeds and non-native species could include the decline and possible eventual replacement of native species by non-natives, increased soil erosion, and reduction or fragmentation of habitat. The AMSO RD&D project site does not contain wetlands or riparian areas, and no wetlands will be permanently filled or drained as a result of proposed construction activities. Dewatering and reinjection of formation groundwater will be conducted during operation of the AMSO project and could possibly affect groundwater fluctuations or discharges to surface water in the vicinity. Wetland and riparian areas along Black Sulphur Creek, a perennial stream, or Ryan Gulch, an intermittent stream, located 1 and 2 mi from the site, respectively, could be indirectly affected if they are hydrologically connected with the groundwater units involved and if changes in groundwater levels or discharges to surface water occur.

The majority of the vegetation on the three Shell RD&D project sites will be cleared. Potential indirect impacts from vegetation removal may include increased soil erosion, invasion of noxious weeds and non-native plant species, habitat fragmentation, and generation of fugitive dust. Effects of invasion of noxious weeds and non-native species could include reduced biodiversity, with the decline and possible eventual replacement of native species by non-natives. Plant community structure could also be impacted by creating, eliminating, or changing the density of vegetation layers or canopy cover. Replacement of native species by noxious weeds could also result in an increase in the frequency and intensity of fires and a change in soil nutrient regimes. Impacts on vegetation will extend throughout the duration of the Shell projects, including the reclamation phase, covering a period of 20 years or longer. Restoration of vegetation communities similar to those existing on the sites will require 1 to 2 years for herbaceous vegetation, 20 to 75 years for big sagebrush communities, and 100 to 300 years for pinyon-juniper woodland.

On Shell Site 1, 80% of the vegetation will be cleared for construction and operations; vegetation not cleared will be lightly disturbed. Approximately 96 acres of pinyon-juniper woodland, 49 acres of upland sagebrush shrubland, and 2 acres of bottomland sagebrush shrubland will be cleared. Previously, 13 acres of the site were impacted by the construction of well pads and associated access roads. Construction of the site access road will also impact upland sagebrush shrubland and pinyon-juniper woodland. About 110 acres will be cleared on Shell Site 2. Previously, 50 acres of the site were disturbed and will not be used for in situ testing. Vegetation clearing will primarily impact upland sagebrush shrubland composed of Wyoming big sagebrush and associated shrubs and grasses, and will include 85 acres of shrubland with mixed pinyon pine and Utah juniper, 23 acres of shrubland, and 2 acres of pinyon-juniper woodland. Vegetation on 75% of Shell Site 3 will be removed; vegetation not cleared will be lightly disturbed. Vegetation clearing will impact approximately 103 acres of upland sagebrush shrubland, 48 acres of pinyon-juniper woodland, and 9 acres of bottomland sagebrush shrubland.

No wetlands or riparian habitats occur on the three Shell project sites or proposed routes for access roads. No streams were identified on Shell Test Site 1. On Test Site 2, approximately 2,000 ft of intermittent stream channels are present and could be impacted by construction and operation activities associated with the project. These streams are tributaries of Stake Springs Draw, an intermittent stream with segments of perennial flow in association with springs and seeps. About 2,100 ft of an intermittent stream, a tributary of Big Duck Creek, is located on Site 3 and could be impacted by project activities. About 1,200 ft of the stream channel will be located in the immediate area of major facilities.

At the Enefit project site in Utah, in addition to development of the site, ROWs for an access road, transmission line, and pipeline will be constructed. Vegetation on the site and along the ROWs includes sagebrush shrubland, pinyon-juniper shrubland, greasewood flats, saltbush shrublands, and grassland communities with scattered shrubs. Approximately 134 acres of upland habitat will be disturbed by activities associated with the project. The greatest impact

(63%) will occur in big sagebrush shrubland. Approximately 82 acres of the 160-acre site have been previously disturbed by development of an underground mining operation and surface storage of mined shale. No wetlands or riparian areas occur on the Enefit site; however, ephemeral streams are present. The proposed electric transmission line and pipeline routes will cross the White River, a perennial stream, as well as a number of ephemeral streams. The transmission line will also cross Evacuation Creek, an intermittent stream. Riparian and wetland areas occur along the White River and Evacuation Creek at the crossing locations. Wetlands and riparian areas will be avoided to the extent practicable; however, impacts on riparian habitat near the water supply wells will occur. The transmission line and pipeline will cross the White River 100-year floodplain, and the water supply wells will be located near the White River, within the 100-year floodplain. Cottonwood, Russian olive, and tamarisk are common species in White River riparian areas. Enefit, which recently acquired the site from OSEC, might propose a different plan that would have different impacts.

Impacts on plant communities during construction and operations on the ExxonMobil and Natural Soda proposed project sites in the Piceance Basin would likely affect big sagebrush shrubland and pinyon-juniper woodland, the predominant cover types on those sites (USGS 2004d). While these cover types are roughly equal in area on the ExxonMobil site, the pinyon-juniper woodland constitutes about two-thirds of the Natural Soda site. Intermittent streams on these sites, tributaries of Yellow Creek, could potentially be affected. Impacts would depend on project configuration within the RD&D site, and locations of roads, pipelines, transmission lines, or other infrastructure.

Impacts on plant communities during construction and operations on the Aurasource proposed project site in the Uinta Basin would likely affect pinyon-juniper woodland, the predominant cover type on that site, representing just over half of the area (USGS 2004d). Additional cover types present that could be affected include pinyon-juniper shrubland and big sagebrush shrubland. Intermittent streams on this site, tributaries of Evacuation Creek, could potentially be affected. Impacts would depend on project configuration within the RD&D site and on locations of roads, pipelines, transmission lines, or other infrastructure.

**6.1.3.7.3 Wildlife.** Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands. An additional 1,920 acres of land are included in the two potential new leases in Colorado and one in Utah. Impacts on wildlife could occur from post-lease construction and operations as described in Section 4.8.1.3. The areas identified for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for various wildlife species. These include lands designated as (1) NSO (where BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) TL (where the BLM may allow specified activities, but not during certain sensitive seasons such as when raptors are nesting or when big game are on their winter ranges). The only stipulations identified for Alternative 3 are the protection of 78 acres (0.3 $km^2$) of big game severe winter range and 483 acres (2.0 $km^2$) of mule deer and elk summer ranges in Colorado.

The Alternative 3 areas identified as available for leasing overlap areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.1.3-1 and 6.1.3-2). Table 6.1.3-1 presents the acreage of these habitats, identified by state, that occur in the Alternative 3 lease areas and could be impacted by potential future commercial oil shale development in these areas.

Lands that would be available for application for oil shale leasing under Alternative 3 overlap 328 acres of the Piceance-East Douglas Creek HMA (Figure 6.1.3-3). Any oil shale development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Impacts on wildlife from commercial oil shale projects (see Section 4.8.1.3) could occur in a number of ways and would be related to (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of biota; (3) mortality; (4) exposure to hazardous materials; and (5) increase in human access. These impacts can result in changes in species distribution and abundance; changes in habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with the oil shale project or its workforce, but instead associated with the potentially increased human access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads may lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, (2) an increase in the incidence of fires, and (3) increased runoff that could adversely affect riparian or other wetland areas that are important to wildlife.

**6.1.3.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 3, a total of 30,720 acres would be available for five current RD&D leases in Colorado, one current RD&D lease in Utah, and two potential new leases in Colorado and one in Utah, as well as for the PRLA lands associated with each RD&D lease, existing and potential. There would be no potential leases available in Wyoming under this Alternative. A summary of this alternative is provided in Table 2.3.2-2. There would be no impacts on threatened and endangered species associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.4. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects. There are no identified stipulations for the protection of threatened, endangered, or sensitive species.

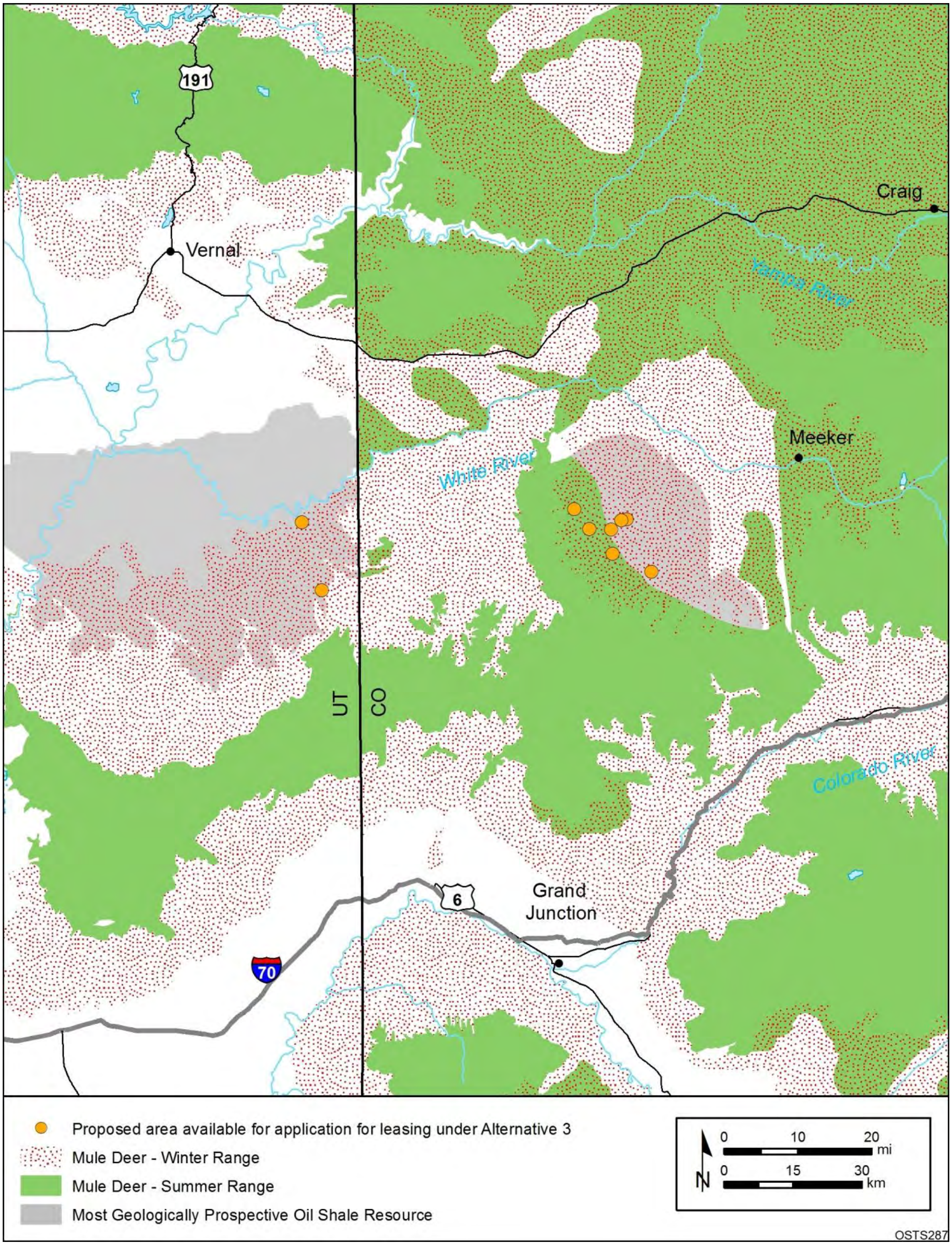


**FIGURE 6.1.3-1 Lands Available for Oil Shale Leasing under Alternative 3 in Relation to the Summer and Winter Ranges of the Mule Deer**

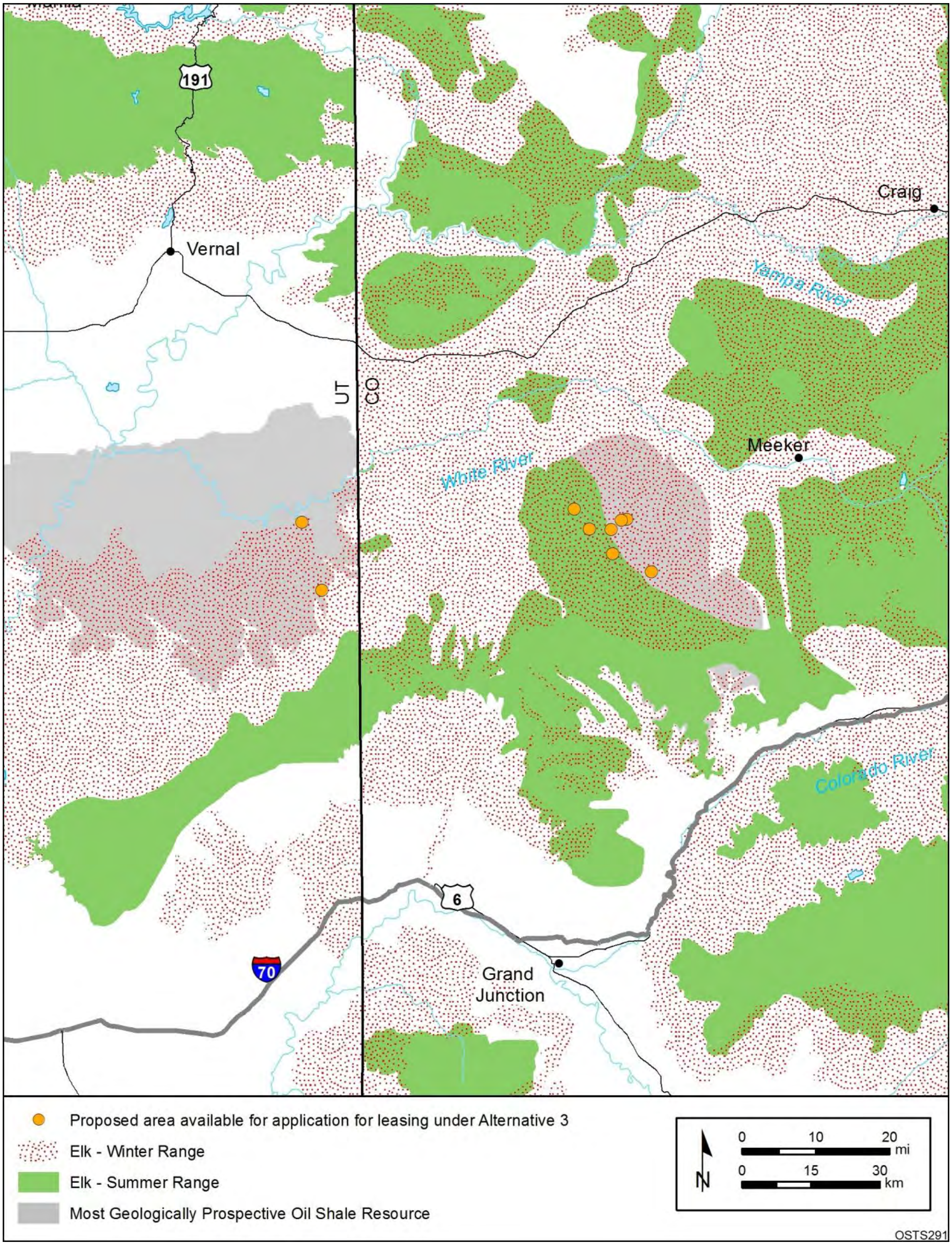


**FIGURE 6.1.3-2 Lands Available for Application for Oil Shale Leasing under Alternative 3 in Relation to the Summer and Winter Ranges of the Elk**

**TABLE 6.1.3-1 State-Identified Elk and Mule Deer Habitat Present in the Alternative 3 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | |
|---|---|---|---|
| Habitat Description | Colorado | Utah | Total |
| ***Mule Deer*** | | | |
| Winter habitat | 1,121 | 335 | 1,456 |
| Summer habitat | 483 | 0 | 483 |
| ***Elk*** | | | |
| Winter habitat | 1,121 | 335 | 1.456 |
| Summer habitat | 483 | 0 | 483 |

Under Alternative 3, 42 of the 69 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.1.3-2, and 9 of the 17 federally listed threatened or endangered species listed in Table 6.1.3-3 could occur in areas that would remain available for application for leasing. This determination is based on records of occurrence in project counties of Colorado and Utah, species occurrences from state natural heritage programs,[6] and the presence of potentially suitable habitat.[7] Under this alternative, there are no critical habitats for species listed under the ESA in the RD&D areas or any of the PRLAs. However, critical habitat for Colorado River endangered fishes occurs within 5 mi (8 km) from potential lease areas (Figure 6.1.3-4). Areas including greater sage-grouse habitat are shown in Figure 6.1.3-5. Although the current oil shale RD&D lease areas are excluded from greater sage-grouse core and priority habitats, a portion of the Enefit PRLA in Utah occurs within greater sage-grouse priority habitat (approximately 2,338 acres). Oil shale RD&D leases and PRLAs in Colorado do not occur in the vicinity of greater sage-grouse core and priority habitats (Figure 6.1.3-5).

The potential impacts on threatened, endangered, and sensitive species (and their habitats) by commercial oil shale development are directly related to the amount of land disturbance that could occur with a commercial project (including ancillary facilities such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface

[6] Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the potential lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.1.3-2 and 6.1.3-3.

[7] Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the potential lease areas. This quantification is presented in Tables 6.1.3-2 and 6.1.3-3.

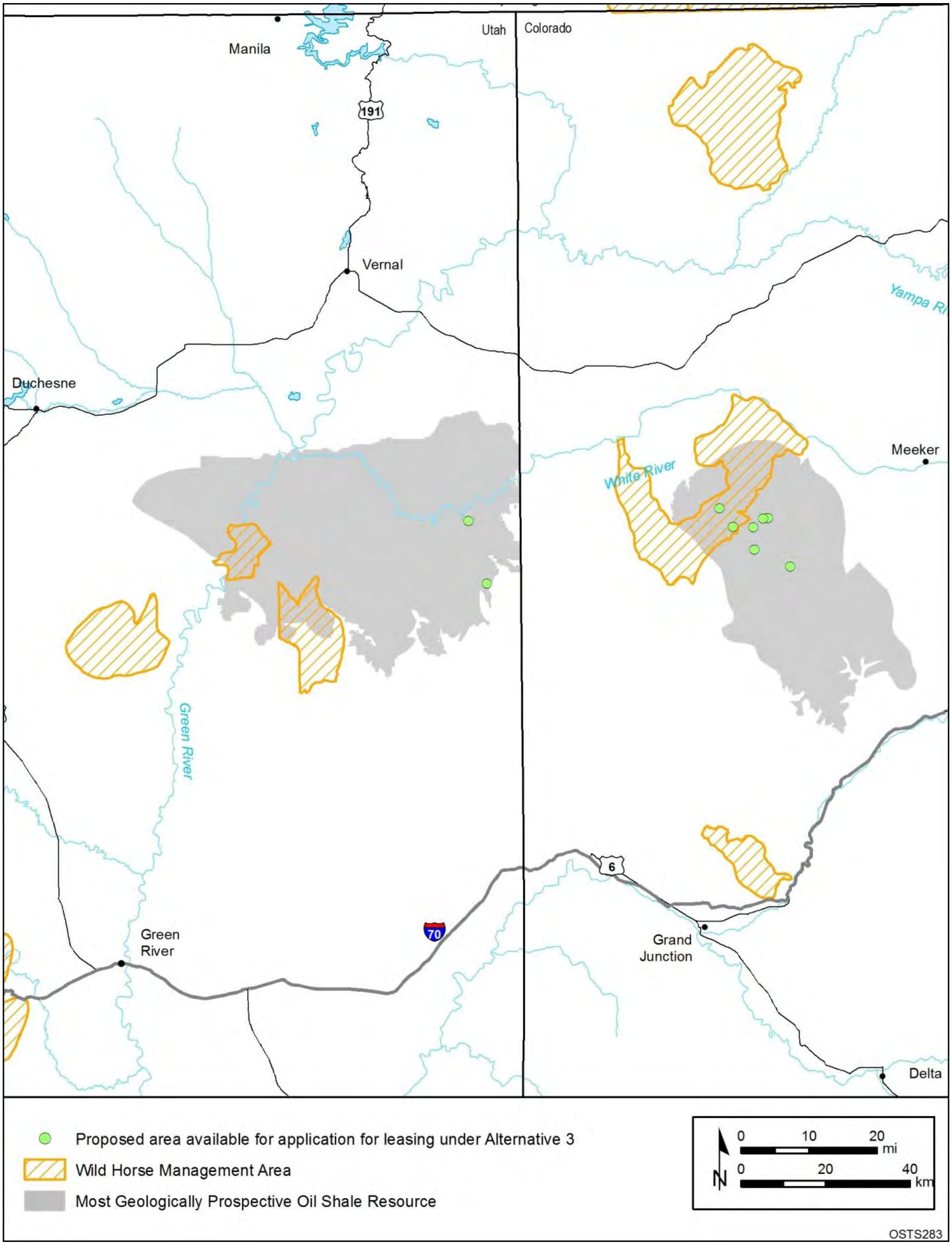


**FIGURE 6.1.3-3 Lands Available for Application for Oil Shale Leasing under Alternative 3 in Relation to Wild Horse and Burro Herd Management**

**TABLE 6.1.3-2 Potential Effects of Commercial Oil Shale Development under Alternative 3 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Amsonia jonesii* | Jones blue star | BLM-S | UT–Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | UT–Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | CO–Garfield; UT–Emery, Garfield, Grand, Wayne | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | CO–Garfield; UT–San Juan | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 25 mi (40 km) from the project area in Colorado. |
| *Bolophyta ligulata* | Ligulate feverfew | BLM-S | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 13 mi (21 km) from the project area in Utah. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S; WY-SC | UT–Uintah | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S; WY-SC | CO–Rio Blanco; UT–Duchesne, San Raphael, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project areas in Colorado and Utah. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | CO–Garfield; UT–Grand | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Gentianella tortuosa* | Utah gentian | BLM-S | CO–Rio Blanco; UT–Duchesne, Emery, Garfield, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 7 mi (11 km) from the project area in Colorado. |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Lesquerella parviflora* | Piceance bladderpod | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Colorado. |
| *Listera borealis* | Northern twayblade | BLM-S | CO–Garfield; UT–Duchesne, San Juan | **No impact.** This species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 50 mi (80 km) from the project area in Colorado. |
| *Mentzelia goodrichii* | Goodrich's blazingstar | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | CO–Rio Blanco; UT–Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Colorado. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S; CO-SC | CO–Garfield, Rio Blanca; UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Gila copei* | Leatherside chub | BLM | UT–Duchesne, Emery, Garfield, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. |
| *Gila robusta* | Roundtail chub | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 7 mi (11 km) from the project area in Colorado. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; CO-E; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Uintah, Wayne | **Potential negative impact.** Approximately 2,192 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Colorado. |
| *Rana pipiens* | Northern leopard frog | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 14 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Colorado. |
| *Spea intermontana* | Great basin spadefoot | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 32,566 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 6 mi (10 km) from the project area in Colorado. |
| ***Reptiles*** | | | | |
| *Crotalus oreganus concolor* | Midget faded rattlesnake | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| *Gambelia wislizenii* | Longnose leopard lizard | BLM-S; CO-SC | CO–Garfield | **Potential for negative impact.** Suitable habitat for the species may occur in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | UT–Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat for the species may occur in the project area. Quad-level occurrences are within 40 mi (64 km) from the project area in Utah. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 5,067 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | UT–Duchesne, Uintah, Utah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the project area. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Athene cunicularia* | Burrowing owl | BLM-S; CO-T; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 13,166 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |
| *Bucephala islandica* | Barrow's goldeneye | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 399 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 40 mi (64 km) from the project area in Colorado. |
| *Buteo regalis* | Ferruginous hawk | BLM-S | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 12,241 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S; WY-SC | UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Cypseloides niger* | Black swift | BLM-S; CO-SC; UT-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Uintah | **No impact.** Suitable habitat for the species does not occur in the project habitat, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |
| *Falco peregrinus anatum* | American peregrine falcon | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 32,936 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| *Grus canadensis tabida* | Greater sandhill crane | CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 9,707 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Colorado. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; CO-T; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 21,905 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 9 mi (14 km) from the project area in Colorado. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 25 mi (40 km) from the project area in Utah. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Numenius americanus* | Long-billed curlew | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | CO–Garfield, UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 427 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 25 mi (40 km) from the project area in Utah. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area. |
| *Plegadis chihi* | White-faced ibis | BLM-S; WY-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat for the species may occur in the project area. Quad-level occurrences of this species intersect the project area in Colorado. |
| *Tympanuchus phasianellus columbianus* | Columbian sharp-tailed grouse | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| ***Mammals*** | | | | |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 32,637 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Approximately 11,728 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |

**TABLE 6.1.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 32,452 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 40 mi (64 km) from the project area in Utah. |
| *Gulo gulo* | Wolverine | CO-E; WY-SC | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Colorado. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 33,050 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | CO–Garfield; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 33,021 acres of potentially suitable habitat for this species occurs in the project area. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Vulpes macrotis* | Kit fox | BLM-S; CO-E; UT-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 25 mi (40 km) from the project areas in Colorado and Utah. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-SC = species of special concern in the state of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 3 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the Alternative 3 footprint (i.e., study area).

**TABLE 6.1.3-3 Potential Effects of Commercial Oil Shale Development under Alternative 3 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Lesquerella congesta* | Dudley Bluffs bladderpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Colorado. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Physaria obcordata* | Dudley Bluffs twinpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the project area in Utah. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | UT–Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | UT–Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 20 mi (32 km) from the project area in Utah. |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | UT–Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | CO–Garfield; UT–Carbon, Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 25 mi (40 km) from the project area in Colorado. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | UT–Duchesne, Garfield, Uintah, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 30 mi (48 km) from the project area in Utah. |

**TABLE 6.1.3-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E; CO-T | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for this species may in the vicinity of the project areas. Designated critical habitat does not occur near any of the project areas. |
| *Gila elegans* | Bonytail | ESA-E | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for this species may in the vicinity of the project areas. Designated critical habitat does not occur near any of the project areas. Nearest occurrences are approximately 25 mi (40 km) from the project area in Utah. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E; CO-T | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the vicinity of the project areas. Designated critical habitat may occur within 1 mi (1.6 km) downstream from project areas in Utah. Quad-level occurrences are within 8 mi (13 km) from project areas in Utah. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E; CO-E | CO–Garfield, Rio Blanco; UT–Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the vicinity of the project areas. Designated critical habitat may occur within 1 mi (1.6 km) downstream from project areas in Utah. Quad-level occurrences are within 6 mi (10 km) from the project area in Utah. |
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 399 acres of potentially suitable habitat for this species occurs in the project area. |
| *Grus americana* | Whooping crane | ESA-XN; CO-E | CO–Garfield, Rio Blanco | **No impact.** Suitable habitat for the species does not occur in the project area. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | UT–Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area. Designated critical habitat does not occur near any of the project areas. |

**TABLE 6.1.3-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T; CO-E; WY-SC | CO–Garfield, Rio Blanco; UT–Emery, Uintah | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the project area. Nearest occurrences are approximately 30 mi (48 km) from the project area in Colorado. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN; CO-E | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 826 acres of potentially suitable habitat for this species occurs in the project area. Quad-level occurrences are within 8 mi (13 km) from the project area in Utah. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 3 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 3 footprint (i.e., study area). Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

water or groundwater depletions, contamination, and disturbance and harassment of animal species, would be proportional to the amount of land disturbance.

Potential impacts on threatened and endangered species under Alternative 3 are similar to or the same as impacts on aquatic resources; plant communities and habitats; and wildlife described in Sections 6.1.3.7.1, 6.1.3.7.2, and 6.1.3.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing (including, but not limited to, conversion from RD&D to commercial lease) and development.

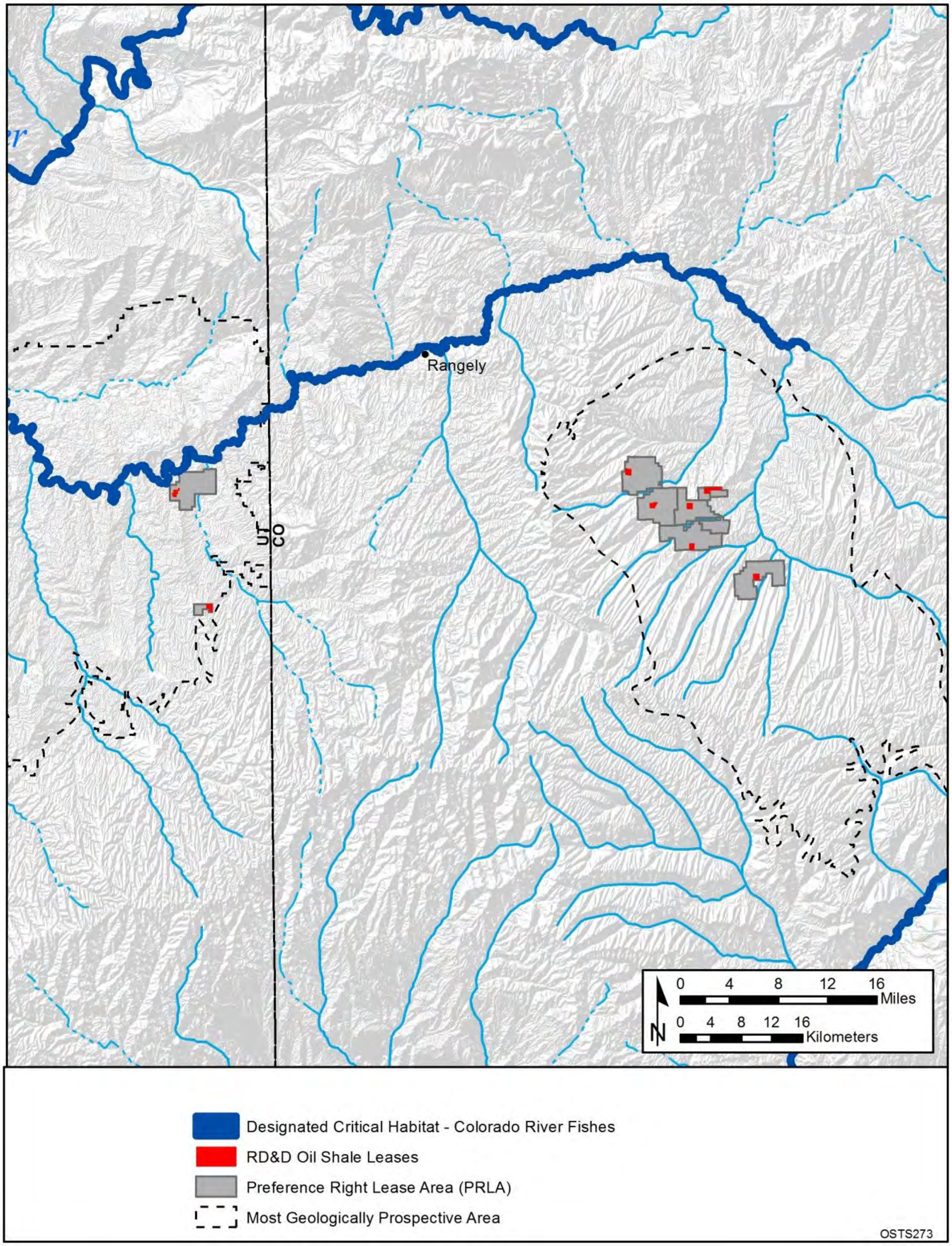


**FIGURE 6.1.3-4 Designated Critical Habitat of Threatened and Endangered Species That Are near Oil Shale RD&D Areas**

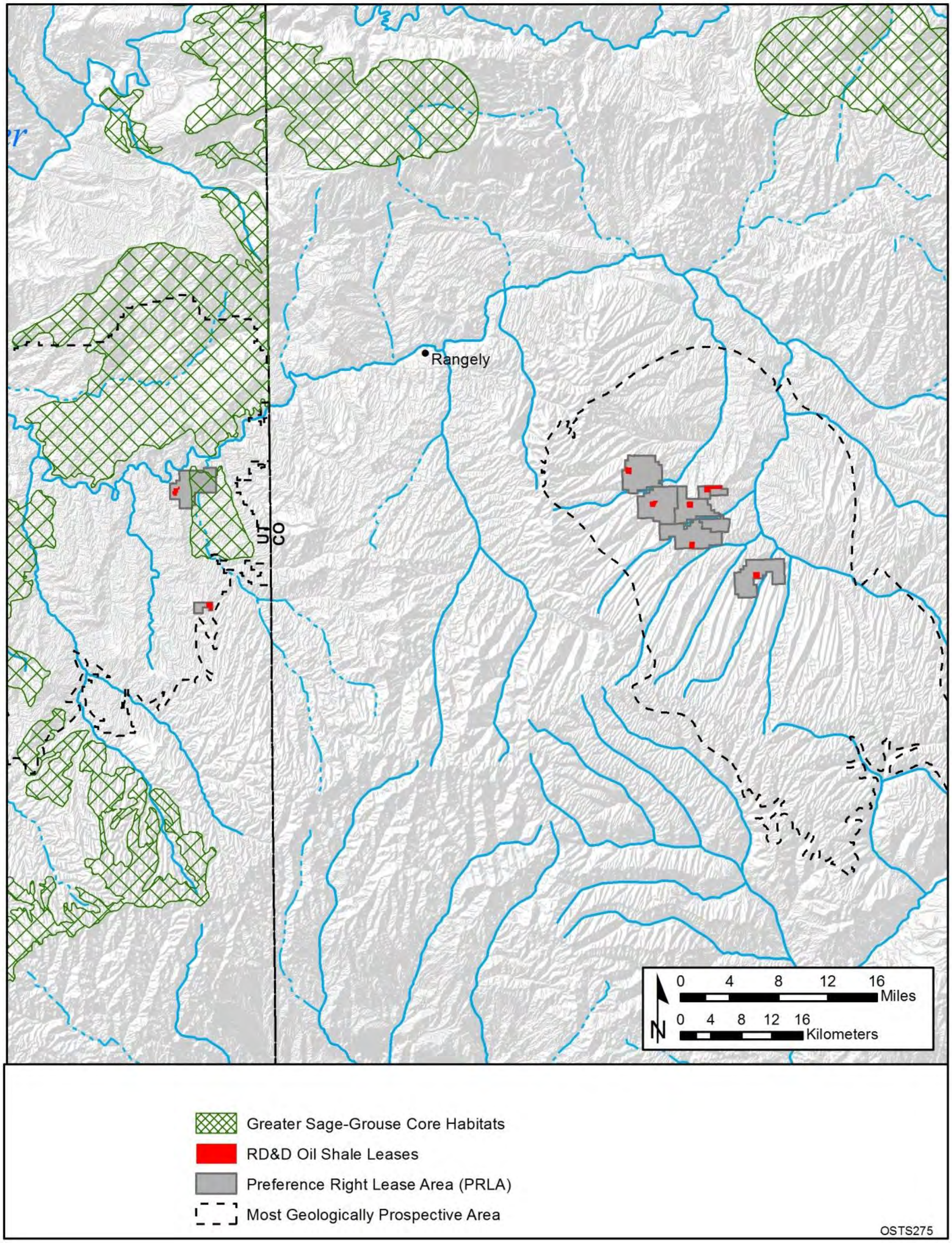


**FIGURE 6.1.3-5 Distribution of Core and Priority Habitat Areas for Greater Sage-Grouse That Are near Oil Shale RD&D Areas**

#### 6.1.3.8 Visual Resources

Under Alternative 3, visual impacts are associated with the following:

- The construction, operation, and reclamation of the RD&D projects, and the construction, operation, and reclamation of oil shale facilities that might be developed on the PRLAs for the RD&D projects if RD&D operators are granted use of the PRLAs for commercial development; and

- The construction, operation, and reclamation of oil shale facilities that might be developed in the oil shale priority management areas (Utah) and the lands available for oil shale leasing in Colorado.

**6.1.3.8.1 Impacts Associated with the Existing RD&D Lease Areas.** Under this alternative, the effects of the six existing and the three proposed RD&D projects on 160-acre lease are analyzed (see Table 2.3-2 and Figure 2.3-2). Direct visual impacts associated with construction and operation of the RD&D projects and subsequent reclamation can be divided into short-term impacts associated with activities that occur during the construction and reclamation phases of the projects, and longer term impacts that result from construction and operation of the facilities themselves. Major construction activities that will have a visual impact include vegetation clearing; recontouring of landforms; road building and/or upgrading; pad, building, and tank construction; and utility ROW construction. Other construction activities will include digging of drilling reserve pits and possibly retention ponds, construction of berms around some tanks, and the addition of fencing around some or all of the lease sites. These various construction activities will require work crews, vehicles, and equipment that will add to visual impacts during construction. Traffic movement, associated fugitive dust emissions, and temporary parking resulting from workers' vehicles and large equipment (trucks, graders, excavators, and cranes) will also result in visual impacts. Construction equipment might produce emissions and visible exhaust plumes. In addition, piles of building materials, as well as brush piles and soil piles, will be visible at times.

Visual impacts from the operation of the various RD&D projects will be associated with vegetation clearing; the presence of the project facilities and associated infrastructure; and the presence and activities of workers, vehicles, and equipment. These impacts will occur to some degree throughout the operational life of the projects, and some impacts might occur beyond the operational life of the projects. Project components and activities that will likely be associated with each of the RD&D projects and that could result in visual impacts include the following:

- Vegetation clearing (ranging from 35 to 160 acres cleared, depending on the project) with associated debris;

- Recontouring of landforms;

- New or upgraded roads;

- Pads for structures and or equipment (e.g., well pads);
- Buildings (generally of sheet metal construction), such as offices and laboratories;
- Groundwater monitoring wells;
- Flare stacks;
- Utilities, such as electric transmission lines, pipelines, and communication data lines (with associated rows and structures) within and/or outside the 160-acre lease boundaries depending on the project, and with ROWs 25 to 65 ft in width and up to 1 mi long, depending on the project;
- Communication towers;
- Storage tanks for water, syncrude, fuel, and other liquids associated with oil shale processing;
- Retention ponds and runoff-control structures;
- Earthen berms around some storage tanks;
- Mounds of stored soil;
- Fencing around all or part of the lease site;
- Vehicular, equipment, and worker presence and activity, and associated vegetation and ground disturbances;
- Dust and emissions; and
- Light pollution, resulting from facilities operating at night or from security lighting.

The in situ technology projects also are expected to have extensive numbers of production and injection wells and drilling reserve pits, which could result in visual impacts. Similarly, the Enefit RD&D project involving underground mining with surface retort processes will have additional visual impacts associated with the surface retorts, ore-crushing facilities, spent-shale handling facilities, processing buildings and associated structures, and piles of raw and spent shale.

Construction activities and the presence of the visible site components described above will introduce contrasts in form, line, color, texture, and a relatively high degree of human activity into what are generally natural-appearing landscapes (although the Enefit site currently has significant existing visual intrusions from previous development activity). In general, visual impacts associated directly with construction activities will be temporary, but because of the phased nature of the RD&D projects, construction activities will occur several times during the course of the project, giving rise to brief periods of intense construction activity (and associated visual impacts) followed by periods of inactivity. Much of the contrast will be associated with vegetation removal and the presence of buildings and other structures with strong geometric lines, spatial symmetry, and flat, monochromatic surfaces. These man-made industrial facilities will draw visual attention because of their size, color, and shape. Removal of vegetation and recontouring during construction will introduce unnatural-appearing linear features into the landscape and might create contrasting soil and vegetation colors and patterns. Soil scars, exposed slope faces, eroded areas, and areas of compacted soil could result from recontouring and equipment and vehicle movement, and could introduce noticeable color contrasts, depending on soil type. Invasive species might colonize disturbed and stockpiled soils and compacted areas. These species might be introduced naturally, in seeds, plants, or soils introduced for intermediate restoration, or by vehicles. The presence of workers and construction activities could also result in litter and debris that could create negative visual impacts within and around work sites.

The five in situ technology projects are generally similar in nature and extent of the visual impacts that are expected, although the three Shell projects will involve more vegetation clearing than the other in situ projects, prior to exercising of the preferential leases. The Chevron site will be the most prominent in its proposed location on Hunter Ridge adjacent to County Road 69. Because of the presence of a mine and associated buildings and structures, one or more retorts, and raw and spent shale piles, the Enefit project will have somewhat different impacts than the in situ technology projects; it will have more and potentially larger structures and eventually a large spent shale pile, covering 38 acres.

As portions of the RD&D project sites are reclaimed, visual impacts will be similar to those encountered during construction, but likely of shorter duration. Reclamation likely will be an intermittent or phased activity persisting over extended periods of time and will include the presence of workers, vehicles, and temporary fencing at the work site. Restoring an area to preproject conditions could also entail recontouring, grading, scarifying, seeding and planting, and perhaps stabilizing disturbed surfaces, but might not be possible in all cases (i.e., the contours of restored areas might not always be identical to preproject conditions). Newly disturbed soils might create visual contrasts that could persist for several seasons before revegetation will begin to disguise past activity. Invasive species might colonize reclaimed areas, likely producing contrasts of color and texture.

Should the existing RD&D developments prove successful, if the terms of the existing leases are met, commercial development could proceed on adjacent PRLA acreages totaling 24,800 acres in the Piceance Basin and on 4,960 acres adjacent to the Enefit site in Utah. The general nature of visual impacts associated with commercial development in the PRLAs would be similar to impacts noted above for the six RD&D projects. However, the scale of the impacts would be larger, because the disturbed land area would be larger; buildings and other structures more numerous and, in some cases, considerably larger; spent soil and/or shale piles (for mining-based projects) much larger; and more employees and vehicles present. Greater volumes of smoke, dust, and other impacts associated with oil shale processing would be visible, and in general, the level of activity visible would be greater. The impacts associated with the project would also be experienced for a longer duration, because of the relatively long period of operation of the facility and longer times required for construction and decommissioning of the developments.

**6.1.3.8.2 Impacts Associated with Potential Future Commercial Oil Shale Development.** Common visual impacts associated with commercial oil shale development are described in detail in Section 4.9.1. Acreages and applicable technologies for potential commercial oil shale development under Alternative 3 are described in Chapter 2. Impacts associated with commercial oil shale development in the oil shale priority management areas in Utah could include those associated with underground mining and/or in situ methods, which are described in Sections 4.9.1.2 and 4.9.1.3, respectively. Impacts associated with commercial oil shale development in the lands available for oil shale leasing under the White River RMP in Colorado could include those associated with underground mining and/or in situ methods, which are described in Sections 4.9.1.2 and 4.9.1.3, respectively.

The RD&D leases and the lands made available for application for leasing under Alternative 3 support a variety of visual resources (Section 3.8). These resources are not affected by the identification of these lands as available for application for commercial leasing. However, visual resources in and around these potential lease areas could be affected by subsequent commercial development of oil shale.

Scenic resource areas are located within 5 or 15 mi of the RD&D leases and areas that are available for application for commercial leasing under Alternative 3 in both Utah and Colorado (Figures 6.1.3-6 and 6.1.3-7, respectively). These 5- and 15-mi zones correspond to the BLM's VRM foreground-middleground and background distance limits, respectively. Based on the assumption of an unobstructed view of a commercial oil shale project, viewers in these areas would be likely to perceive some level of visual impact from a commercial oil shale project; impacts would be expected to be greater for resources within the foreground-middleground distance and lesser for those areas within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.1.3-4 presents the scenic resource areas that fall within these zones under Alternative 3.

Visual resources could be affected at and near Alternative 3 lease areas where RD&D or commercial oil shale projects are developed and operated, and at areas where supporting infrastructure (e.g., plants and utility and pipeline ROWs) could be located. Visual resources could be affected by ROW clearing and by project construction and operation (see Section 4.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components such as shale-processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

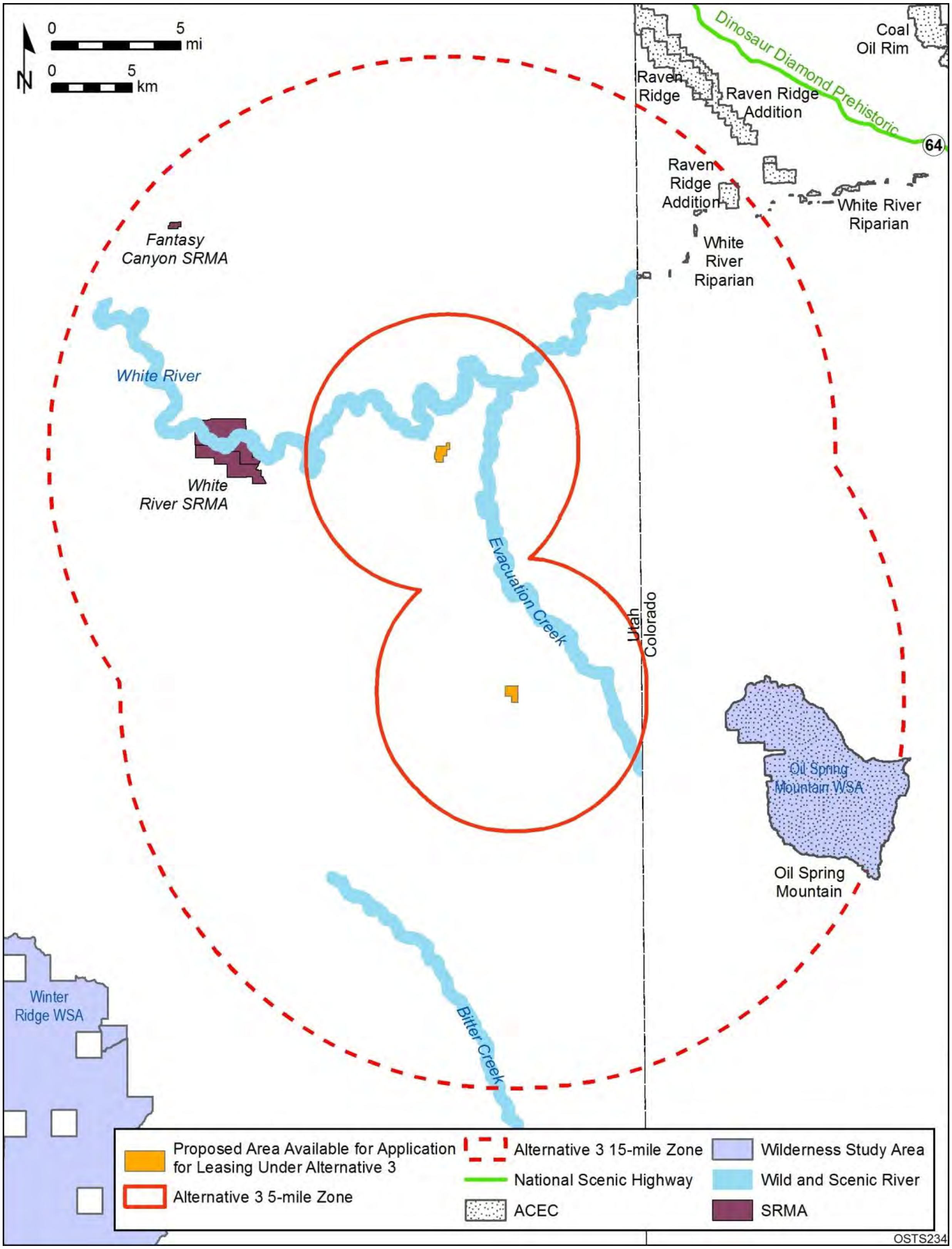


**FIGURE 6.1.3-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 3 in Utah**

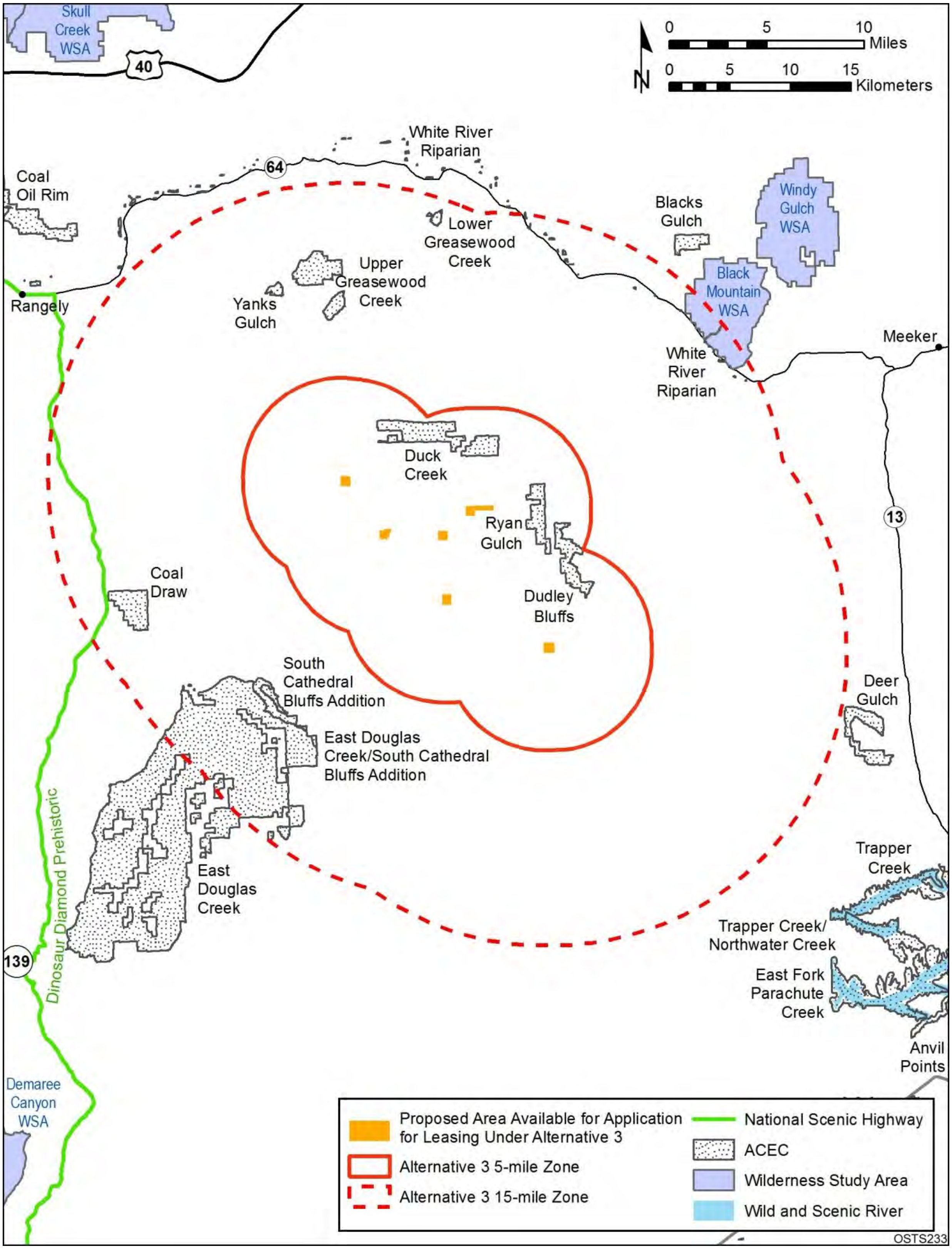


**FIGURE 6.1.3-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 3 in Colorado**

**TABLE 6.1.3-4 Visually Sensitive Areas That Could Be Affected by Oil Shale Projects Developed in the Alternative 3 Lease Areas**

| State | Scenic Resources within 5 mi of Alternative 3 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 3 Lease Areas |
|---|---|---|
| ***Utah*** | NA[a] | Oil Spring Mountain, Raven Ridge Addition, and White River Riparian ACECs; Fantasy Canyon, and White River SRMAs; and Oil Spring Mountain WSA. |
| ***Colorado*** | Duck Creek, Dudley Bluffs, and Ryan Gulch ACECs | Coal Draw, East Douglas Creek, East Douglas Creek/South Cathedral Bluffs Addition, Lower Greasewood Creek, South Cathedral Bluffs Addition, South Cathedral Bluffs/South Cathedral Bluffs Addition, Upper Greasewood Creek, White River Riparian, and Yanks Gulch ACECs; Dinosaur Diamond Prehistoric Scenic Highway; and Black Mountain WSA. |

[a] NA = not applicable.

### 6.1.3.9 Cultural Resources

Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. Individual RD&D lessees may also apply to convert their 160-acre leases (plus 4,960 adjacent acres) to a 20-year commercial-scale lease once specific requirements are met. Therefore, under Alternative 3, commercial-scale oil shale development could occur. Should such development occur, projects will be subject to ful compliance with Section 106 of the NHPA and other pertinent laws, regulations, and policies.

The lands that would remain available under Alternative 3 overlap with lands that have been specifically identified as having cultural resources. Of the public lands that are available under Alternative 3, approximately 3% in the Piceance Basin and none of the lands in Utah have been surveyed for cultural resources. A total of 14 sites have been identified in these surveyed areas. Additional cultural resources are likely to exist in the unsurveyed portions of the proposed lease areas. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), about 1,071 acres (4%) in the Piceance Basin and about 335 acres (6%) in the Uinta Basin within the Alternative 3 footprints have been identified as having a medium or high sensitivity for containing cultural resources.

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to have an impact on cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts from development could include the destruction of individual resources present within development footprints, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resource from looting or vandalism to resources as a result of increased human presence/activity in the sensitive areas, and visual degradation of cultural setting (see Section 4.10). Any future leasing or development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts or denial of the lease or project. Development can also lead to scientifically beneficial discoveries that may not have otherwise been made.

Unlike the other alternatives considered in the PEIS, active leasing and environmental compliance activities, including Section 106 consultation, have been occurring for the existing RD&D areas. This allows for a more detailed understanding of the environmental conditions under this alternative than is possible for the other alternatives. The following is a summary of the material that has been collected for the existing RD&D areas. (See the introduction to Section 6.1.3 for further clarification of the scope of Alternative 3.)

Adverse impacts on significant cultural resources in association with the RD&D activities are possible, particularly at the Shell Site 3 and the Enefit site because surveys for these locations have identified resources. Avoidance of the resources and/or additional testing and possible data recovery would be needed to mitigate any impacts that resulted from an action.

The 160-acre Chevron lease tract and associated utility line route were surveyed for cultural resources in March and April 2006. No cultural resources were identified, and the potential for subsurface remains is considered low in this area on the basis of results of previous surveys in the area and the north-sloping terrain (Connor 2006a,b). A recent wellpad survey (Baer et al. 2010) overlapped into the lease tract, where it encountered an isolated find. That find was not considered historically significant. The proposed development of oil shale resources for RD&D activities on the Chevron lease tract will therefore not impact any known significant cultural resources.

The 160-acre AMSO lease tract and associated utility line route were surveyed for cultural resources in April and May 2006, respectively (Hoefer and Greenberg 2006a,b). Two previously reported prehistoric sites were relocated, and two prehistoric isolated finds were encountered during the survey of the 160-acre lease tract. An isolated find is either a single artifact (that could be broken in several pieces, like a ceramic cup) or a small collection, typically fewer than five items, of the same type of artifact, such as four small pieces of chipped stone flakes. Two additional isolated finds dating to the historic period were encountered during the utility ROW survey. Of the six cultural resource locations identified during the surveys, none meet the eligibility criteria for listing on the NRHP; five of the sites have a field recommendation of "not eligible," and one of the previously recorded sites has an official determination of not eligible. The proposed development of oil shale resources for RD&D activities on the AMSO lease tract will therefore not impact any known significant cultural resources.

The three 160-acre lease tracts that Shell proposes to develop under the RD&D program have all undergone cultural resource surveys. Shell Site 1, the Oil Shale Test Site, was surveyed previously as part of two different surveys in 2004 and 2005. The total acreage previously surveyed was 1,368 acres, and 7 prehistoric sites, 1 historic site, and 10 isolated finds were recorded (Connor et al. 2004, 2005). One of the isolated finds—considered not significant—was encountered in the 160-acre lease tract of Site 1. Shell Site 2, the Nahcolite Test Site, was surveyed in 2006. One paleontological site was encountered, but no cultural resources were recorded (Darnell 2006). The proposed development of oil shale resources for RD&D activities on the Shell Sites 1 and 2 lease tracts will therefore not impact any known significant cultural resources.

Shell Site 3, the Advanced Heater Test Site, was surveyed previously in 2001. The total acreage previously surveyed was 3,507 acres, and 9 prehistoric sites, 7 historic sites, and 23 prehistoric isolated finds were encountered (Connor and Davenport 2001). One site, 5RB4296, a prehistoric open camp, is located within the Site 3 lease tract. There are insufficient data regarding the eligibility of the site; therefore, the site must be treated as eligible until further testing of the site can be completed. Adverse impacts on this site will occur without the application of mitigation actions. The Shell EA states that this site will be avoided, including any necessary erosion control measures, and that conditions of approval will be added to the lease to ensure that the site will be safeguarded until eligibility of the site is determined.

The 160-acre Enefit lease tract has undergone previous land disturbance because it was previously mined for oil shale. The Enefit EA indicates that 28 separate cultural resource investigations have been conducted in the vicinity of the lease tract. The initial archaeological survey of the area was conducted in 1975 for oil shale lease areas Ua and Ub. The total acreage previously surveyed was 27,200 acres (Berry and Berry 1975). No additional survey of the lease tract was conducted for the RD&D activities specifically, but survey for an access road corridor through the area was conducted in 2008. No sites are recorded in the Enefit lease tract, but it is unclear whether the 1975 survey work adequately covered the entire area. Additional survey will probably be needed.

The three new RD&D locations have yet to undergo cultural resources surveys specific to oil shale RD&D in compliance with Section 106 of the NHPA. No surveys have been conducted in the Utah location. However, other cultural resource surveys have overlapped into these areas in Colorado. Unrelated surveys in the ExxonMobil and Natural Soda tracts have recorded two prehistoric isolated finds, one prehistoric site, and an historic trash dump. The significance of the site has not been evaluated, but the isolated finds and the dump have been determined not significant.

Each of the EAs recognizes that responsibility for protecting cultural resources does not end with the cultural resources surveys identified above. In the event that unanticipated cultural resources are discovered during development activities, the potential impact on these resources will need to be mitigated by stopping work and contacting the BLM authorized officer immediately for further instruction prior to proceeding. If human remains are encountered during project operations, the BLM authorized officer must be notified by telephone with written confirmation immediately upon the discovery. All activities must stop in the vicinity of the discovery, and the discovery must be protected for 30 days or until the operator is notified to proceed by the BLM authorized officer. Pursuant to 43 CFR 10.4, this process must be followed upon the discovery of Native American human remains, funerary items, sacred objects, or objects of cultural patrimony. All employees of the operator and any subcontractors must be informed by the operator before commencement of operations that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted. Violation of the laws that protect these resources will be treated as law enforcement/ administrative issues. The operator will be held accountable for the conduct of employees and subcontractors in this regard.

#### 6.1.3.10 Indian Tribal Concerns

Under Alternative 3, the six current RD&D oil shale leases of PRLA lands in Colorado and Utah, totaling 30,720 acres, and three potential new RD&D leases (two in Colorado and one in Utah), totaling 1,920 acres, would be available for oil shale leasing (Section 2.3.3.2). These are the only lands available for oil shale lease applications under this alternative. Under this alternative, surface mining would not be permitted. Development of the lease tracts could impact resources important to Indian tribes. Adverse effects could include destruction or damage resulting from the construction and operation of lease facilities including excavation and vibration from drilling; increased access by OHVs resulting from the construction of additional ROWs; damage or vandalism resulting from the presence and activities of facility personnel; and visual and auditory intrusions on sacred sites. Conducting required surveys and consultation in association with site-specific development could have a positive effect as sites and resources are identified and are taken into account in development and operation plans. Under this alternative much less land would be available for oil shale lease applications. Of the four oil shale alternatives, Alternative 3 has the least potential for adverse impact on resources of tribal concern.

As discussed in Section 6.1.3.9, cultural resources surveys have been conducted in association with oil shale lease applications. NEPA documentation included consideration of Native American concerns (BLM 2006c,d, e). Although cultural resource surveys associated with compliance with Section 106 of the NHPA for this project in the area have identified the kind of sites often considered important by Native Americans (e.g., rock art, rock shelters, and stone circles), no such sites have been identified by Indian tribes. If development beyond the initial 160-acre parcels proceeds, previously unidentified sites or resources are likely to be identified. Developers currently have procedures in place to protect known resources as well as previously unidentified resources that might be encountered. These include procedures to follow at the discovery of human remains or items of tribal patrimony, protection of known sites from damage and erosion, and education of facility personnel regarding their responsibilities and legal requirements to protect resources important to Native Americans and allow reasonable access to sites of current cultural or religious significance.

#### 6.1.3.11 Socioeconomics

Construction of eight in situ processing facilities (five approved and three pending in situ RD&D projects) would create 2,059 jobs (1,080 direct and 979 indirect), and $123 million in personal income, and operation would create 1,016 jobs (535 direct and 481 indirect) and $61 million in income. Underground mining would create 360 jobs and $18 million in personal income, and operation would create 362 jobs and $18 million in income. Construction employment for each facility would represent an increase of less than 1.5% over the projected employment baseline in the two ROIs in the peak construction year.

In addition to oil shale production facilities, employer-provided temporary housing and housing constructed in local communities would produce employment and income in each ROI. Temporary housing built for workers at the seven in situ projects would create 456 jobs (343 direct and 113 indirect) and $11.5 million in income in the Colorado ROI (Table 6.1.1-13). Construction of housing for the two underground mine projects would produce employment of 40 (32 direct and 8 indirect jobs) and $0.8 million in income in the Utah ROI.

Population increases associated with the construction of the in situ RD&D projects under Alternative 3, not including any subsequent commercial development, would represent a 0.7% increase over the ROI baseline population for the peak construction year of 2012 (see Section 3.11.2). In Utah, increases in population during the peak construction year of the underground mine projects in 2012 would lead to an increase of 0.5% in population in the ROI (see Section 3.11.2). Given the relatively small direct labor force requirements for each project, population in-migration in Colorado and Utah is likely to be small, with minor impacts on local social disruption in each ROI expected.

Given the relatively small scale of the RD&D projects under Alternative 3, any property value impacts in the vicinity of federal land are likely to be local and temporary. In the ROIs in Colorado and Utah, in general, few workers are expected to in-migrate. Individual projects are not expected to produce large increases in local employment and economic activity, meaning that property value impacts will be small.

Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands. An additional 1,920 acres of land are included in new RD&D proposals and 2,100 acres of land are included in a proposed tar sands project in Utah. Impacts could result from post-lease construction and operation of commercial oil shale projects as described in Sections 4.12 and 5.12. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects.

Impacts on transportation systems and infrastructure could result from post-lease construction and operation as described in Section 4.12. Impacts of subsequent leasing and development actions would be considered in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects.

#### 6.1.3.12 Environmental Justice

Environmental and human health impacts on the general population from the RD&D projects under the No Action Alternative are expected to be low. No significant, adverse air quality impacts are likely to occur during construction and operation of the RD&D projects. Land use impacts associated with the RD&D projects, not including any subsequent commercial development, are likely to be relatively small given the small amount of land disturbed and the relative remoteness of locations in each state. Noise effects during energy project operation will also likely be minimal. In general, visual impacts associated with construction activities under Alternative 3 will be small and temporary, although some construction activities will occur several times during the course of the project, which will give rise to brief periods of intense construction activity and the associated visual impacts. Providing that mitigation measures are implemented as described in the EAs and FONSIs, water quality impacts of the RD&D projects are expected to be temporary and local, while water use during oil shale facility operations under Alternative 3 is expected to be low and within the capacity of regional water suppliers.

Construction and operation of the six RD&D projects will have minor disproportionate impacts on minority and low-income populations, primarily associated with changes in quality of life and social disruption caused by rapid in-migration of population into some rural communities, changes in air and water quality, and the impact of water diversions on agriculture. There may be property value and visual impacts depending on the locations of land parcels impacted by oil shale projects, their importance for subsistence, their cultural and religious significance, and possible alternate economic uses.

Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. Environmental justice impacts could result from post-lease construction and operation as described in Sections 4.13 and 5.13. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects.

#### 6.1.3.13 Hazardous Materials and Waste Management

With few exceptions, the hazardous materials associated with the six RD&D projects will be very similar. Commercially available fuels to support equipment and/or provide for comfort heating (natural gas, propane, diesel fuel, and gasoline) are expected to represent the largest category of hazardous materials present on-site. As stated in Section 4.1, it is assumed that on-site upgrading of recovered products will not take place at the RD&D project sites; therefore, hazardous materials and wastes specifically associated with upgrading activities will not be present at the RD&D facilities.

The products of oil shale development efforts will exhibit hazardous properties. Whether it is the raw shale oil recovered from the one RD&D project utilizing an aboveground retort or the recovered upgraded products that are anticipated at any of the five in situ RD&D projects, the research nature of each of these projects suggests that the resulting products will exhibit characteristics unique to the particular recovery and retorting schemes that created them. Consequently, each of the RD&D products will need careful characterization (i.e., creation of a Material Safety Data Sheet [MSDS]) before appropriate management protocols can be established. However, despite the research nature of these ventures, developers still have responsibilities under the General Duty Clause of OSHA or the regulations promulgated at 29 CFR 1910.1200 (Hazard Communication Standard) to protect their workers against the hazards of the products being created. It is assumed that those responsibilities will be met expeditiously and effectively in all cases.

Execution of some of the resource recovery techniques to be employed at the RD&D facilities will require the use of hazardous materials, sometimes in substantial amounts. Examples include the anhydrous ammonia that will be used as a refrigerant in each of the three Shell in situ RD&D projects and explosives that may be used in underground mining associated with the Enefit project. Small amounts of herbicides will also be used at each facility for vegetation management within industrial areas for fire safety. Neither explosives nor herbicides are expected to be stored on-site but instead will be brought to the site on an as-needed basis.

During RD&D operations, limited volumes of waste streams are expected to be generated. Those associated with similar activities will be virtually the same for each project. At the quantities likely to be generated, it is reasonable to expect that all the solid and hazardous wastes will be containerized and delivered to off-site facilities for treatment and disposal. The largest volume solid waste stream that can be anticipated is the spent shale that will be generated in the later RD&D phases of the Enefit project. Enefit anticipates producing 8,000 tons of spent shale during Phase 2 and 1.2 million tons during Phase 3; these spent shales will be disposed of either in the underground mine or in an on-site facility. At these amounts of spent shales, disposal at on-site facilities will likely be conducted under the auspices of permits issued by state or local authorities. Well drilling activities at the Shell projects and at the AMSO project will generate cuttings; however, such cuttings are expected to be nonhazardous and will be disposed of on-site.

Both sanitary and industrial wastewater streams will be generated at each of the RD&D projects. In most instances, volumes will be small. However, for each of the three Shell projects and the AMSO project, substantial quantities of well drilling fluids will be generated. It is expected that drilling fluids will be captured in temporary sediment ponds and recycled to a great extent. Management schemes for other wastewater streams vary among the six projects and involve combinations of surface discharge, recycling, disposal by subsurface injection, on-site storage and treatment, and off-site disposal at permitted facilities. In all instances, however, the management and disposal of these wastewaters will be subject to regulatory agency approval and, in some cases, permit requirements.

In addition, one of the by-products of aboveground retorting is water (sometimes referred to as pyrolysis water). This water will often contain hydrocarbon pyrolysis products that have enough polar character to be water soluble; however, the quality of pyrolysis water will vary. Shell anticipates that pyrolysis water from its projects will be initially collected in lined ponds and treated before being released. Others plan to containerize pyrolysis water in aboveground tanks prior to shipment off-site for treatment. Pyrolysis water that is free of hydrocarbon and heavy metal contamination may be suitable for use in dust control of spent shale disposal piles or as a wetting agent for the spent shale to promote adequate compaction in the disposal cell. Pyrolysis water is also created in all in situ retorting technologies and recovered from production wells, together with hydrocarbon pyrolysis products. Here, too, the quality of pyrolysis water can vary. Water with little to no contamination can be put to beneficial uses on the site such as for fugitive dust control on roads or reinjected downgradient of the retort zone to help the groundwater contours reequilibrate. Contaminated pyrolysis water will require treatment before discharge, either to surface water or to groundwater downgradient of the retort zone.

Potentially adverse health and environmental impacts could result from improper management of hazardous materials and waste streams. In general, impacts will result from the release of hazardous materials to the environment as a result of accident or improper storage and use practices. Likewise, impacts can result from accidental release from temporary storage facilities or improper management and control of on-site waste disposal or water treatment facilities. Direct impacts of such releases could include contamination of vegetation, soil, and surface and groundwater; indirect impacts on the public and on flora and fauna populations could subsequently result. If all applicable regulations governing the use, storage, and disposal of hazardous materials and regulations and permits governing the management of wastes are complied with and appropriate management practices are implemented, the adverse impacts associated with hazardous materials and most of the anticipated wastes are expected to be minimal to nonexistent. Concerns exist, however, for the potential of spent shale disposed of at the Enefit RD&D project to cause environmental damage. As documented in the project EA, however, Enefit intends to design and construct a spent shale disposal site equipped with adequate engineering features to ensure the capacity both to identify such impacts as they develop and to mitigate them to minor consequence.

Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. Impacts related to hazardous materials and wastes could occur during future development of commercial oil shale projects within the Alternative 3 lease areas. Such impacts are generally independent of location and would be unique to the technology combinations used for oil shale development. However, impacts from hazardous materials and wastes are similar for some of the ancillary support activities that would be required for development of any oil shale facility regardless of the technology used. These include the impacts from development or expansion of support facilities such as employer-provided housing and power plants.

Hazardous materials and wastes could be used and generated during both the construction and operation of commercial oil shale facilities and supporting infrastructure (e.g., power plants). Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, and corrosion control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites and other wastes typically associated with construction, none of which is expected to be hazardous (Section 4.14.1).

During project operations, hazardous materials could be utilized, and a variety of wastes (some hazardous) could be generated. Hazardous materials used include fuels, solvents, corrosion control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations will depend on the specific design of the commercial oil shale project (surface or subsurface mining, surface retorting, or in situ processes). Waste materials produced during operations may include spent shale, waste engine fuels and lubricants, pyrolysis water, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 4.14.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial oil shale project, it is not possible to quantify project-related impacts of these materials. Under Alternative 3, individual facilities could be located anywhere within the area identified as available for leasing, pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Section 4.15) at locations wherever the individual projects are sited within the Alternative 3 lease areas.

#### 6.1.3.14 Health and Safety

For the in situ RD&D projects, chemical and physical hazards associated with mining will not be applicable. The types of health hazards discussed in Section 4.15 (Table 4.15-1) that may be of concern for workers at the in situ RD&D facilities are mainly injuries and hearing loss. Workers at the Enefit underground mine facility and construction workers could be exposed to respirable dusts and thus be at risk of developing lung disease. The inhalation hazard will be lower for workers at the in situ projects, because emissions will be lower. For all the RD&D projects, the number of cases of lung disease will likely be small (if any) given the small scale of RD&D operations, the low number of employees, and required adherence to occupational health and safety standards.

A rough estimate of the numbers of injuries and fatalities that will be expected under Alternative 3 can be made by using the numbers of direct jobs estimated (see Section 6.1.1.11.2) and published fatality and injury rates for construction and mining (NSC 2006). The 2004 fatality and injury rates for construction are 11.6 per 100,000 full-time equivalents (FTEs) and 6.4 per 100 FTEs, respectively; the rates for mining are 28.3 per 100,000 FTEs and 3.8 per 100 FTEs, respectively. For this assessment, construction rates are used to estimate impacts for all phases of in situ projects.

For all 6 RD&D projects, the estimated total number of direct construction jobs is 930 (810 in Colorado and 120 in Utah), and the number of direct operations jobs is 655 (535 in Colorado and 120 in Utah). By using these employment numbers and appropriate fatality and injury rates, the estimated numbers of annual fatalities under Alternative 3 are as follows: during construction, 0.14; during operations, 0.09. The estimated numbers of annual injuries under Alternative 3 are as follows: during construction, 75; during operations, 39. For all RD&D projects, a comprehensive facility health and safety plan and worker safety training will be required as part of the plan of development. Health and safety impacts for potential future commercial technologies on the PRLA lands would be qualitatively similar, but it is not possible to estimate the number of injuries and fatalities related to construction and operation of such facilities at this time.

Under Alternative 3, a total of 30,720 acres of land in Colorado and in Utah have already been allocated for RD&D projects and surrounding PRLA lands; an additional 1,920 acres of land are included in new RD&D proposals. Impacts could result from post-lease construction and operation as described in Section 4.15. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including, but not limited to, conversion from RD&D to commercial lease) and development phases of projects.

### 6.1.4 Impacts of Alternative 4, Moderate Development

Alternative 4 would amend eight land use plans to make available 1,963,414 acres for application for commercial leasing (see Figures 2.3.3-9, 2.3.3-10, and 2.3.3-11) and is structured to remove all of the Adobe Town Very Rare or Uncommon Area, all additional ACECs designated since completion of the 2008 PEIS and ROD, and any potential ACECs from ongoing planning efforts, and to recognize that the management of both sage-grouse core habitat and LWC may affect the lands that will be available for commercial leasing. (See Sections 2.3.3 and 2.3.3.2 for a complete description of Alternative 4, including the reason there is a range of acres to be designated.) Specific land use plan amendments are provided in Appendix C.

Lands other than those 1,963,414 acres to be designated as available for application for leasing for commercial development of oil shale under Alternative 4 that are currently open would be closed to such leasing and development, that is, the difference between 2,017,714 acres currently open and the actual acreage that would be designated in this alternative. As described below, the potential impacts on lands currently available for application for leasing for commercial development but considered in Alternative 4 for closure to such leasing and development would not be adverse, as no leasing or development would take place, and unless otherwise discussed, any benefit would accrue in proportion to the number of acres closed.

The eight land use plans that would be amended are as follows:

- Colorado
  - Glenwood Springs RMP (BLM 1988, as amended by the 2006 Roan Plateau Plan Amendment [BLM 2006i, 2007c, 2008a])
  - Grand Junction RMP (BLM 1987)
  - White River RMP (BLM 1997a, as amended by the 2006 Roan Plateau Plan Amendment [BLM 2006i, 2007c, 2008a])

- Utah
  - Price RMP (BLM 2008d)
  - Vernal RMP (BLM 2008e)

- Wyoming
  - Green River RMP (BLM 1997a, as amended by the Jack Morrow Hills Coordinated Activity Plan [BLM 2006a])
  - Kemmerer RMP (BLM 2010d)
  - Rawlins RMP (BLM 2008f)

As discussed in Section 2.3.3.3, these land use plans would be amended under Alternative 4 specifically to (1) designate lands within these most geologically prospective areas as available or not available for application for leasing and (2) identify any technology restrictions. On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with amending land use plans to make lands available or not available for application for commercial leasing in the three-state study area, but there may be impacts on land values. The development of commercial oil shale projects on lands identified as remaining available for application for commercial leasing by these land use plan amendments, however, would have impacts on these resources. In addition, Alternative 4 could include the same level of development of the RD&D projects, as well as commercial development on their associated PRLAs, as described in Section 6.1.3 for Alternative 3. The effects of the RD&D projects under this alternative would be the same as those under Alternative 3. The following sections describe the impacts of Alternative 4 on the environment and the socioeconomic setting of the areas identified as available for application for leasing under this alternative. The impacts described would not be expected to occur with respect to the lands identified as not available for application for commercial oil shale leasing, apart from possible indirect impacts on such lands from activities that might occur on lands identified as available.

In general, potential impacts of future commercial development on specific resources located within the 1,472,370 to 1,799,733 acres cannot be quantified at this time because key information about the location of projects, the technologies employed, the project size or production level, and development time lines are unknown. Although it is not possible to quantify the impacts of future project development, it is possible to make observations and draw conclusions on the basis of certain lands being made available for application for leasing and their overlap with specific resources. The following sections identify the potential impacts that could accompany subsequent commercial oil shale leasing, many of which might be successfully avoided or mitigated depending on site- and project-specific factors and future regulations that would guide leasing actions.

#### 6.1.4.1 Land Use

Alternative 4 would amend the same eight land use plans as Alternative 2 but would identify 1,963,414 acres of public land in Colorado, Utah, and Wyoming as remaining available for application for leasing for commercial leasing and development of oil shale. The amendment of the land use plans is expected to have no direct impacts on land uses, although there may be some impact on land values. The identification of these lands as available for application for commercial leasing and development of oil shale does not authorize or approve any ground-disturbing activities that could affect existing land uses. Existing land uses could, however, be adversely affected by future commercial oil shale development on these lands.

The nature of the impacts of Alternative 4 on land uses would be the same as those listed under Alternative 1 above, with exceptions that are included below. Alternative 4 makes fewer acres available for application for commercial oil shale leasing than does Alternative 1.

The impacts on land use from Alternative 4 could differ from those impacts on land use described for Alternative 1 in Section 6.1.1.1 in the following areas:

- Alternative 4 removes from application for leasing an additional approximately 44,325 acres of land identified as ACECs.

- No lands that are currently recommended as potential ACECs lie within the Alternative 4 footprint.

- Alternative 4 removes the whole of the Adobe Town Very Rare or Uncommon Area from consideration from leasing.

- Lands available for application for lease contain all or portions of areas that have been recognized by the BLM in Colorado, Utah, and Wyoming as LWC. Table 6.1.1-2 lists these areas. Should commercial development occur on these lands, the identified wilderness characteristics in both the areas that are developed and those that border the developed areas would be lost. Alternative 4 includes approximately 198,000 acres of these lands that could be subject to development, which is about 23,000 acres fewer than under Alternative 1.

- A portion of the land within the PRLA established for the Enefit RD&D project is not available for application for leasing under Alternative 1 by an applicant other than the Enefit RD&D leaseholder unless the Vernal Field Office prepares a plan amendment to make this area available for lease (see Figure 2.3.3-8).

- Under this alternative, the 30,720 acres, including the existing RD&D leases, and, absent exceptions such as that noted above, their PRLAs, will be available for future leasing if the current leaseholders relinquish their existing leases.

- While there are about 653,000 acres (Table 2.3.3-4) with oil shale resources that contain either sage-grouse core habitat or LWC in Alternative 4, it is not possible to estimate how much of that land ultimately will be committed to protection of such lands. Tables 2.3.3-4 and 2.3.3-5 present potentially available acreages ranging from 1,472,270 to 1,799,733 acres, corresponding to 75% and 25% protection of sage-grouse habitat and LWC acreages.

### 6.1.4.2 Soil and Geologic Resources

Under Alternative 4, land use plans in Colorado, Utah, and Wyoming would be amended to designate 1,963,414 acres as available for commercial oil shale leasing (Section 2.3.3.3). The designation of leasing areas, as well as the amendment of land use plans to incorporate these areas, would not affect soil or geologic resources because these actions do not authorize or approve any ground-disturbing activities. Soil and geologic resources could, however, be affected by future commercial oil shale development on these lands.

Construction-related activities could directly disturb surface and subsurface soils during clearing and grading activities and construction of project facilities and infrastructure. This disturbance could include soil disturbance, removal, and compaction, and disturbed areas would be more susceptible to the effects of precipitation and wind-driven erosion (see Section 4.3.1). Surface and subsurface mining activities during project operations would directly disturb geologic resources. Erosion of exposed soils could lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust. Soils in project areas would remain susceptible to erosion until completion of construction, mining, and oil shale-processing activities, and site stabilization and reclamation (e.g., revegetation of pipeline ROWs, surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as areas where associated off-lease infrastructure (such as access roads, utility ROWs, and power plants) would be located. For any project, the erosion potential of the soils will be a direct function of the lease and project location, and the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

Under Alternative 4, project-related impacts could occur wherever individual projects are located within the 1,963,414 acres identified for application for potential leasing under this alternative. Wyoming would have the most land (967,446 acres) and Colorado the least land (340,147 acres) where commercial oil shale development could affect soil and geologic resources.

### 6.1.4.3 Paleontological Resources

Under Alternative 4, land use plans in Colorado, Utah, and Wyoming would be amended to designate 1,963,414 acres as available for commercial oil shale leasing (Section 2.3.3.3). Paleontological resources within these areas could be adversely affected if leasing and subsequent commercial development occur. Of the acreage designated under Alternative 4, a total of 1,751,266 acres (about 89% of the 1,963,414 acres that would be available under Alternative 4) have been identified as overlying geologic formations having a high potential to contain important paleontological resources (Murphey and Daitch 2007). Approximately 329,550 of these acres are in the Piceance Basin, Colorado; 582,676 acres are in the Uinta Basin, Utah; and 839,040 acres are in the Green River and Washakie Basins, Wyoming. All existing ACECs, some of which have been identified for their paleontological values, would not be made available for application for leasing under this alternative, and therefore the paleontological resources in these areas would not be affected under this alternative.

Impacts from oil shale development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development area, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 4.4.

#### 6.1.4.4 Water Resources

Under Alternative 4, land use plans in Colorado, Utah, and Wyoming would be amended to designate something less than 2,017,741 acres as available for commercial oil shale leasing (Section 2.3.3.3). The acreage available for application for leasing in this alternative, 1,963,414 acres, specifically excludes all ACECs and the whole of the Adobe Town Very Rare or Uncommon Area (see Table 2.3.3-3). Excluding these lands from application for leasing would provide complete protection from direct impacts from oil shale development for the resources found on these lands. However, indirect effects are still possible. In those areas that are available for application for leasing in Alternative 4, the potential impacts would be the same as described in Section 6.1.1.4 of this PEIS.

The total stream miles within the four oil shale basins is approximately 753 mi. Alternative 4 contains approximately 662 mi of these perennial streams (see Table 6.1.1-3).

The assessment of impacts on water resources under Alternative 4 has the same limitations as referenced under Alternative 1. Without site-specific information regarding location and type of technology to be employed, it is not possible to assess the overall impacts of this alternative.

#### 6.1.4.5 Air Quality

Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale (Section 2.3.3.3). Of the acreage designated under Alternative 4, about 340,147 acres are in the Piceance Basin, Colorado; 655,821 acres in the Uinta Basin, Utah; and 967,446 acres in the Green River and Washakie Basins, Wyoming. Air resources in the three states would not be affected by this action. Air resources in and around these areas could, however, be affected by potential future commercial oil shale development within the basin areas. Under Alternative 4, local, short-term air quality impacts could be incurred as a result of (1) PM releases (fugitive dust, diesel exhaust) during construction activities such as site clearing and grading in preparation of facility construction, and (2) exhaust emissions ($NO_X$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 4.6). These potential impacts would be of short duration, and largely limited to specific project locations and the immediately adjacent areas. Similar short-term impacts could also occur in other areas where project-related electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the oil shale. Processing activities could also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, which could extend beyond the lease areas identified under Alternative 4. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during oil shale processing (Section 4.6). In addition, ozone precursors of $NO_x$ and VOC from oil shale development could exacerbate wintertime high-ozone occurrences already prevalent in the study area. Operational releases of certain HAPs (e.g., benzene, toluene, and formaldehyde) as well as diesel PM could also affect on-site workers and nearby residences, but these impacts would be localized to the immediate project location and subject to further analysis prior to implementation.

During all phases of oil shale development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustion sources could contribute to climate change to some extent.

If development of oil shale requires expansion of capacity of existing electric power plants, or the construction and operation of new electric power plants off-lease, those would also have longer term impacts on regional air quality. Table 6.1.6-3 presents a summary of the emissions from coal-fired electric power plants.

#### 6.1.4.6 Noise

Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. Ambient noise levels would not be affected by this action. However, ambient noise levels could be affected by future commercial development of oil shale. Under Alternative 4, local, short-term changes in ambient noise levels could be incurred during the construction, operation, and reclamation of oil shale projects (see Section 4.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Noise impacts on wildlife and recreational users are discussed in Sections 4.8.1.3 and 4.2.1.4, respectively.

Increased noise levels could result from the operation of construction equipment (graders, excavators, and haul trucks) and from any blasting activities that might occur. Increases in noise levels during operations could be associated with mining and oil shale–processing activities and could be more long term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could increase in the immediate vicinity of any pipeline pump stations and be affected by project-related vehicular traffic at the project site and related locations (such as access roads to the site).

Construction-related noise levels could exceed EPA guidelines and/or Colorado regulations at some distances from the construction sites (there are currently no state guidelines/regulations for Utah or Wyoming; however, local jurisdictions regulate construction noise). Similarly, operational noise associated with mining and retort activities could, in the absence of mitigation, exceed EPA guidelines and/or Colorado regulations at some project locations. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline and/or Colorado regulation levels except for short durations and in areas close to roads or traffic.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes in ambient noise levels due to project development could occur wherever a project is located within the 1,963,414 acres identified as available for application for leasing under Alternative 4.

#### 6.1.4.7 Ecological Resources

Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. These lands support a wide variety of biota and their habitats (Section 3.7). Ecological resources in these areas would not be affected by the identification of lands available for application for leasing or by amendment of land use plans to incorporate these potential lease areas. However, ecological resources in and around these areas could be affected by future commercial development of oil shale in these areas. The following sections describe the potential impacts on ecological resources that may result from commercial oil shale development within the areas identified as available for application for commercial leasing under Alternative 4.

The magnitude of the impact on specific ecological resources that could be affected by commercial oil shale development in areas identified as available for application for commercial leasing in Alternative 4 would depend on the specific location of the commercial oil shale projects as well as on specific project design.

**6.1.4.7.1 Aquatic Resources.** Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. There are no impacts on aquatic habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

Potential impacts on aquatic resources from oil shale development could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 4.8.1.1. As described in Section 4.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals are occurring. Consequently, the analysis here considers the potential for impacts in waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities become more distant from waterways, the potential for negative effects on aquatic resources is reduced. For the analysis of potential impacts on each of the alternatives considered in the PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increases.

Under Alternative 4, 30 perennial streams and about 219 mi of perennial stream habitat within the Piceance, Uinta, Green River, and Washakie Basins are directly overlain by areas that would be potentially available for oil shale development. When an additional 2-mi zone surrounding these areas is considered, t49 perennial streams and about 662 mi of perennial stream habitat could be affected by future development activities (Table 6.1.1-4). The development of commercial oil shale projects in the areas identified under Alternative 4 could affect aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 4.8.1.1, impacts from water quality degradation and water depletions could affect resources not only in areas within or immediately adjacent to leased areas, but also in areas farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the Piceance, Uinta, Green River, and Washakie Basins are described in Section 3.7.1. Some of these aquatic habitats could contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. However, because most of the areas within the oil shale basins that contain known sensitive aquatic habitats and species would be excluded from consideration for leasing via land use plan amendments under this alternative, the potential impacts on aquatic resources are likely considerably smaller under Alternative 4 than under Alternative 1. Specific impacts would depend greatly upon the locations selected, methods of extraction used, and mitigation measures implemented by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing decisions to evaluate potential impacts in greater detail.

**6.1.4.7.2 Plant Communities and Habitats.** Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. There would be no impacts on plant communities and habitats associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

Areas identified as available for application for commercial leasing under Alternative 4 support a wide variety of plant communities and habitats (see Section 3.7.2). These areas include approximately 146,677 acres that are currently identified in BLM land use plans for the protection of wetlands, riparian habitats, floodplains, special status and sensitive plant species, and remnant vegetation associations. Direct and indirect impacts on plant communities and habitats could be incurred on these areas during project construction and operation, extending over a period of several decades (especially within facility and infrastructure footprints) (see Section 4.8.1.2). Some impacts, such as habitat loss, may continue beyond the termination of shale oil production.

Direct impacts would include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities, such as access roads, pipelines, transmission lines, employer-provided housing, and new power plants, would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be local in nature (occurring within construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction and facilities would occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The areas identified as available for application for commercial leasing under Alternative 4 potentially include locations outside of ACECs that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of oil shale development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

No ACECs are included in the lands available under this alternative. Therefore direct impacts on sensitive plant species and plant communities within ACECs would not occur. However, ten ACECs are located adjacent to the Alternative 4 footprint: Duck Creek, Dudley Bluffs, Ryan Gulch, Trapper Creek/Northwater Creek, and East Fork Parachute Creek, all located adjacent to the Piceance Basin; Pariette Wetlands, Nine Mile Canyon, and Lower Green River, all located adjacent to the Uinta Basin; Special Status Plant Species and Greater Red Creek, both located adjacent to the Green River Basin. Each ACEC includes rare plant species and/or rare or important plant communities. Indirect impacts on these species and communities could occur.

Twelve ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) the Alternative 4 footprint: Upper Greasewood Creek (1 mi), Lower Greasewood Creek (3.1 mi), Yanks Gulch (3.6 mi), South Cathedral Bluffs (3.1 mi), East Douglas Creek (2.7 mi), Magpie Gulch (3.3 mi), Deer Gulch (0.4 mi), and White River Riparian (2.7 mi), all near the Piceance Basin; Raven Ridge (2.2 mi), Oil Spring Mountain (4.4 mi), and White River Riparian (0.6 mi), all near the Uinta Basin; and Special Status Plant Species (0.9 mi) and Hells Canyon (2.9 mi), both near the Washakie Basin. Indirect impacts on the sensitive species or communities within these ACECs could occur. Impacts would generally decrease with increasing distance.

**6.1.4.7.3 Wildlife.** Under Alternative 4, a total of 1,963,414 acres of public land would remain available within Colorado, Utah, and Wyoming for application for leasing for commercial development of oil shale. While no impacts on wildlife species associated with the identification of lands as available for application for commercial leasing are expected, impacts could result from post-lease construction and operation as described in Section 4.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the lease and development phases of projects. The areas available for application for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for different wildlife species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than two years]); (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest); and (3) TL (where the BLM may allow specified activities, but not in those lands during certain sensitive seasons such as when raptors are nesting or when big game are on their winter ranges). Table 6.1.4-1 presents the acreage of habitat protected by these stipulations in areas available for application for oil shale leasing in Alternative 4. In most instances, the stipulations are for TLs.

Areas identified in Alternative 4 as available for application for commercial leasing do overlap with areas identified by state natural resource agencies as seasonal habitat for big game

**TABLE 6.1.4-1 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 4 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | |
|---|---|---|---|
| Habitat Description | Colorado[a] | Utah[a] | Wyoming[a] |
| ***Birds*** | | | |
| Raptor nests | 26,730 (29,349)[b] | –[c] | 76,989 (132,850) |
| Raptor nesting and fledging habitat | 59 (61) | – | – |
| Raptor habitat/nesting area | – | – | – |
| Raptor concentration areas | – | – | 10,036 (11,912) |
| ***Big Game*** | | | |
| Big game severe winter range | 83,134 (90,088) | – | – |
| Big game winter range | 24 (25) | – | – |
| Big game | 30 (31) | – | – |
| Deer and elk summer range | 162,099 (165,409) | – | – |
| Elk crucial winter habitat | – | 65,787 (67,854) | 61,041 (80,184) |
| Elk calving | – | 1,190 (1,190) | 10,902 (19,389) |
| Mule deer crucial winter habitat | – | 110,424 (112,993) | 89 (889) |
| Mule deer winter range | – | – | 60,871 (106,089) |
| Mule deer fawning | – | 20,984 (40,789) | |
| Mule deer migration corridor | – | 5,021 (5,038) | |
| Moose winter range | – | – | 11 (11) |
| Pronghorn crucial winter habitat | – | – | 10,486 (20,215) |
| Pronghorn winter range | – | – | 237,866 (455,557) |
| ***Other*** | | | |
| Wildlife seclusion above the rim | 70 (3,282) | – | – |
| Wildlife seclusion areas | 11 (11) | – | – |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the wildlife habitat acreage identified for protection within the most geologically prospective lands.

[c] A dash indicates not identified for protection, or identified otherwise for protection within the state.

species. These areas include mule deer and elk winter and summer ranges (Figures 6.1.4-1 and 6.1.4-2, respectively). Table 6.1.4-2 presents the acreages of these habitats (as identified by state resource agencies) that occur in the Alternative 4 lease areas and that could be impacted by future commercial oil shale development in these areas.

Several wild horse HMAs overlap with the lands that are identified as available for application for commercial leasing, including the Piceance–East Douglas Creek HMA in Colorado) 60,836 acres); the Hill Creek HMA in Utah (29,799 acres); and the Adobe Town (58,383 acres), Little Colorado (207,702 acres), Salt Wells Creek (117,186 acres), and White Mountain (170,868 acres) HMAs in Wyoming (Figure 6.1.4-3). Any oil shale development that

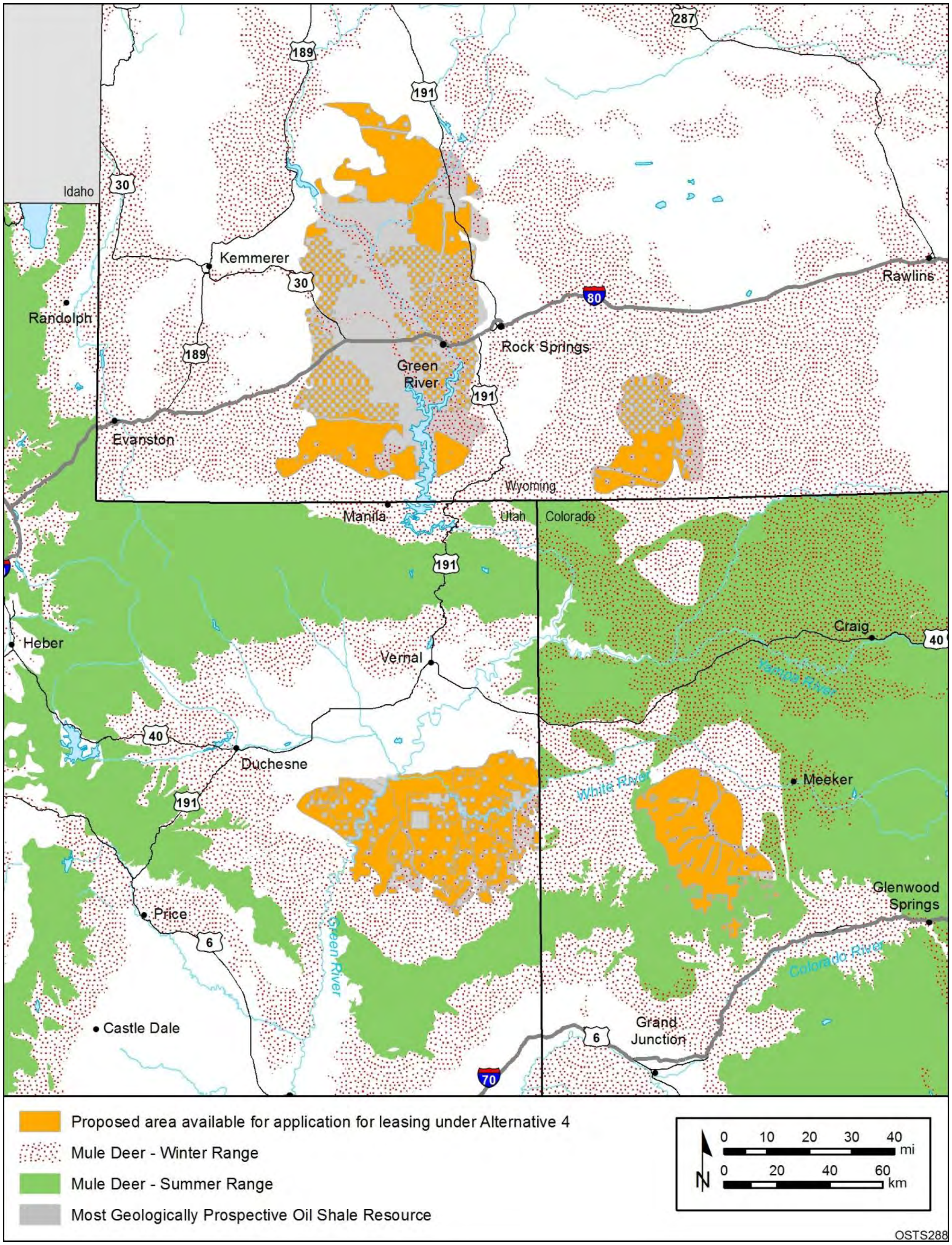


**FIGURE 6.1.4-1 Lands Available for Application for Oil Shale Leasing under Alternative 4 in Relation to the Summer and Winter Ranges of the Mule Deer**

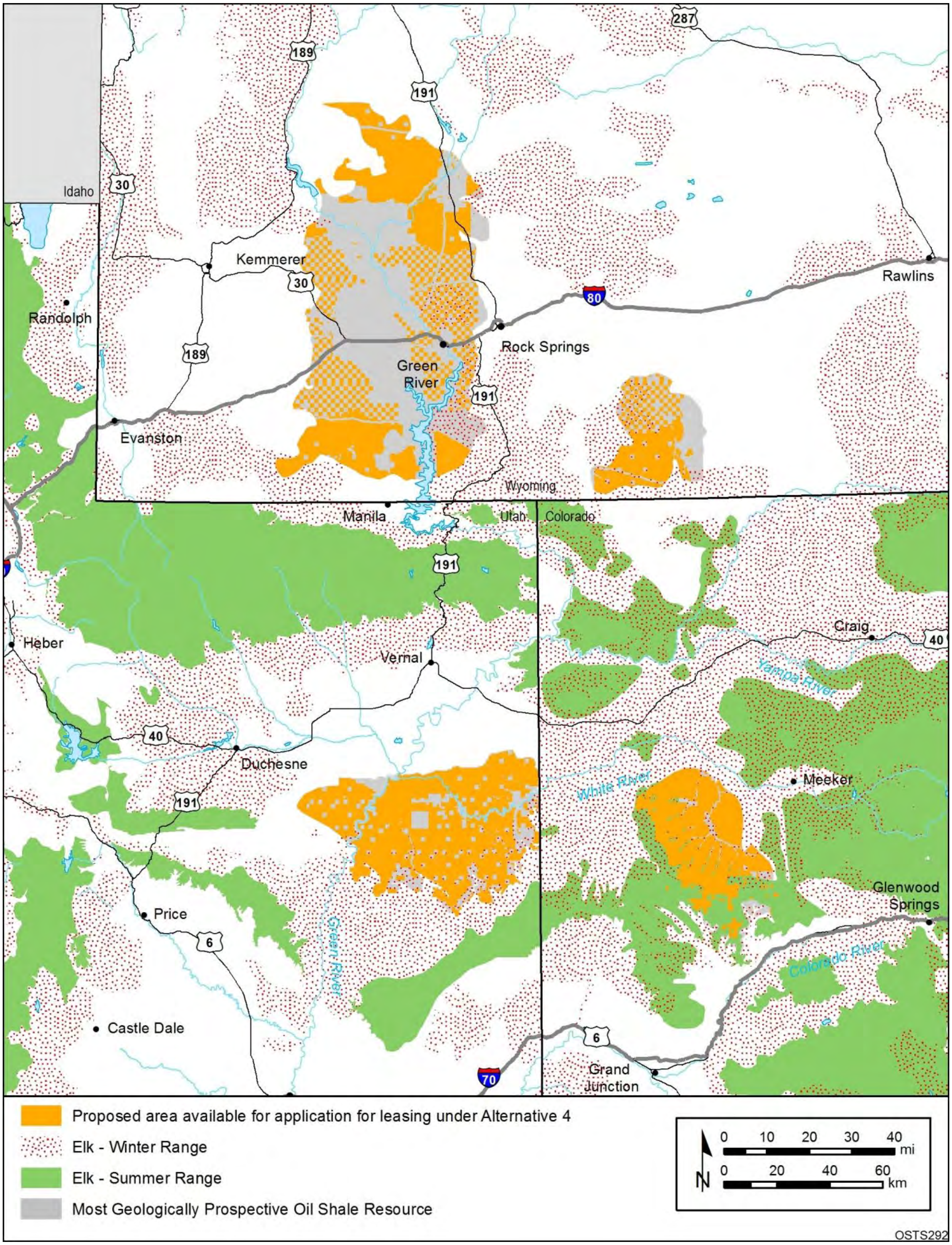


**FIGURE 6.1.4-2 Lands Available for Application for Oil Shale Leasing under Alternative 4 in Relation to the Summer and Winter Ranges of the Elk**

**TABLE 6.1.4-2 State-Identified Elk and Mule Deer Habitat Present in the Oil Shale Potential Lease Areas Identified under Alternative 4**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Colorado | Utah | Wyoming | Total |
| ***Mule Deer*** | | | | |
| Winter habitat | 239,186 | 252,679 | 329,675 | 821,540 |
| Summer habitat | 171,852 | 0 | NA[a] | 171,852 |
| ***Elk*** | | | | |
| Winter habitat | 313,814 | 265,781 | 234,247 | 813,842 |
| Summer habitat | 171,633 | 0 | NA | 171,633 |

[a] NA = data not available.

occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Impacts on wildlife from commercial oil shale projects (see Section 4.8.1.3) in Alternative 4 lease areas could occur in a number of ways and would be related to (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of biota; (3) mortality; (4) exposure to hazardous materials; and (5) increase in human access. These impacts could result in changes in species distribution and abundance; habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with the oil shale project or its workforce but instead associated with the increased access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads could lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, (2) an increase in the incidence of fires, and (3) an increase in runoff that could adversely affect riparian or other wetland areas important to wildlife.

The potential for impacts on wildlife and their habitats from commercial oil shale development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. Their magnitude is also considered to be proportional to the amount of land disturbance.

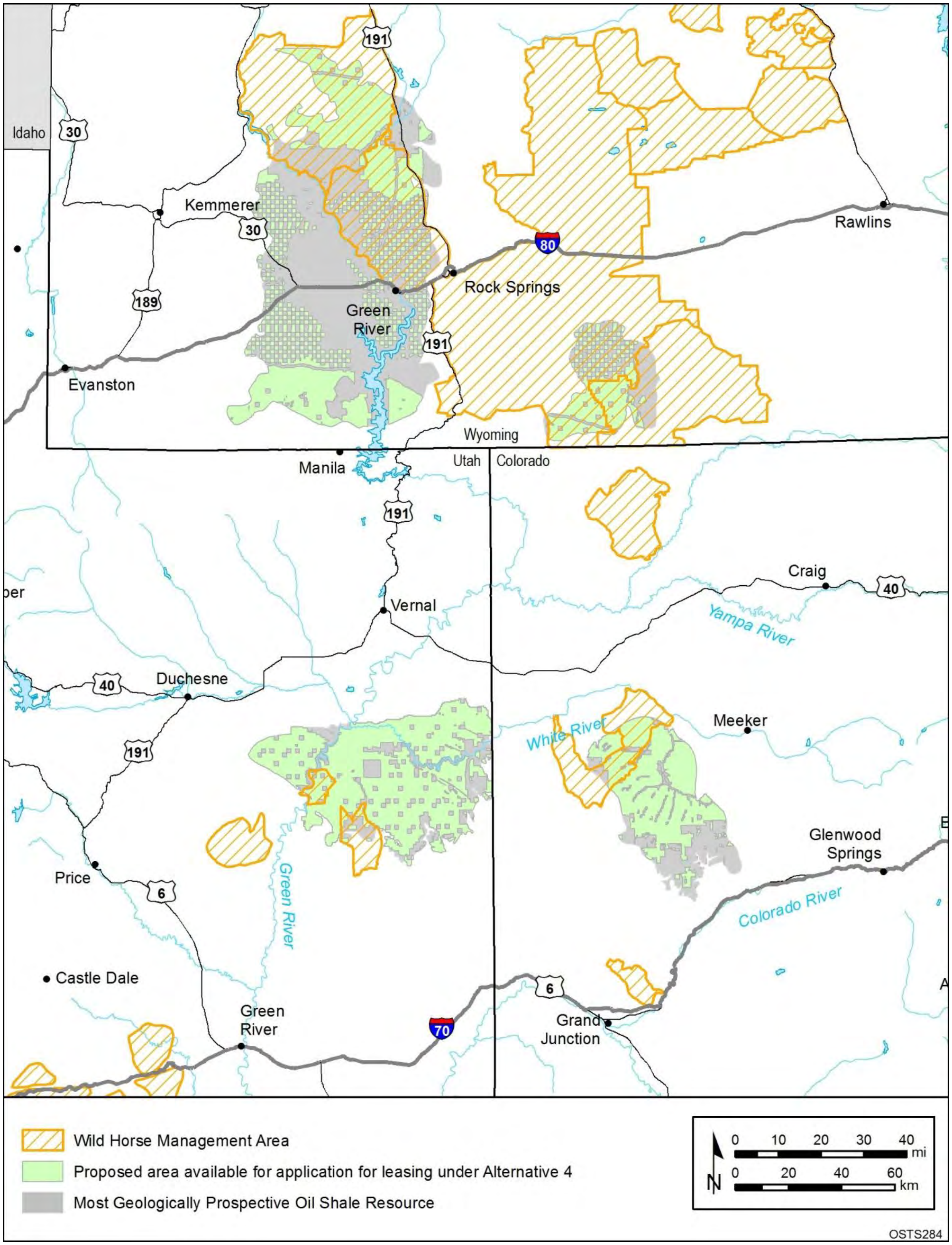


**FIGURE 6.1.4-3 Lands Available for Application for Oil Shale Leasing under Alternative 4 in Relation to Wild Horse and Burro Herd Management**

**6.1.4.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 4, land use plans would be amended to identify 1,963,414 acres of land in Colorado, Utah, and Wyoming as remaining available for application for leasing for commercial development of oil shale. Under this alternative, lands excluded from leasing include Adobe Town and ACECs (see Table 2.3.2-2 for a summary of Alternative 4 for commercial oil shale development). There would be no impacts on threatened, endangered, and sensitive species associated with this land use plan amendment action. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.4. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. Various stipulations are included in the BLM RMPs that provide protection for various threatened, endangered, and sensitive species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as sage-grouse leks), and (3) TL (where the BLM may allow specified activities but not during certain sensitive seasons such as sage-grouse brooding seasons). Table 6.1.4-3 identifies the amount of habitats protected

**TABLE 6.1.4-3 Habitat for Threatened, Endangered, and Sensitive Species Protected by Stipulations in BLM RMPs within the Alternative 4 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | |
|---|---|---|---|
| Habitat Description | Colorado[a] | Utah[a] | Wyoming[a] |
| ***Plants*** | | | |
| Habitat for BLM special status plants | 41,166 (46,680)[b] | –[c] | 922 (985) |
| ***Birds*** | | | |
| Bald eagle habitat | 1,462 (1,463) | 14,467 (36,920) | – |
| Habitat for listed, proposed, or candidate threatened or endangered and BLM-designated sensitive raptors other than bald eagle | 2,100 (2,100) | – | – |
| Sage-grouse habitat | 43,585 (43,806) | 61,987 (62,068) | 263,271 (764,055) |
| ***Mammals*** | | | |
| Black-footed ferret habitat | – | 38,041 (38,046) | – |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the acreages identified for protection within the most geologically prospective lands.

[c] A dash indicates not identified for protection, or identified otherwise for protection within the state.

by these stipulations in areas available for application for oil shale leasing in Alternative 4. In most instances, the stipulations for these species are TLs.

Under Alternative 4, 166 of the 186 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.1.4-4 and 20 of the 22 federally listed threatened or endangered species listed in Table 6.1.4-5 could occur in areas that would remain available for application for commercial leasing. This determination is based on records of occurrence in project counties of Colorado, Utah, and Wyoming, species occurrences from state natural heritage programs,[8] and the presence of potentially suitable habitat.[9] Potential lease areas include about 99 mi of critical habitat for Colorado River endangered fishes in Colorado and Utah; designated critical habitat for the Mexican spotted owl (*Strix occidentalis lucida*) also occurs about 5 mi (8 km) south of potential lease areas in Utah (Figure 6.1.4-4). Greater sage-grouse (*Centrocercus urophasianus*) core habitats and lek sites are shown in Figure 6.1.4-5. Under Alternative 4, potential oil shale lease areas intersect approximately 228,358 and 271,330 acres of core sage-grouse habitat in Utah and Wyoming, respectively. Potential oil shale lease areas under Alternative 4 do not intersect sage-grouse core and priority areas in Colorado (Figure 6.1.4-5). The areas available for application for leasing under Alternative 4 also include more than 382,000 acres for which lease stipulations have been established in existing RMPs to protect federally listed and candidate species, BLM-designated sensitive species, and other special status species.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) from commercial oil shale development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions, contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) from commercial oil shale development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions,

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8 Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the potential lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.1.4.-4 and 6.1.4-5.

9 Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the potential lease areas. This quantification is presented in Tables 6.1.4.-4 and 6.1.4-5.

**TABLE 6.1.4-4 Potential Effects of Commercial Oil Shale Development under Alternative 4 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Abies concolor* | White fir | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Achnatherum swallenii* | Swallen mountain-ricegrass | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Amsonia jonesii* | Jones blue star | BLM-S | UT–Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 25 mi (40 km) from the study area in Utah. |
| *Androstephium breviflorum* | Purple funnel-lily | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Antennaria arcuata* | Meadow pussytoes | BLM-S; WY-SC | WY–Sublette | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | UT–Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Artemisia biennis* var. *diffusa* | Mystery wormwood | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus bisulcatus* var. *haydenianus* | Hayden's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus calycosus* var. *calycosus* | King's milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus coltonii* var. *moabensis* | Moab milkvetch | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus debequaeus* | Debeque milkvetch | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus lentiginosus* var. *salinus* | Sodaville milkvetch | WY-SC | WY–Lincoln, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | CO–Garfield; UT–Emery, Garfield, Grand, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Utah. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | CO–Garfield; UT–San Juan | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 8 mi (13 km) from the study area in Colorado. |
| *Astragalus paysonii* | Payson's milkvetch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus proimanthus* | Precocious milkvetch | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Astragalus racemosus* var. *treleasei* | Trelease's racemose milkvetch | BLM-S; WY-SC | WY–Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 6 mi (10 km) from the study area in Wyoming. |
| *Atriplex falcata* | Sickle saltbush | WY-SC | WY–Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Atriplex wolfii* | Wolf's orache | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera crandallii* | Crandall's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Boechera selbyi* | Selby's rockcress | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Bolophyta ligulata* | Ligulate feverfew | BLM-S | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 4 mi (6 km) from the study area in Utah. |
| *Brickellia microphylla* var. *scabra* | Little-leaved brickell-bush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Ceanothus martinii* | Utah mountain lilac | WY-SC | WY–Lincoln, Sweetwater | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the WY study areas. Nearest occurrences are approximately 70 mi (113 km) from the study area in Wyoming. |
| *Cercocarpus ledifolius* var. *intricatus* | Dwarf mountain mahogany | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chamaechaen-actis scaposa* | Fullstem | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Chrysothamnus greenei* | Greene rabbitbrush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cirsium aridum* | Cedar Rim thistle | BLM-S; WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S; WY-SC | UT–Uintah; WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cirsium perplexans* | Adobe thistle | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | UT-Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Collomia grandiflora* | Large-flower collomia | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha gracilis* | Slender cryptantha | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S; WY-SC | CO–Rio Blanco; UT–Duchesne, San Raphael, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Utah. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 4 mi (6 km) from the study area in Utah. |
| *Descurainia pinnata* var. *paysonii* | Payson's tansy mustard | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Descurainia torulosa* | Wyoming tansymustard | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Downingia laeta* | Great Basin downingia | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Draba juniperina* | Uinta draba | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Elymus simplex* var. *luxurians* | Long-awned alkali wild-rye | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Ephedra viridis* var. *viridis* | Green Mormon tea | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriastrum wilcoxii* | Wilcox eriastrum | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Erigeron compactus* var. *consimilis* | San Rafael daisy | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | CO–Garfield; UT–Grand | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Eriogonum corymbosum* var. *corymbosum* | Crisp-leaf wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum divaricatum* | Divergent wild buckwheat | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Eriogonum hookeri* | Hooker wild buckwheat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Galium coloradoense* | Colorado bedstraw | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gentianella tortuosa* | Utah gentian | BLM-S | CO–Rio Blanco; UT–Duchesne, Emery, Garfield, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Glossopetalon spinescens* var. *meionandrum* | Utah greasebush | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lathyrus lanszwertii* var. *lanszwertii* | Nevada sweetpea | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium integrifolium* var. *integrifolium* | Entire-leaved peppergrass | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |
| *Lesquerella macrocarpa* | Large-fruited bladderpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 9 mi (14 km) from the study area in Wyoming. |
| *Lesquerella multiceps* | Western bladderpod | BLM-S; WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lesquerella parviflora* | Piceance bladderpod | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Lesquerella parvula* | Narrow-leaved bladderpod | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lesquerella prostrata* | Prostrate bladderpod | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the WY study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Wyoming. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Listera borealis* | Northern twayblade | BLM-S | CO–Garfield; UT–Duchesne, San Juan; WY–Sublette | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |
| *Lomatium triternatum* var. *anomalum* | Ternate desert-parsley | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia goodrichii* | Goodrich’s blazinstar | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia rhizomata* | Roan Cliffs blazingstar | BLM-S | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | UT–Duchesne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Monolepis pusilla* | Red poverty-weed | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *juniperina* | Juniper prickly-pear | WY-SC | WY–Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Opuntia polyacantha* var. *rufispina* | Rufous-spine prickly-pear | WY-SC | WY–Lincoln, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Oxytheca dendroidea* | Tree-like oxytheca | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Oxytropis besseyi* var. *obnapiformis* | Maybell locoweed | WY-SC | WY–Sweetwater, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the Wyoming study areas. Nearest occurrences are approximately 80 mi (129 km) from the study area in Wyoming. |
| *Packera crocata* | Saffron groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | CO–Rio Blanco; UT–Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Penstemon acaulis* var. *acaulis* | Stemless beardtongue | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Penstemon gibbensii* | Gibbens' beardtongue | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Wyoming. |
| *Penstemon harringtonii* | Harrington beardtongue | BLM-S | CO–Garfield | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Penstemon laricifolius* ssp. *exilifolius* | White beardtongue | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C; | CO–Rio Blanco; UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Penstemon scariosus* var. *garrettii* | Garrett's beardtongue | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia demissa* | Intermountain phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia glandulosa* var. *deserta* | Desert glandular phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia incana* | Western phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia salina* | Nelson phacelia | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phacelia tetramera* | Tiny phacelia | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Philadelphus microphyllus* var. *occidentalis* | Little-leaf mock-orange | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox albomarginata* | White-margined phlox | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Phlox pungens* | Beaver Rim phlox | BLM-S; WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Physaria condensata* | Tufted twinpod | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 7 mi (11 km) from the study area in Wyoming. |
| *Physaria dornii* | Dorn's twinpod | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 25 mi (40 km) from the study area in Wyoming. |
| *Physocarpus alternans* | Dwarf ninebark | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Populus deltoides* var. *wislizeni* | Fremont cottonwood | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Potentilla multisecta* | Deep Creek cinquefoil | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Psilocarphus brevissimus* | Dwarf woolly-heads | WY-SC | WY–Sublette | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Ranunculus flabellaris* | Yellow water-crowfoot | WY-SC | WY–Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Rorippa calycina* | Persistent sepal yellowcress | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 4 mi (6 km) from the study area in Wyoming. |
| *Sambucus cerulea* | Blue elderberry | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Senecio spartioides* var. *multicapitatus* | Many-headed broom groundsel | WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Silene douglasii* | Douglas' campion | WY-SC | WY–Lincoln | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Thelesperma caespitosum* | Green River greenthread | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Thelesperma pubescens* | Uinta greenthread | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Townsendia microcephala* | Cedar Mountain Easter-daisy | BLM-S; WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish (Cont.)*** | | | | |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S CO-SC | CO–Garfield, Rio Blanca; UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gila copei* | Leatherside chub | BLM-S; UT-SC; WY-SC | UT–Duchesne, Emery, Garfield, Wayne; WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 70 mi (113 km) from the study area in Utah. |
| *Gila robusta* | Roundtail chub | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Oncorhynchus clarkii utah* | Bonneville cutthroat trout | BLM-S; WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 30 mi (48 km) from the study area in Wyoming. |
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; CO-E; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Uintah, Wayne; WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 52,549 acres of potentially suitable habitat for this species occurs in the study area. This species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 20 mi (32 km) from the study area in Wyoming. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians (Cont.)*** | | | | |
| *Rana luteiventris* | Columbia spotted frog | BLM-S; WY-SC | UT–Utah, Wasatch; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 114 acres of potentially suitable habitat for this species occurs in the study area. This species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 40 mi (64 km) from the study area in Wyoming. |
| *Rana pipiens* | Northern leopard frog | BLM-S; CO-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 23,585 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Spea intermontana* | Great basin spadefoot | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,516,213 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| ***Reptiles*** | | | | |
| *Crotalus oreganus concolor* | Midget faded rattlesnake | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sweetwater | **Potential for negative impact.** Approximately 316,932 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Gambelia wislizenii* | Longnose leopard lizard | BLM-S; CO-SC | CO–Garfield | **Potential for negative impact.** Suitable habitat for the species does not occur in the study area. Quad-level occurrences are within 4 mi (6 km) from the study area in Utah. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Reptiles (Cont.)*** | | | | |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | UT–Carbon, Duchesne, Grand, San Juan, Uintah | **No impact.** Suitable habitat for the species does not occur in the study area and it is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Utah. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY-Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,126,934 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Aechmophorus clarkii* | Clark's grebe | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 1,295 acres of potentially suitable habitat for this species occurs in the study area. |
| *Aegolius funereus* | Boreal owl | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area and it is not known to occur in the vicinity of the study areas. Nearest occurrences are approximately 90 mi (145 km) from the study area in Wyoming. |
| *Ammodramus bairdii* | Baird's sparrow | BLM-S; WY-SC | WY–Uinta | **Potential for negative impact.** Approximately 2,867,364 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | UT–Duchesne, Uintah, Utah, Wasatch | **Potential for negative impact.** Approximately 963,649 acres of potentially suitable habitat for this species occurs in the study area. |
| *Aphelocoma californica* | Western scrub-jay | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 870,023 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 967,791 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Athene cunicularia* | Burrowing owl | BLM-S; CO-T; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,558,515 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Baeolophus ridgwayi* | Juniper titmouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 619,731 acres of potentially suitable habitat for this species occurs in the study area. |
| *Botaurus lentiginosus* | American bittern | WY-SC | WY–Lincoln, Sweetwater, Uinta | **Potential for negative impact.** Approximately 816,435 acres of potentially suitable habitat for this species occurs in the study area. |
| *Bucephala islandica* | Barrow's goldeneye | BLM-S | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 130,448 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 30 mi (48 km) from the study area in Colorado. |
| *Buteo regalis* | Ferruginous hawk | BLM-S; CO-SC; UT-SC; WY-SC | CO-Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,421,434 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Calcarius mccownii* | McCown's longspur | WY-SC | WY–Sweetwater | **No impact.** Suitable habitat for the species does not occur in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Charadrius montanus* | Mountain plover | BLM-S; CO-SC; UT-SC; WY-SC | CO–Rio Blanco; WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 1,004,584 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S; WY-SC | UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat does not occur in the study area. Quad-level occurrences are within 15 mi (24 km) from the study area in Utah. |
| *Cygnus buccinator* | Trumpeter swan | WY-SC | WY–Lincoln, Sublette, Sweetwater | **Potential for negative impact.** Approximately 217,257 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Cypseloides niger* | Black swift | BLM-S; CO-SC; UT-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Approximately 142 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 12 mi (19 km) from the study area in Colorado. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 92,701 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 12 mi (19 km) from the study area in Utah. |
| *Falco peregrinus anatum* | American peregrine falcon | BLM-S; CO-SC | CO–Garfield, Rio Blanco; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 1,861,185 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Gavia immer* | Common loon | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 5,665 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Grus canadensis tabida* | Greater sandhill crane | CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Approximately 1,080,903 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 20 mi (32 km) from the study area in Colorado. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; CO-T; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 2,255,105 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |
| *Icterus parisorum* | Scott's oriole | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 235,902 acres of potentially suitable habitat for this species occurs in the study area. |
| *Lanius ludovicianus* | Loggerhead shrike | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,900,782 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Uinta | **Potential for negative impact.** Approximately 120,954 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 11 mi (18 km) from the study area in Utah. |
| *Numenius americanus* | Long-billed curlew | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 981,868 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Oreoscoptes montanus* | Sage thrasher | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,743,889 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | CO–Garfield, UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 961,187 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Picoides arcticus* | Black-backed woodpecker | WY-SC | WY–Lincoln | **No impact.** Suitable habitat does not occur in the study area. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat does not exist in the study area. |
| *Plegadis chihi* | White-faced ibis | BLM-S; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 839,820 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Psaltriparus minimus* | Bushtit | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,200,334 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sitta pygmaea* | Pygmy nuthatch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 463,435 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sphyrapicus thyroideus* | Williamson's sapsucker | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 14,219 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Spizella breweri* | Brewer's sparrow | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,636,812 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Sterna caspia* | Caspian tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 4,868 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sterna forsteri* | Forster's tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 270,802 acres of potentially suitable habitat for this species occurs in the study area. |
| *Tympanuchus phasianellus columbianus* | Columbian sharp-tailed grouse | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat does not occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| ***Mammals*** | | | | |
| *Antrozous pallidus* | Pallid bat | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 972,787 acres of potentially suitable habitat for this species occurs in the study area. |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC; WY-SC | UT–Garfield, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 961,657 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 948,519 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 7 mi (11 km) from the study area in Utah. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Grand, Uintah; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,491,163 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sweetwater | **Potential for negative impact.** Approximately 739,333 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 10 mi (16 km) from the study area in Utah. |
| *Gulo gulo* | Wolverine | CO-E; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 569 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 6 mi (10 km) from the study areas in Colorado and Wyoming. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; CO-T; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 2,255,105 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado, Utah, and Wyoming. |
| *Icterus parisorum* | Scott's oriole | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 235,902 acres of potentially suitable habitat for this species occurs in the study area. |
| *Lanius ludovicianus* | Loggerhead shrike | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,900,782 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | UT–Carbon, Emery, Grand, Garfield, San Juan, Wayne | **No impact.** Suitable habitat for the species does not occur in the study area and it is not known to occur in the vicinity of the study area. Nearest occurrences are approximately 40 mi (64 km) from the study area in Utah. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC; WY-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Uinta | **Potential for negative impact.** Approximately 120,954 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences are within 11 mi (18 km) from the study area in Utah. |
| *Microtus richardsoni* | Water vole | WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 9,622 acres of potentially suitable habitat for this species occurs in the study area. |
| *Myotis evotis* | Long-eared myotis | BLM-S | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,203,082 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Duchesne, Garfield, Grand, San Juan, Uintah, Wayne; WY–Sublette | **Potential for negative impact.** Approximately 917,064 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Numenius americanus* | Long-billed curlew | BLM-S; CO-SC; UT-SC; WY-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 981,868 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | CO–Garfield; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 819,509 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Oreoscoptes montanus* | Sage thrasher | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,743,889 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | CO–Garfield, UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 961,187 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Peromyscus crinitus* | Canyon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 311,609 acres of potentially suitable habitat for this species occurs in the study area. |
| *Peromyscus truei* | Pinon mouse | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 828,049 acres of potentially suitable habitat for this species occurs in the study area. |
| *Picoides arcticus* | Black-backed woodpecker | WY-SC | WY–Lincoln | **No impact.** Suitable habitat does not occur in the study area. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat does not exist in the study area. |
| *Plegadis chihi* | White-faced ibis | BLM-S; WY-SC | CO–Garfield, Rio Blanco; WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 839,820 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Colorado and Wyoming. |
| *Psaltriparus minimus* | Bushtit | WY-SC | WY–Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,200,334 acres of potentially suitable habitat for this species occurs in the study area. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Sitta pygmaea* | Pygmy nuthatch | WY-SC | WY–Lincoln, Sublette | **Potential for negative impact.** Approximately 463,435 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sorex preblei* | Preble's shrew | WY-SC | WY–Lincoln, Uinta | **No impact.** Suitable habitat for the species does not occur in the study area. |
| *Sphyrapicus thyroideus* | Williamson's sapsucker | WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 14,219 acres of potentially suitable habitat for this species occurs in the study area. |
| *Spizella breweri* | Brewer's sparrow | BLM-S; WY-SC | WY–Lincoln, Sublette, Sweetwater, Uinta | **Potential for negative impact.** Approximately 1,636,812 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Sterna caspia* | Caspian tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 4,868 acres of potentially suitable habitat for this species occurs in the study area. |
| *Sterna forsteri* | Forster's tern | WY-SC | WY–Lincoln | **Potential for negative impact.** Approximately 270,802 acres of potentially suitable habitat for this species occurs in the study area. |
| *Tamias dorsalis utahensis* | Cliff chipmunk | WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 588,560 acres of potentially suitable habitat for this species occurs in the study area. |
| *Thomomys clusius* | Wyoming pocket gopher | BLM-S | WY–Sweetwater | **Potential for negative impact.** Approximately 85,442 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Thomomys idahoensis* | Idaho pocket gopher | BLM-S; WY-SC | WY–Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 133,494 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |

**TABLE 6.1.4-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Tympanuchus phasianellus columbianus* | Columbian sharp-tailed grouse | BLM-S; CO-SC | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat does not occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Vulpes macrotis* | Kit fox | BLM-S; CO-E; UT-SC | CO–Garfield, Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the study area. Quad-level occurrences are within 8 mi (13 km) from the study area in Colorado. |
| *Vulpes velox* | Swift fox | BLM-S; WY-SC | WY–Sweetwater | **Potential for negative impact.** Approximately 11,970 acres of potentially suitable habitat for this species occurs in the study area. Nearest occurrences are approximately 50 mi (80 km) from the study area in Wyoming. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-SC = species of special concern in the state of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 4 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 4 footprint (i.e., study area).

contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

Potential impacts on threatened, endangered, and sensitive species under Alternative 4 are similar to or the same as impacts on aquatic resources, plant communities and habitats, and wildlife described in Sections 6.1.4.7.1, 6.1.4.7.2, and 6.1.4.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the

**TABLE 6.1.4-5 Potential Effects of Commercial Oil Shale Development under Alternative 4 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Lepidium barnebyanum* | Barneby ridge-cress | ESA-E | UT–Duchesne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 11 mi (18 km) from the study area in Utah. |
| *Lesquerella congesta* | Dudley Bluffs bladderpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Penstemon debilis* | Parachute beardtongue | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM; | CO–Rio Blanco; UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Phacelia argillacea* | Clay phacelia | ESA-E; | UT–Utah, Wasatch | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 40 mi (64 km) from the study area in Utah. |
| *Phacelia scopulina* var. *submutica* | Debeque phacelia | ESA-T | CO–Garfield | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Physaria obcordata* | Dudley Bluffs twinpod | ESA-T | CO–Rio Blanco | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | UT–Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Colorado. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |

**TABLE 6.1.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | UT–Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | CO–Garfield; UT–Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 5 mi (8 km) from the study area in Colorado. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | UT–Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences are within 13 mi (21 km) from the study area in Utah. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E; CO-T | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Gila elegans* | Bonytail | ESA-E | UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study area in Utah. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E; CO-T | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Colorado |
| *Rhinichthys osculus thermalis* | Kendall Warm Springs dace | ESA-E | WY–Sublette | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 60 mi (64 km) from the study area in Wyoming. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E; CO-E | CO–Garfield, Rio Blanco; UT–Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Colorado |

**TABLE 6.1.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | States and Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds*** | | | | |
| *Grus americana* | Whooping crane | ESA-XN; CO-E | CO–Garfield, Rio Blanco | **Potential for negative impact.** Suitable habitat for the species does not occur in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | UT–Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 870,948 acres of potentially suitable habitat for this species occurs in the study area. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | UT–Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 22,062 acres of potentially suitable habitat for this species occurs in the study area. This species is not known to occur in the vicinity of any study areas. Nearest occurrences are approximately 100 mi (161 km) from the study area in Utah. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T; CO-E; WY-SC | CO–Garfield, Rio Blanco; UT–Emery, Uintah; WY Lincoln, Sublette, Uinta | **Potential for negative impact.** Approximately 1,167 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study area in Wyoming. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN; CO-E | CO–Rio Blanco; UT–Carbon, Duchesne, Emery, Grand, San Juan, Uintah; WY–Sublette, Sweetwater | **Potential for negative impact.** Approximately 133,223 acres of potentially suitable habitat for this species occurs in the study area. Quad-level occurrences of this species intersect the study areas in Utah and Wyoming. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; CO-E = listed as endangered by the State of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population; WY-SC = species of special concern in the state of Wyoming.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the Alternative 4 footprint (i.e., study area). Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the Alternative 4 footprint (i.e.., study area). Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

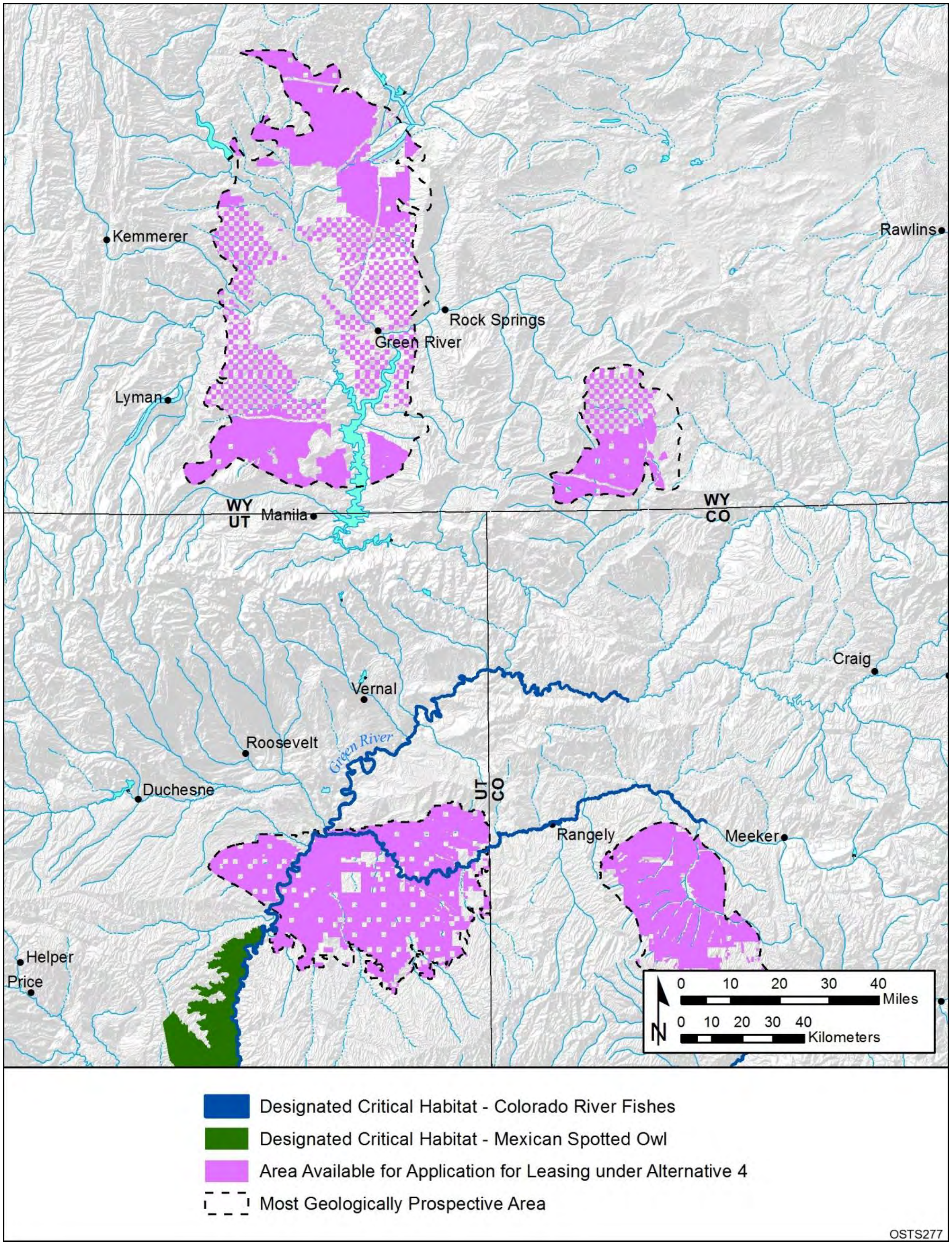


**FIGURE 6.1.4-4 Designated Critical Habitats of Threatened and Endangered Species That Are near Lands Available for Application for Leasing for Oil Shale under Alternative 4**

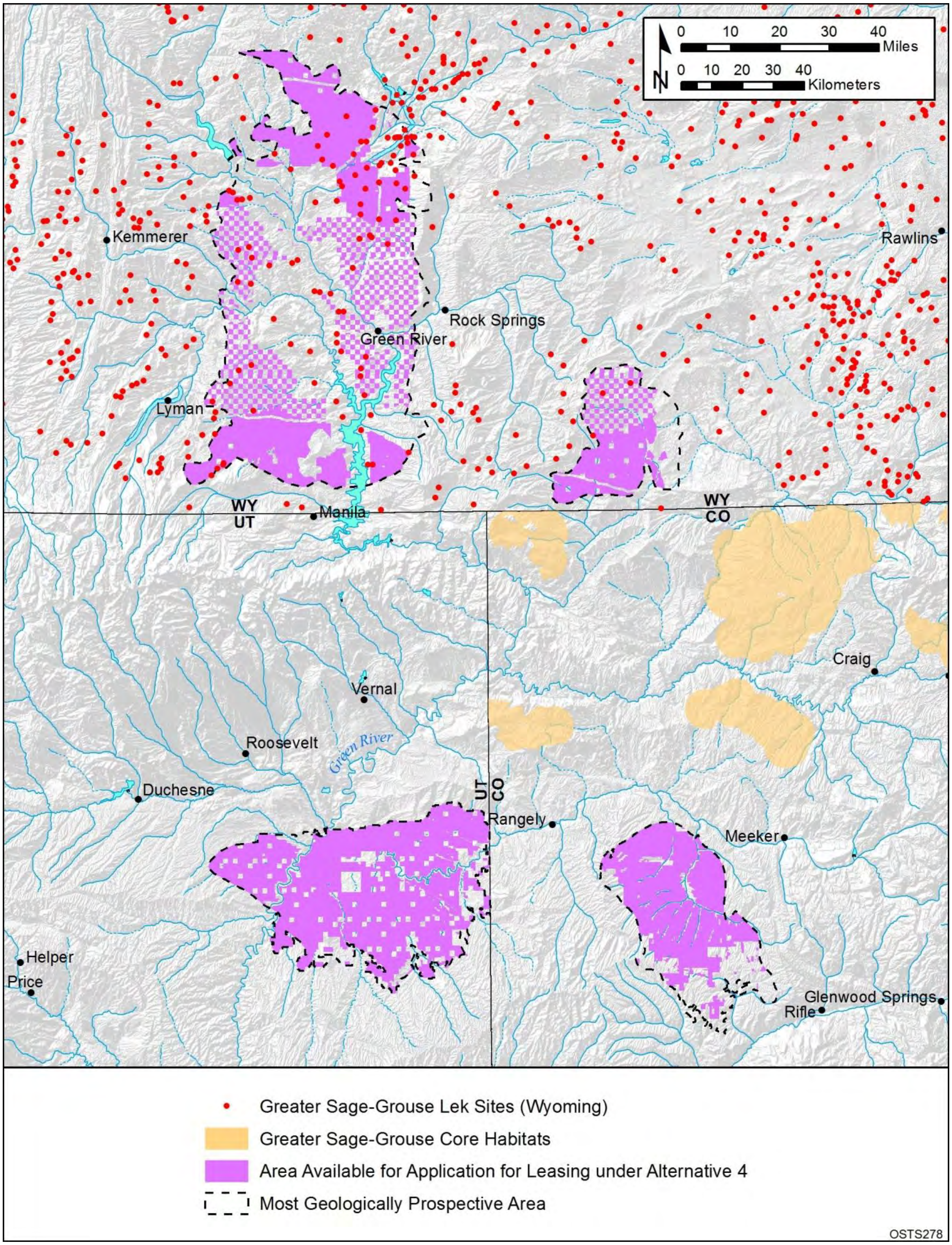


**FIGURE 6.1.4-5 Distribution of Core and Priority Habitat Areas and Lek Sites for Greater Sage-Grouse That Are near Lands Available for Application for Leasing for Oil Shale under Alternative 4**

details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

### 6.1.4.8 Visual Resources

The lands that would remain available for application for leasing under Alternative 4 support a wide variety of visual resources (Section 3.8). These resources would not be affected by the amendment of land use plans or by the identification of these lands as available for application for commercial leasing. Visual resources in and around these potential lease areas, however, could be affected by subsequent commercial development of oil shale.

Several scenic resource areas are located in Utah within the area that would be available for application for commercial leasing under Alternative 4. Specifically, these areas include Fantasy Canyon and White River SRMAs, and Lower Green River and Middle Green River Wild and Scenic Rivers.

Scenic resource areas are also located within 5 or 15 mi of the areas that would be made available for application for commercial leasing under Alternative 4 (Figures 6.1.4-6 [Colorado], 6.1.4-7 [Utah], and 6.1.4-8 [Wyoming]). These 5- and 15-mi zones correspond to the BLM's VRM foreground-middleground and background distance limits, respectively. Based on the assumption of an unobstructed view of a commercial oil shale project, viewers in these areas would be likely to perceive some level of visual impact from a commercial oil shale project; impacts are expected to be greater for resources within the foreground-middleground distance and lesser for those areas within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.1.4-6 presents the scenic resource areas that would fall within these zones under Alternative 4.

Visual resources could be affected at and near the Alternative 4 potential lease areas where commercial oil shale projects are developed and operated, and at areas where supporting infrastructure (e.g., plants and utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 4.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components such as shale-processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

### 6.1.4.9 Cultural Resources

Under Alternative 4, the amendment of land use plans to identify 1,963,414 acres of public land as remaining available for commercial oil shale development would not result in impacts on cultural resources. Existing ACECs, some of which have been identified for their cultural values, including about 7,300 acres in Wyoming (the West Sand Dunes Archaeological District), will not be made available for application for leasing under this alternative, and

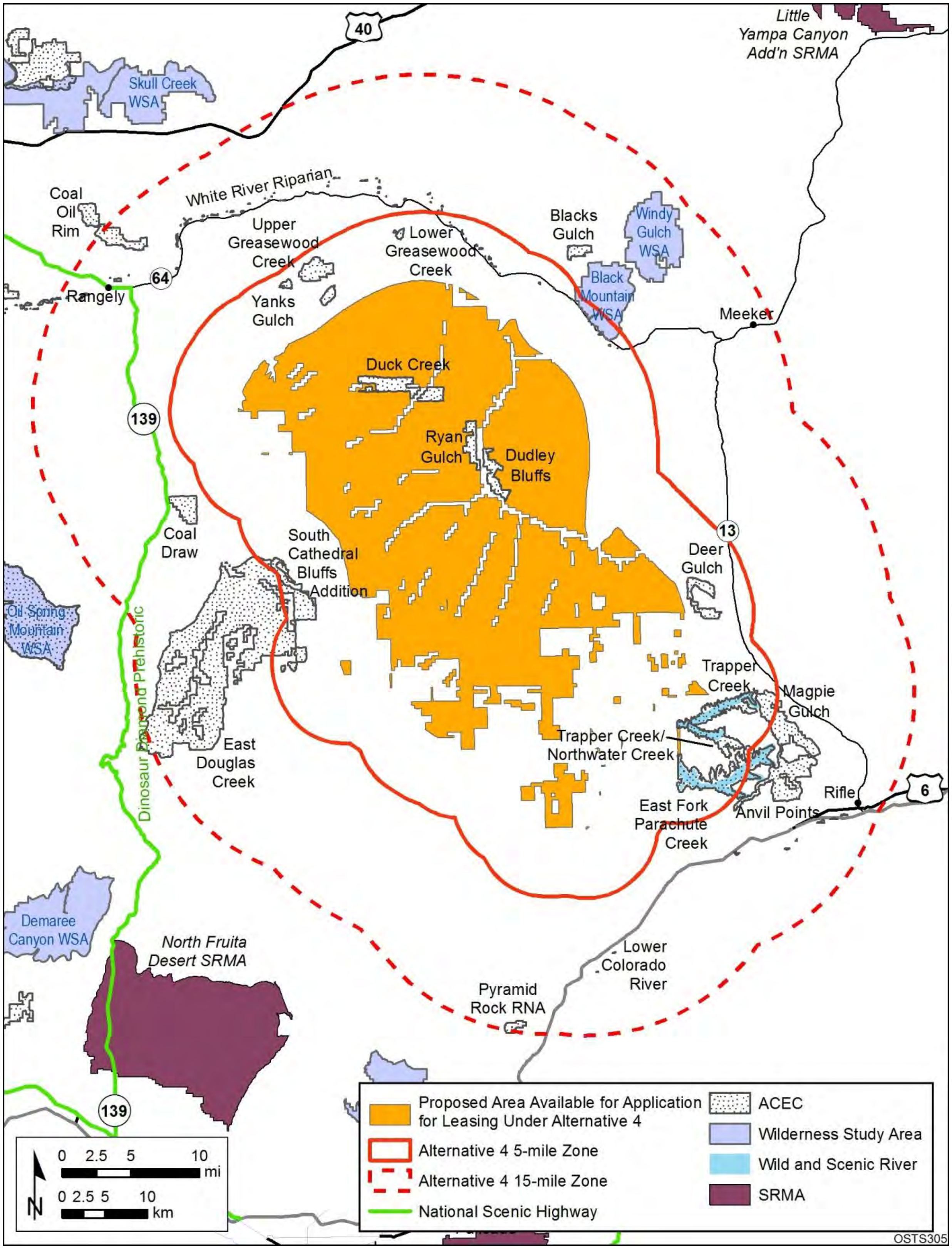


**FIGURE 6.1.4-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 in Colorado**

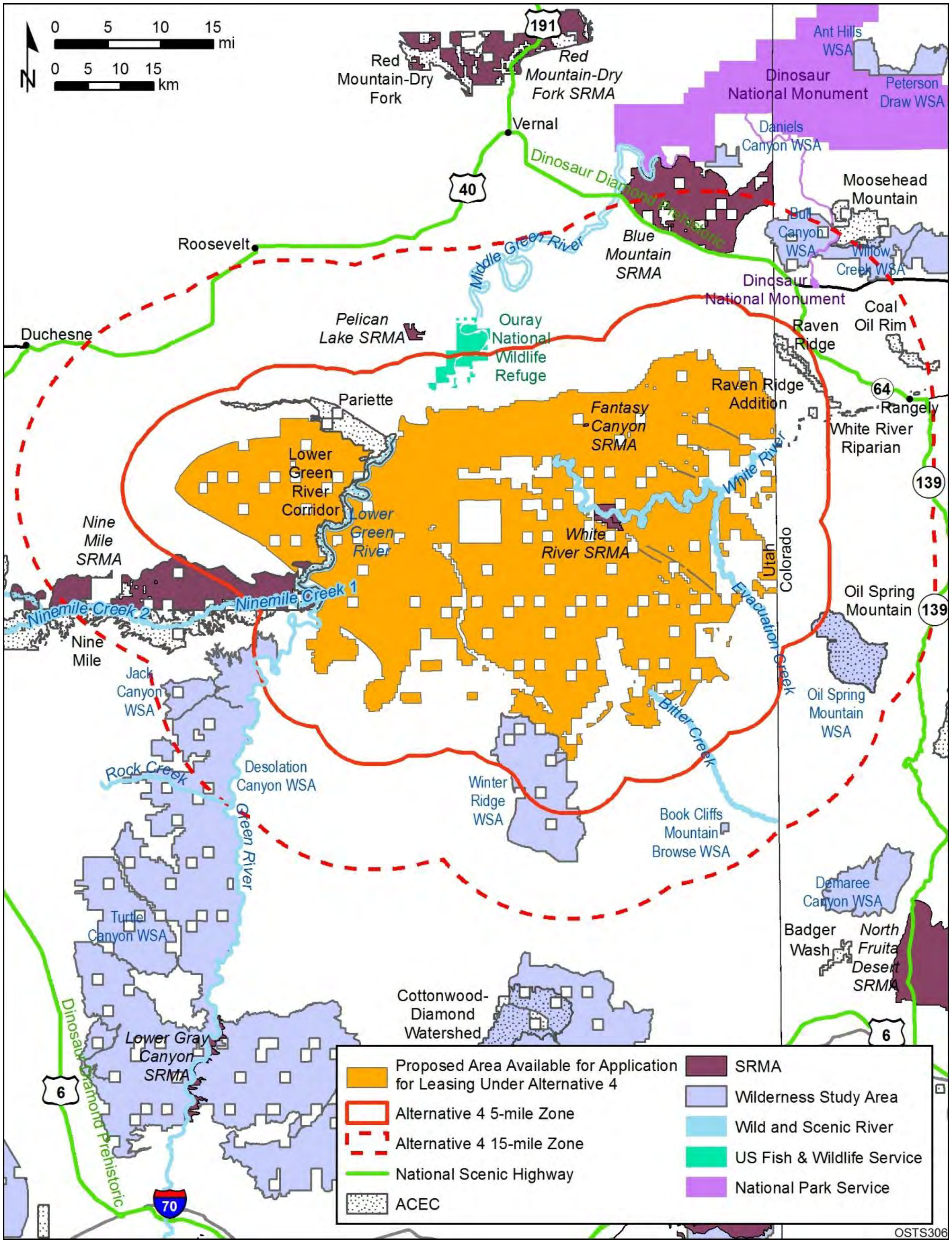


**FIGURE 6.1.4-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 in Utah**

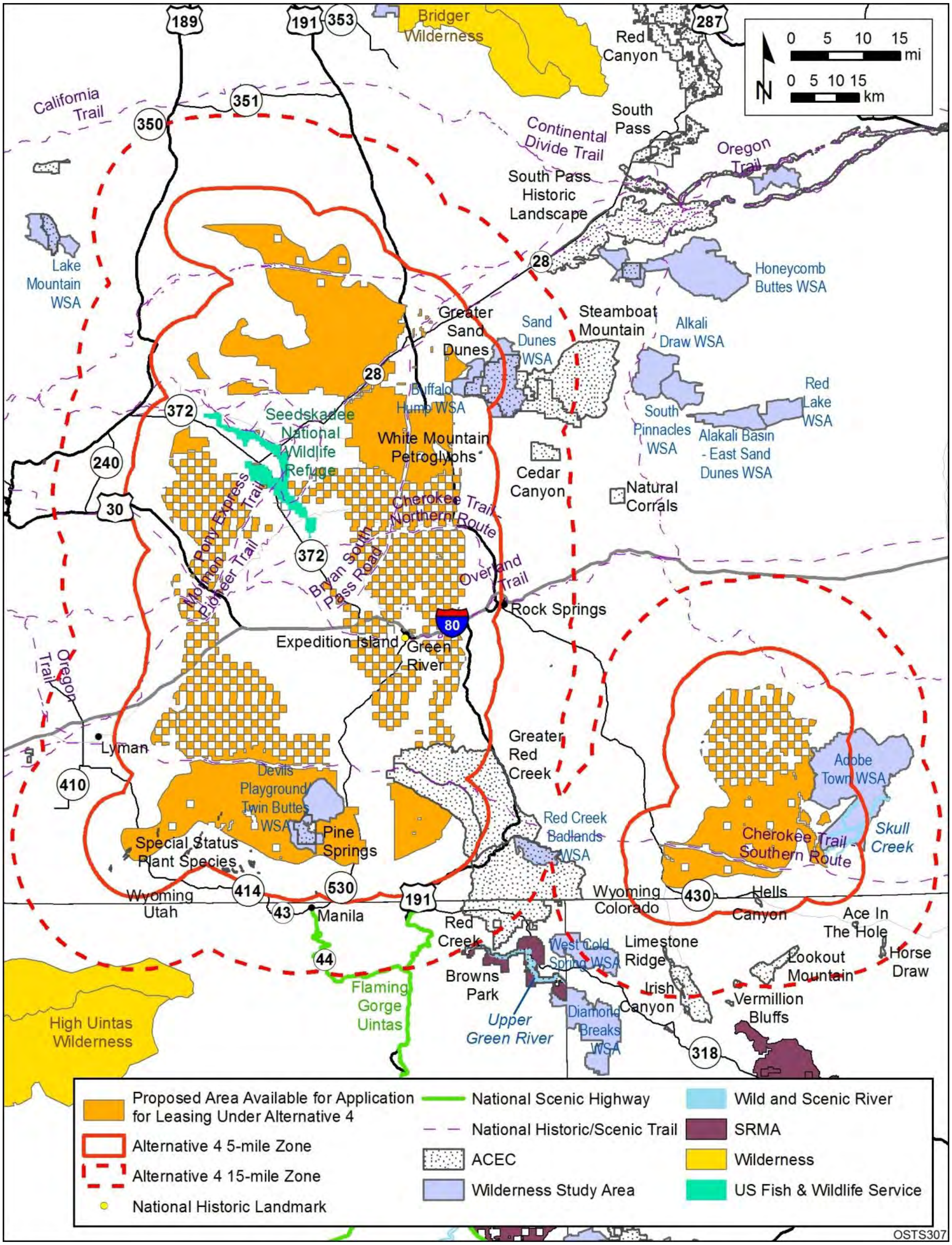


**FIGURE 6.1.4-8 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 in Wyoming**

**TABLE 6.1.4-6 Visually Sensitive Areas That Could Be Affected by Commercial Oil Shale Projects Developed in the Alternative 4 Lease Areas**

| Location | Scenic Resources within 5 mi of Alternative 4 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 4 Lease Areas |
|---|---|---|
| ***Colorado*** | Deer Gulch, Duck Creek, Dudley Bluffs, East Douglas Creek, East Douglas Creek/South Cathedral Bluffs Addition, East Fork Parachute Creek, Lower Greasewood Creek, Magpie Gulch, Ryan Gulch, South Cathedral Bluffs Addition, South Cathedral Bluffs/South Cathedral Bluffs Addition, Trapper Creek, Trapper Creek/Northwater Creek, Upper Greasewood Creek, White River Riparian, and Yanks Gulch ACECs; segments of East Fork Parachute Creek, Trapper Creek, and Northwater Creek determined to be eligible for WSR designation; and Black Mountain WSA. | Anvil Points, Blacks Gulch, Coal Draw, Coal Oil Rim, East Douglas Creek, East Fork Parachute Creek, Lower Colorado River, Magpie Gulch, Pyramid Rock RNA, and White River Riparian ACECs; Dinosaur Diamond Prehistoric Scenic Highway; segments of East Fork Parachute Creek determined to be eligible for WSR designation; and Black Mountain and Windy Gulch WSAs. |
| ***Utah*** | Oil Spring Mountain, Winter Ridge, and Desolation Canyon WSAs; Lower Green River, Nine Mile, and Pariette ACECs; Bitter Creek–P.R. Spring, Bitter Creek, Coyote Basin–Coyote Basin, Coyote Basin–Kennedy Wash, Coyote Basin–Myton Bench, Coyote Basin–Snake John, Desolation Canyon, Four Mile Wash, Lower Green River, Main Canyon, Nine Mile, Nine Mile–Canyon Expansion, and White River potential ACECs; segments of the Green River, Lower Green River, Bitter Creek, Evacuation Creek, Nine Mile Creek, and White River determined to be eligible for WSR designation; and Dinosaur Diamond Prehistoric National Scenic Highway. | Bull Canyon, Willow Creek, Oil Spring Mountain, Jack Canyon, Winter Ridge, Desolation Canyon, and Book Cliffs Mountain Browse WSAs; Nine Mile ACEC; Bitter Creek–P.R. Spring, Bitter Creek, Coyote Basin–Myton Bench, Coyote Basin–Snake John, Desolation Canyon, Main Canyon, Nine Mile, and Nine Mile–Canyon Expansion potential ACECs; segments of the Green River, Middle Green River, Bitter Creek, and Nine Mile Creek determined to be eligible for WSR designation; Dinosaur National Monument, managed by the NPS; and Dinosaur Diamond Prehistoric National Scenic Highway. |
| ***Wyoming*** | Greater Red Creek, Greater Sand Dunes, Hells Canyon, Pine Springs, Special Status Plant Species, White Mountain Petroglyphs ACECs; Expedition Island NHL; Bryan South Pass Road, California, Cherokee Trail - Northern Route, Cherokee Trail - Southern Route, Mormon Pioneer, Oregon, Overland, and Pony Express National Historic Trails; Seedskadee NWR; segments of Skull Creek determined to be eligible for WSR designation; and Adobe Town, Buffalo Hump, Devils Playground/Twin Buttes, and Sand Dunes WSAs. | Ace in the Hole, Browns Park, Cedar Canyon, Greater Red Creek, Greater Sand Dunes, Horse Draw, Irish Canyon, Limestone Ridge, Lookout Mountain, Red Creek, Special Status Plant Species, Steamboat Mountain, and Vermillion Bluffs ACECs; Bryan South Pass Road, California, Cherokee Trail - Northern Route, Cherokee Trail - Southern Route, Mormon Pioneer, Oregon, Overland, and Pony Express National Historic Trails; Flaming Gorge Uintas Scenic Highway; segments of Skull Creek and Upper Green River (Utah) determined to be eligible for WSR designation; High Uintas Wilderness; and Adobe Town, Red Creek Badlands, Sand Dunes, and West Cold Spring WSAs. |

therefore the cultural resources present in these areas would not be directly impacted under this alternative. The remaining lands made available for application for leasing overlap with some lands identified as having cultural resources present. Of the public lands that would remain available for application for leasing under Alternative 4, approximately 30% in the Piceance Basin, approximately 28% in the Uinta Basin, and approximately 8% in the Green River and Washakie Basins have been surveyed for cultural resources. In these areas that have been surveyed, nearly 7,000 sites have been identified. Additional resources are likely in unsurveyed portions of the study area. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), 203,590 acres (60%) of the Piceance Basin, 571,789 acres (94%) of the Uinta Basin, and 843,997 acres (87%) of the Green River and Washakie Basins Alternative 4 footprints have been identified as having a medium or high sensitivity for containing cultural resources.

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to have an impact on cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts of development could include the destruction of individual resources present within development footprints, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resources from looting or vandalism as a result of increased human presence/activity in the sensitive areas, and visual degradation of cultural setting (see Section 4.10). Any future leasing and subsequent development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts to cultural resources, or to denial of the lease or project.

#### 6.1.4.10 Indian Tribal Concerns

Under Alternative 4, a total of 1,963,414 acres would remain available for application for commercial lease. Alternative 4 differs from Alternative 1 only in the exclusion of the whole of Adobe Town, all ACECs analyzed in the 2008 OSTS PEIS, and additional ACEC acreages resulting from recently completed BLM planning efforts in Utah and Wyoming. As with Alternative 1, making parcels available for application for commercial leasing will not in and of itself have adverse effects on traditional properties and other resources of concern to Native Americans, but the leasing and development of the parcels would increase the likelihood that such impacts would be considered during the leasing and developing stage. Because somewhat less land would be available for commercial leasing, it is likely that fewer traditional properties and other resources important to Native Americans would be affected. However, the reduction in impact would not be precisely proportional to the reduction in acreage, because the nature and scope of impacts from development depend on the location of the development facility and the steps taken to mitigate impacts. Compliance with Section 106 of the NHPA as well as NEPA analyses, consultation with interested tribes, and other laws, regulations, and policies are important steps in avoiding, minimizing, or mitigating adverse effects on tribally significant resources. This is particularly true for the split estate lands in the Uintah and Ouray Reservation Hill Creek extension where the tribe owns the surface estate and the federal government the subsurface estate. Specific lease stipulations developed in consultation with affected tribes could reduce the impacts on resources that would be affected by the development of specific parcels.

#### 6.1.4.11 Socioeconomics

Socioeconomic and transportation impacts associated with Alternative 4 would be dependent on the exact locations of future development; the types of impacts that could occur would be the same as those described in Section 4.12 and summarized in Section 6.1.1.11 for Alternative 1. The specific impacts would be dependent upon the technologies employed, the project size or production level, development time lines, mitigation measures, and the location of employee housing.

Under Alternative 4, it is possible that there will be property value impacts simply from designating land as available or not available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.12.1.6).

#### 6.1.4.12 Environmental Justice

Although the environmental justice impacts of Alternative 4 would be dependent on the exact locations of specific developments, the types of impacts that could occur as a result of development on lands identified as available for application for leasing under Alternative 4 would be the same as those described in Section 4.13 and summarized in Section 6.1.1.12.

#### 6.1.4.13 Hazardous Materials and Waste Management

The amendment of land use plans under Alternative 4 to identify 1,963,414 acres of land as available for application for leasing for commercial oil shale development would not result in any hazardous material or waste management concerns. Impacts related to hazardous materials and wastes could occur during future development of commercial oil shale projects within the areas identified in Alternative 4 as available for application for commercial leasing. Such impacts are generally independent of location and would be unique to the technology combinations used for oil shale development. However, impacts of hazardous materials and wastes are similar for some of the ancillary support activities that would be required for development of any oil shale facility regardless of the technology used. These include the impacts from development or expansions of support facilities, such as employer-provided housing and power plants.

Hazardous materials and wastes would be used and generated during both the construction and operation of commercial oil shale facilities and supporting infrastructure (e.g., power plants). Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, and corrosion control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites, and other wastes typically associated with construction, none of which are expected to be hazardous (Section 4.14.1).

During project operations, hazardous materials would be utilized, and a variety of wastes (some hazardous) would be generated. Hazardous materials would include fuels, solvents, corrosion-control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations will depend on the specific design of the commercial oil shale project (surface or subsurface mining, surface retorting, and in situ processes). Waste materials produced during operations may include spent shale, waste engine fuels and lubricants, pyrolysis water, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 4.14.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial oil shale project, it is not possible to quantify project-related impacts of these materials. Under Alternative 4, individual facilities could be located anywhere within the area identified as available for leasing pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Sections 4.15 and 6.1.4.14) at locations where the individual projects are sited within the Alternative 4 lease areas.

#### 6.1.4.14 Health and Safety

The amendment of land use plans to identify 1,963,414 acres of land as available for application for leasing for commercial oil shale development would not result in any direct health and safety concerns. However, a number of health and safety concerns would be associated with the commercial development of oil shale projects within the areas in Alternative 4 identified as available for application for commercial leasing. For commercial oil shale development in Alternative 4, potential health and safety impacts from the construction and operation of commercial oil shale projects would be associated with the following activities: (1) constructing project facilities and associated infrastructure, (2) mining (if processing is not in situ) the oil shale; (3) obtaining and upgrading the crude oil, either through surface retorting or in situ processing; (4) transporting construction and raw materials to the upgrading facility and transporting product from the facility; and (5) exposing the general public to water and air contamination associated with oil shale development. Hazards from oil shale development (summarized in Table 4.15-1) could include physical injury from construction, oil shale processing, and vehicle transportation accidents and exposure to fugitive dust and hazardous materials, such as retort emissions and industrial chemicals (Section 4.15). Health and safety impacts would be largely restricted to the immediate workforce of each facility. Accidents could also affect members of the general public who could be present in the immediate vicinity of an accident (e.g., project-related truck accident on a public road, recreational users in areas adjacent to the project lease area).

Hazards for workers at oil shale development facilities include risks of accidental injuries or fatalities, lung disease caused by inhalation of particulates and other hazardous substances, and hearing loss. Estimates of expected injuries and fatalities can be made on the basis of numbers of employees and the type of work. Based on the numbers of employees projected to be needed for construction and operation of oil shale facilities, statistically there would be less than 1 death and about 125 injuries per year expected per facility during construction activities, and less than 1 death and less than 100 injuries per year expected per facility during operations (NSC 2006). As a measure to decrease worker injuries, a comprehensive facility health and safety plan and worker safety training could be recommended to be included in the plans of development for proposed commercial oil shale projects.

Health and safety concerns are largely independent of the location of oil shale development facilities. However, the health and safety impacts on the general public from emissions from these facilities would depend both on the specific characteristics and level of emissions and on the distance of the emissions source from population centers. The level of air and water emissions would be regulated under required permits. Potential impacts on the general public from emissions would be assessed in future site-specific NEPA and permitting documentation.

### 6.1.5 Comparison of Oil Shale Alternatives

Alternative 1, the No Action Alternative, maintains current land use allocations from the 2008 PEIS and ROD, which allow commercial oil shale leasing on 2,017,741 acres of BLM-administered lands, subject to additional NEPA analysis and subject to other land use plan decisions that affect lands within the areas designated for leasing (e.g., designated ACECs). No other lands within the study area are currently designated for commercial oil shale leasing. The development and operation of the RD&D leases are common to all the alternatives being considered. By the terms of the existing RD&D leases, the operations could convert to commercial facilities. Within the Piceance Basin, this conversion could lead to a relatively dense development complex of up to 24,800 acres, which could dramatically affect existing land uses within the area. This conversion and the associated impacts of commercial operation on the expanded PRLA lands would be common to all alternatives.

The three action alternatives—Alternatives 2 (Conservation Focus), 3 (Research Lands Focus), and 4 (Moderate Development)—would amend up to eight BLM land use plans in Colorado, Utah, and Wyoming to (1) designate lands within the most geologically prospective areas as available or not available for application for leasing and (2) identify any technology restrictions. These alternatives are described in detail in Sections 2.3.3, 2.3.3.1, 2.3.3.2, and 2.3.3.3; specific land use plan amendments to implement Alternatives 2, 3, and 4 are provided in Appendix C. The analyses of potential impacts associated with each alternative are presented in Sections 6.1.1, 6.1.2, 6.1.3, and 6.1.4 of this chapter.

As noted in the preceding impact analysis sections for Alternatives 1 through 4, with the exception noted in the socioeconomic analysis regarding potential impacts on land values, these land use plan amendments would not result in any impacts on the environment or socioeconomic setting. However, the future development of commercial oil shale projects that could be approved after subsequent NEPA analysis identified in both of these alternatives would have impacts on these resources. The types of impacts that could be associated with future commercial oil shale development are described in Chapter 4. The magnitude of the impacts cannot be quantified at this time because key information about the location of commercial projects, the technologies that may be employed, the project size or production level, development time lines, and mitigations is unknown.

#### 6.1.5.1 Land Use

Under Alternative 1, a total of 2,017,741 acres are potentially available for oil shale leasing. Approved extraction methods could include surface and underground mining and in situ processes. Commercial leases issued subsequent to the existing land use plans would have the same impacts as described in Chapter 4 of the PEIS.

Decisions implementing any of the three action alternatives, or any combination of any elements thereof, or of the No Action Alternative, would neither grant rights to third parties nor approve any ground-disturbing activities; however, the intent of these alternatives is to create a program that will facilitate future leasing and development of oil shale resources. The future development of commercial oil shale projects that could be approved after subsequent NEPA analysis identified in both alternatives would have the same impacts as those described in Chapter 4. Note that none of the alternatives impose either a minimum level or a cap on the level of development that may occur; that is, they only identify the areas available for potential commercial leasing (where "commercial" includes RD&D as well) and development.

Table 6.1.5-1 summarizes the acreages available for potential development by alternative.

The following is a summary of the principal differences in potential impact on land uses among Alternatives 1, 2, 3, and 4:

- Alternative 1 includes about 221,000 acres of land identified as LWC, and these lands could be available for application for commercial development. Alternatives 2 and 3 do not include any such lands, while Alternative 4 contains about 23,000 fewer acres of LWC than Alternative 1. Alternative 2 specifically removes from consideration for future leasing lands with sensitive resources that have been identified in BLM land use plans, including all existing ACECs. Alternative 1 removes only ACECs closed to mineral entry from consideration for leasing. Alternative 4 impacts are similar to those from Alternative 1, but Alternative 4 removes all existing ACECs, the whole Adobe Town Very Rare or Uncommon Area, and an undetermined percentage of the LWC and sage-grouse core habitat area. It is expected that Alternative 4 likely would have less impact than Alternative 1 on the latter resources, although it is assumed that the implementation of Alternative 1 will be subject to the same policies regarding protection of sage-grouse core habitat and LWC.

**TABLE 6.1.5-1 Acreages Available for Potential Development under Alternatives 1, 2, 3, and 4**

| | Acreages Available | | | |
|---|---|---|---|---|
| Alternative | Total | Colorado | Utah | Wyoming |
| 1 | 2,017,741 | 346,609 | 670,558 | 1,000,574 |
| 2 | 461,965 | 35,308 | 252,181 | 174,476 |
| 3 | 32,640 | 26,880 | 5,760 | 0 |
| 4 | 1,963,414 | 340,147 | 655,821 | 967,446 |

- In the Piceance Basin, Alternative 3 would have the least impact on oil and gas development than the other alternatives because considerably fewer acres of potentially valuable oil and gas deposits are available for application for commercial oil shale development. Alternative 2 would have the second-lowest level of impact on oil and gas resources. The impacts of Alternatives 1 and 4 are essentially the same within the Piceance Basin.

- The potential development area within the Piceance Basin in Colorado is much smaller under Alternatives 2 and 3 than under either Alternatives 1 or 4, which are very similar. However, because of the presence of the five existing RD&D leases and the associated PRLAs in near proximity to each other, there could be an intensive area of oil shale development within the Piceance Basin under all four alternatives.

- Overall, Alternatives 2 and 3 would have much less potential impact on designated ACECs, LWC, and sage-grouse core or priority habitat than Alternatives 1 and 4.

### 6.1.5.2 Soil and Geologic Resources

The types of impacts on soil and geologic resources would be the same under all four alternatives; these impacts would be associated with soil removal and compaction, subsurface disturbance of geologic resources during drilling and mining activities, and increased potential for erosion of exposed soils and geologic materials.

The designation of public lands under Alternatives 1, 2, 3, and 4 as available for commercial oil shale leasing and the associated amendment of appropriate land use plans would not affect soils or geologic resources in any of the lease areas. Soil and geologic resources, however, could be affected by future development of commercial oil shale projects in these areas under each alternative. Potential impacts, related primarily to construction and operation of project facilities and related infrastructure, could include soil disturbance, removal or compaction, and erosion.

Although the types of impacts on soil and geologic resources would be the same for similar projects under each alternative, the total amount of soil and geologic resources would vary because the acreage associated with each alternative is different (Table 6.1.5-2). For example, under Alternative 3, soil and geologic resources could be affected by commercial development on only 32,640 acres, which is far less than the area that could be affected by commercial development under Alternatives 1 (2,017,741 acres), 2 (461,965 acres), or 4 (1,963,414 acres). The nature, location, and magnitude of project-related impacts on soil and geologic resources would depend on the specific location of leases undergoing commercial development as well as the design of the projects.

### 6.1.5.3 Paleontological Resources

Under all the oil shale alternatives, there is a high potential to encounter stratigraphic units that contain significant paleontological resources. Although the types of impacts on paleontological resources would be the same for similar projects under each alternative, the total amount of resources potentially affected would vary because the acreage associated with each alternative is different and because fossils are not uniformly distributed within a particular formation. For example, the largest area affected would be under Alternative 1, where the footprints of future oil shale development, covering a total of 2,017,741 acres, overlie a total of 1,784,765 acres (335,113 acres in Colorado, 592,620 acres in Utah, and 857,032 acres in Wyoming) of geologic formations having a high potential to contain important paleontological resources. This is followed by Alternative 4, covering a total of 1,963,414 acres, where development footprints overlie a total of 1,751,266 acres (329,550 acres in Colorado, 582,676 acres in Utah, and 839,040 acres in Wyoming) of geologic formations having a high potential to contain important paleontological resources. Most of the available acreage overlying high potential geologic formations occurs in Wyoming (Table 6.1.5-2).

**TABLE 6.1.5-2 Available Acreage Overlying Geologic Formations with High Potential to Contain Important Paleontological Resources by Oil Shale Alternative**

| | | Total Acreage Overlying Formations with High Potential | | |
|---|---|---|---|---|
| Alternative | Total Development Acreage | Colorado | Utah | Wyoming |
| 1 | 2,017,741 | 335,113 | 592,620 | 857,032 |
| 2 | 461,965 | 34,405 | 232,239 | 156,648 |
| 3 | 1,920[a] | 1,121 | 335 | 0 |
| 4 | 1,963,414 | 329,550 | 582,676 | 839,040 |

[a] Acreage for three potential new RD&D leases (two pending applications in Colorado and one in Utah) that would be available for oil shale leasing under Alternative 3.

Impacts from oil shale development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development area, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas (Section 4.4). These impacts could be avoided or minimized by applying mitigation measures during project development. Such measures include on-site monitoring by qualified paleontologists to determine whether important paleontological resources are present and to collect data from any such resources uncovered during project activities. Therefore, most of the potential adverse effects on paleontological resources are expected to be mitigated.

#### 6.1.5.4 Water Resources

Under Alternative 1, surface disturbance could lead to increased erosion and possible contribution to sedimentation of local streams, runoff from saline soils, and soils contaminated by industrial processes and activities (see Section 6.1.1.2). In a comparison of the length of streams intercepted by the different alternatives (Table 6.1.5-3), Alternatives 1 and 4 have the most mileage intercepted, while Alternative 3 has by far the least mileage intercepted. The Alternative 2 scenario would create impacts approximately mid-range relative to impacts created by the other alternatives. Therefore, depending on the location of specific projects, the impacts on water resources by soil erosion could be highest in Alternatives 1 and 4 and lowest in Alternative 3. Water impacts for the nine RD&D sites would be the same for all alternatives.

Some of the lands excluded under Alternative 2 are designated for protection by the BLM because of steep slopes and/or fragile or highly erosive soils, which could contribute to adverse effects on water quality if disturbed. The exclusion of these soil areas from potential development may reduce impacts on water quality under Alternative 2. Groundwater would be impacted under the alternatives in terms of use, dewatering, and contamination. For all three alternatives, the impacts would depend on the degree of development, the technologies, and site-specific factors.

**TABLE 6.1.5-3 Perennial Stream Miles within the Four Oil Shale Basins**

| | | Perennial Stream Miles | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | |
| Basin | Perennial Stream Miles | No. of Miles | % of Total | No. of Miles | % of Total | No. of Miles | % of Total | No. of Miles | % of Total |
| Piceance | 199 | 184 | 92 | 110 | 55 | 23 | 12 | 183 | 92 |
| Uinta | 262 | 262 | 100 | 196 | 75 | 5 | 2 | 261 | 100 |
| Green | 253 | 190 | 75 | 63 | 25 | 0 | 0 | 179 | 71 |
| Washakie | 39 | 39 | 100 | 17 | 44 | 0 | 0 | 39 | 100 |
| Total | 753 | 674 | 90 | 386 | 51 | 2 | 4 | 662 | 88 |

Table 6.1.5-3 is a tabulation of perennial stream miles in within the four oil shale basins. Cumulatively, Alternatives 1 and 4 contain approximately 90% of the perennial stream miles in the four basins and, depending upon the location of any future developments, would expose more stream segments to both direct and indirect disturbance. Even under Alternative 3, however, if development occurs on available lands in proximity to streams, there could be indirect effects on the streams as described previously. Impacts on water resources would ultimately be determined by the site location and the technology employed. The gross number of acres available for application, and even the number of stream miles included within the area available for application for leasing, is less important from a water resource standpoint than the actual location of the development and the source of water to support development.

Water requirements to support oil shale development are still unknown, but it is known that general water availability has become more constrained, and not merely from a legal appropriation standpoint. There is the likelihood that senior water rights could be purchased to either support future oil shale development and/or obtain water in a specific location. Access to water supplies, vis-a-vis locations near perennial streams where water rights could be acquired, could be greater in Alternatives 1 and 4 because of the greater number of perennial stream miles present within the potential leasing area. This could be offset by an ability to transfer water in other ways.

#### 6.1.5.5 Air Quality

Previous analyses (summarized in Appendix A, Section A.5.3 [BLM 2006a–h; 2007a,b]) indicated that no significant, adverse direct or cumulative air quality impacts are likely to occur from the six RD&D projects. Thus, the RD&D projects (nine RD&D leases in total, including six current and three potential new RD&D leases) are expected to have no significant air quality impacts under any of the four alternatives.

Under Alternative 3, a total of 32,640 acres of land in Colorado and in Utah have already been allocated for potential commercial oil shale development. No air quality impacts are associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 4.6. These impacts would be considered in project-specific NEPA analyses that would be conducted at the lease (including conversion from any RD&D to a commercial lease) and development phases of projects.

The identification of areas available for application for leasing for commercial oil shale development and the associated amendment of appropriate land use plans would not affect air quality under Alternatives 1, 2, or 4. However, under these alternatives, local and regional air quality and AQRVs could be affected by the future construction and operation of commercial oil shale projects in the areas available for application for leasing and by construction and operation of off-lease infrastructures, such as electric power plants, if needed. Under Alternatives 1, 2, and 4, the potential future commercial development of a similar project in an area where the lease areas of these alternatives overlap would be expected to have local and regional impacts on air quality and AQRVs in the same manner.

Different areas are identified under Alternatives 1, 2, 3, and 4 as available for application for leasing. About 2,000,000 acres of public lands would be available for oil shale development under Alternatives 1 and 4, and about 62,500 acres fewer under Alternative 4 than under Alternative 1. Somewhat less than 500,000 acres of public lands would be available for oil shale development under Alternative 2, which is about one-fourth of those under Alternatives 1 or 4. Local air quality could be affected by commercial development in more locations under Alternative 1 (followed by Alternative 4) than under Alternatives 2 or 3. Many of the lands that would be open for application for leasing under Alternative 1 would be excluded from application for leasing for commercial oil shale development under Alternatives 2 or 4. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of regional air quality and AQRVs impacts of commercial oil shale development under all four alternatives. Thus, it is not possible to differentiate among these alternatives regarding regional air quality and AQRVs impacts.

#### 6.1.5.6 Noise

There are no noise impacts associated with the designation of lands as available for application for oil shale development. Impacts on noise levels would be comparable under all four alternatives for any future similar commercial projects located in areas common to the alternatives (i.e., in areas where these alternatives overlap). Because of the difference in the areas identified under all four alternatives as available for application for leasing, local noise levels could be affected by commercial development at more locations under Alternative 1 (followed by Alternative 4) than under Alternatives 2 or 3. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of noise impacts of commercial oil shale development under Alternatives 1, 2, 3, or 4. Thus, it is not possible to differentiate among these alternatives regarding noise impacts.

#### 6.1.5.7 Ecological Resources

**6.1.5.7.1 Aquatic Resources.** No impacts on aquatic resources are associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The types of impacts on aquatic resources associated with construction and operations would be similar for all alternatives. Differences among alternatives exist in the amount of land that would be made available for application for leasing and the location of potential lease areas. As a consequence, there are differences among alternatives relative to the amount of aquatic habitat that is immediately within or adjacent to the footprint of the allocation areas and in the amount of such habitat within a 2-mi zone surrounding the allocation areas. These differences are described in this section.

Of the four oil shale allocation alternatives, the least amount of land would be available for application for leasing under Alternative 3 (32,640 acres), an intermediate amount under

Alternative 2 (425,790 acres), even more under Alternative 4 (1,963,414, and the most under the No Action Alternative, Alternative 1 (2,017,741 acres). However, Alternatives 1 and 4 would open some areas for consideration for leasing for which lease stipulations have been established in existing RMPs, while these areas would be excluded from consideration for oil shale development leasing under Alternative 2. Because of these differences, aquatic habitat within prospective lease areas or within a 2-mi zone surrounding those areas differs among the alternatives and the relative impacts of the various alternatives are different for the various oil shale basins.

As shown in Table 6.1.1-4, Alternative 3 would affect the smallest amount of aquatic habitat, while Alternative 1 would affect the greatest amount of aquatic habitat. There would be no oil shale leasing on BLM-administered lands in Wyoming under Alternative 3, and therefore no impacts on aquatic habitats within the Green River and Washakie Basins. Alternative 3 would also not directly impact aquatic habitat in the Piceance or Uinta Basins, although several perennial streams are present within 2 mi of the area available for leasing. In the Piceance Basin, Alternative 1 and Alternative 4 would affect about 183 mi of perennial stream habitat (within a 2-mi zone surrounding the allocation area), compared with about 110 mi of perennial stream habitat for Alternative 2 and 23 mi under Alternative 3. In the Uinta Basin, Alternative 1 and Alternative 4 would affect about 261 mi of perennial stream habitat (within a 2-mi zone surrounding the allocation area), followed by about 196 mi of perennial stream habitat for Alternative 2 and 5 mi for Alternative 3. In the Green River Basin, Alternative 1 would affect about 190 mi of perennial stream habitat (within a 2-mi zone surrounding the allocation area), compared with about 179 mi of perennial stream habitat under Alternative 4 and about 63 mi of perennial stream habitat under Alternative 2. In the Washakie Basin, Alternative 1 and Alternative 4 would affect about 39 mi of perennial stream habitat (within a 2-mi zone surrounding the allocation area), compared with about 17 mi of perennial stream habitat under Alternative 2.

**6.1.5.7.2 Plant Communities and Habitats.** There would be no impacts on plant communities and habitats associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

The types of impacts associated with construction and operations would be similar for all alternatives. For similar projects located in areas common to the alternatives (i.e., in areas where land available for development overlaps), impacts on plant communities and habitats would be identical among Alternatives 1, 2, 3, and 4. Impacts on plant communities and habitats would occur at each of the RD&D project locations as a result of construction and operation activities under each of the alternatives. Differences among alternatives exist in the amount of land that would be made available for application for leasing and the location of potential lease areas. These differences are described in this section.

Alternative 1 identifies 2,017,741 acres as available for application for commercial leasing. Included in this acreage are more than 167,000 acres of land that have been identified in land use plans for the protection of wetlands, riparian habitats, and floodplains, special status and sensitive plant species, and remnant vegetation associations (Table 6.1.5-4). About 1.6 million acres of land identified under Alternative 1 (including all of the 167,000 acres identified for protection of wetlands, riparian habitats, floodplains, special status and sensitive plant species, and remnant vegetation associations) would be excluded from availability for leasing under Alternative 2. Commercial oil shale development would be restricted to only 35,308 acres in Colorado, 252,181 acres in Utah, and 174,476 acres in Wyoming (461,965 total acres) under Alternative 2. Alternative 3 identifies 32,640 acres as available for application for commercial leasing in the Piceance and Uinta Basins. Included in this acreage is 39 acres of land that has been identified in land use plans for the protection of sensitive plant species and remnant vegetation associations. Alternative 4 identifies 1,963,414 acres as available for application for leasing, including 146,677 acres identified for protection of wetlands, riparian habitats, floodplains, special status and sensitive plant species, and remnant vegetation associations.

Because of the difference in the amount of land area identified under the different alternatives as available for application for leasing, plant communities and habitats could be affected by commercial development at more locations under Alternative 1 than under Alternatives 2, 3, or 4. Oil shale endemic plant species occur on oil shale outcrops within the available lease areas identified under each of the alternatives. Because Alternative 1 includes more land area in the vicinity of oil shale outcrops than the other alternatives, there is a greater potential for impacts on oil shale endemic species under Alternative 1. Alternative 3 includes the

**TABLE 6.1.5-4 Acreage of Lands in Which Plant Communities and Habitats Could Be Impacted by Future Commercial Oil Shale Development**

| | Land Area (acres) | | | |
|---|---|---|---|---|
| Location | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Land Area Available for Leasing*** | | | | |
| Colorado | 346,609 | 35,308 | 26,880 | 340,147 |
| Utah | 670,558 | 252,181 | 5,760 | 655,821 |
| Wyoming | 1,000,574 | 174,476 | 0 | 967,446 |
| Total | 2,017,741 | 461,965 | 32,640 | 1,963,414 |
| ***Land Area Identified for Protection of Wetlands, Riparian Habitats, Floodplains, Special Status and Sensitive Plant Species, and Remnant Vegetation Associations*** | | | | |
| Colorado | 54,983 | 0 | 39 | 48,258 |
| Utah | 33,918 | 0 | 0 | 20,292 |
| Wyoming | 78,899 | 0 | 0 | 78,127 |
| Total | 167,800 | 0 | 39 | 146,677 |

least land area in the vicinity of oil shale outcrops in the Uinta Basin, while Alternative 2 includes the least land area in the vicinity of oil shale outcrops in the Piceance Basin. There is therefore less potential for impacts on oil shale endemic species under Alternative 3 in the Uinta Basin and under Alternative 2 in the Piceance Basin.

Many ACECs located within or near the most geologically prospective oil shale areas include rare plant species and/or rare or important plant communities. Under Alternative 1, eight such ACECs are partially or entirely included within the footprint of lands available for application for leasing (Table 6.1.5-5). Direct and/or indirect impacts could occur within these ACECs, although stipulations addressing sensitive resources apply to many of these areas. Thirteen additional ACECs are located adjacent to or near (within 5 mi) the Alternative 1

**TABLE 6.1.5-5 ACECs with Sensitive Plant Species and/or Sensitive Plant Communities in or near Lands Available for Lease Application under the Oil Shale Alternatives**

| | Distance from Footprint (mi) | | | |
|---|---|---|---|---|
| ACEC | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Piceance Basin*** | | | | |
| Upper Greasewood Creek | 1.0 | 3.7 | >5 | 1.0 |
| Lower Greasewood Creek | 3.1 | 4.9 | >5 | 3.1 |
| East Douglas Creek | 2.5 | 4.4 | >5 | 2.7 |
| Magpie Gulch | 3.4 | 3.9 | >5 | 3.3 |
| Deer Gulch | 0.5 | 1.8 | >5 | 0.4 |
| Duck Creek | Within | Adjacent | 0.8 | Adjacent |
| White River Riparian | 2.7 | 3.6 | >5 | 2.7 |
| Yanks Gulch | 3.6 | >5 | >5 | 3.6 |
| South Cathedral Bluffs | 3.1 | 4.5 | >5 | 3.1 |
| Dudley Bluffs | Within | 0.7 | 1.3 | Adjacent |
| Ryan Gulch | Within | 1.3 | 1.0 | Adjacent |
| Trapper Creek/Northwater Creek | Adjacent | 1.3 | >5 | Adjacent |
| East Fork Parachute Creek | Within | 4.9 | >5 | Adjacent |
| ***Washakie Basin*** | | | | |
| Special Status Plant Species | 0.9 | 4.2 | >5 | 0.9 |
| Hells Canyon | 2.9 | 3.8 | >5 | 2.9 |
| ***Green River Basin*** | | | | |
| Special Status Plant Species | Within | 0.4 | >5 | Adjacent |
| Greater Red Creek | Within | 3.9 | >5 | Adjacent |
| ***Uinta Basin*** | | | | |
| Raven Ridge | 2.2 | 4.3 | >5 | 2.2 |
| White River Riparian | 0.6 | 0.6 | >5 | 0.06 |
| Oil Spring Mountain | 4.4 | 4.4 | >5 | 4.4 |
| Pariette Wetlands | Within | Adjacent | >5 | Adjacent |
| Lower Green River | Within | Adjacent | >5 | Adjacent |
| Nine Mile Canyon | Adjacent | 2.7 | >5 | Adjacent |

footprint and could be impacted indirectly; impacts would generally decrease with increasing distance. Twenty ACECs are located adjacent to or near the Alternative 2 footprint, three ACECs are located adjacent to or near the Alternative 3 footprint, and 21 ACECs are located adjacent to or near the Alternative 4 footprint. Sensitive plant species or communities within these ACECs could be impacted indirectly.

**6.1.5.7.3 Wildlife.** There would be no impacts on wildlife species associated with identifying lands as available for application for commercial oil shale leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The types of impacts on wildlife species associated with construction and operation would be similar for all alternatives. Differences among alternatives exist in the amount of land that would be made available for application for commercial leasing and the location of areas protected from leasing. These differences are described in this section.

Impacts on wildlife and their habitats (see Section 4.1.8.3) would be identical under all four alternatives for similar projects located in areas common to the alternatives (i.e., in areas where land available for development overlap). Because of the difference in the areas identified under the alternatives as available for application for leasing, wildlife and their habitats could be affected by subsequent commercial development at more locations under Alternative 1 than under the other three alternatives. Alternative 1 identifies 2,017,741 acres as available for application for leasing, Alternative 2 identifies 461,965 acres as available for application for leasing; Alternative 3 identifies 32,640 acres as available for application for leasing; and Alternative 4 identifies 1,963,414 acres as available for application for leasing. Wildlife and their habitats in these areas could be impacted by the construction and operation of commercial oil shale projects.

Table 6.1.5-6 shows the comparison among the four alternatives in the amount of wildlife habitat identified for protection by stipulations identified in BLM RMPs.

Table 6.1.5-7 shows the acreage of state-identified mule deer and elk habitat present in the oil shale lease areas identified under the four alternatives. The number of acres of wild horse and burro HMAs present in the oil shale lease areas for each alternative are as follows: 657,256 for Alternative 1, 112,851 for Alternative 2, 328 for Alternative 3, and 644,775 for Alternative 4.

**6.1.5.7.4 Threatened, Endangered, and Sensitive Species.** No impacts on threatened and endangered species are associated with amending land use plans to identify lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 4.8.1.4. These impacts would be considered in project-specific NEPA analyses and ESA consultations that would be conducted at the lease and development phases of projects. The types of potential impacts on threatened and endangered species associated with construction and operations would be similar for all alternatives. Differences among alternatives exist in the amount of lands that would be made available

**TABLE 6.1.5-6 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 1, 2, 3, and 4 Oil Shale Lease Areas**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Alternative 1[a] | Alternative 2 | Alternative 3 | Alternative 4[a] |
| ***Birds*** | | | | |
| Raptor nests | 106,092 | 0 | 0 | 103,719 |
| Raptor nesting and fledging habitat | 59 | 0 | 0 | 59 |
| Raptor concentration areas | 10,043 | 0 | 0 | 10,036 |
| ***Big Game*** | | | | |
| Big game severe winter range | 89,310 | 0 | 78 | 83,134 |
| Big game winter range | 24 | 0 | 0 | 24 |
| Big game | 30 | 0 | 0 | 30 |
| Elk crucial winter range | 136,991 | 0 | 0 | 126,828 |
| Elk calving | 13,493 | 0 | 0 | 12,092 |
| Elk and mule deer summer range | 163,100 | 0 | 483 | 162,099 |
| Mule deer crucial winter range | 110,671 | 0 | 0 | 110,513 |
| Mule deer winter range | 83,237 | 0 | 0 | 60,871 |
| Mule deer fawning area | 29,334 | 0 | 0 | 20,984 |
| Mule deer migration corridor | 5,021 | 0 | 0 | 5,021 |
| Moose winter range | 11 | 0 | 0 | 11 |
| Pronghorn crucial winter range | 10,600 | 0 | 0 | 10,486 |
| Pronghorn winter range | 241,673 | 0 | 0 | 237,866 |
| ***Other*** | | | | |
| Wildlife seclusion above the rim | 81 | 0 | 0 | 70 |
| Wildlife seclusion areas | 11 | 0 | 0 | 11 |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

**TABLE 6.1.5-7 State-Identified Elk and Mule Deer Habitat Present in the Oil Shale Lease Areas Identified under Alternatives 1, 2, 3, and 4**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Mule Deer*** | | | | |
| Winter habitat | 861,159 | 172,339 | 1,456 | 821,540 |
| Summer habitat | 172,773 | 11,470 | 483 | 171,852 |
| ***Elk*** | | | | |
| Winter habitat | 850,442 | 159,205 | 1,456 | 813,842 |
| Summer habitat | 172,542 | 11,465 | 483 | 171,633 |

for application and the location of potential lease areas. These differences are described in this section.

Of the four alternatives under consideration, the least amount of land available for application for commercial leasing would be under Alternative 3 (32,640 acres); intermediate amounts, under Alternatives 2 and 4 (461,965 and 1,963,414 acres, respectively); and the most, under Alternative 1 (2,017,741 acres). The difference in acreage results in a potential difference in the number of threatened and endangered species that could occur in the study area.

There are 179, 164, 52, and 166 federal candidate, BLM-designated sensitive, and state-listed species that potentially occur in areas that are available for application for oil shale under Alternatives 1, 2, 3, and 4, respectively. There are 20, 14, 9, and 20 federally listed species that potentially occur in areas that are available for tar sands leasing under Alternatives 1, 2, 3, and 4, respectively (Table 6.1.5.8).

Alternatives differ in the amount of critical habitat for Colorado River endangered fishes that are contained within areas available for application for commercial leasing. There are approximately 99 mi of critical habitat for Colorado River endangered fishes associated with Alternatives 1 and 4; there are no critical habitats associated with Alternatives 2 and 3 (Table 6.1.5-8). The amount of core and priority habitats for the greater sage-grouse also differs by alternative. The greatest amount of core and priority habitat for the greater sage-grouse is associated with Alternative 1 (607,087 acres); intermediate amounts of core and priority habitats are associated with Alternatives 3 and 4 (2,338 and 499,688 acres, respectively). No core and priority habitats for the greater sage-grouse are associated with the lands available under Alternative 2 (Table 6.1.5-8). The area that is available for application under Alternative 1

**TABLE 6.1.5-8 Threatened and Endangered Species and Selected Habitats Present in Potential Lease Sale Areas That Could Be Affected by Future Commercial Oil Shale Development**

| Resource That Could Be Affected by Development in the Study Area | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Number of federal candidates, BLM-designated sensitive species, and other special status species | 166 | 151 | 39 | 153 |
| Number of federally listed species | 20 | 14 | 9 | 20 |
| Miles of critical habitat of federally endangered Colorado River fishes | 99 | 0 | 0 | 99 |
| Acres of core and priority habitat areas for the greater sage-grouse | 607,087 | 0 | 2,338 | 499,688 |
| Acres of land identified in land use plans as potential habitat for federally listed and candidate species, BLM-designated sensitive species, and other special status species | 382,000 | 0 | 0 | 0 |

includes about 382,000 acres of land for which lease stipulations have been established in existing RMPs to protect federally listed and candidate species, BLM-designated sensitive species, and other special status species. These lands have been excluded from consideration for leasing under Alternative 2. For Alternatives 1, 3, and 4, however, existing BLM policies regarding protection of sage grouse habitat would be implemented.

#### 6.1.5.8 Visual Resources

Under all the alternatives, the amendment of land use plans to identify areas available for application for leasing for commercial oil shale development would not affect visual resources within or in the vicinity of the lease areas identified. However, a number of potential sensitive visual resources occur within, and in the vicinity of, the potential lease areas identified by the alternatives. These sensitive visual resource areas could be affected if construction and operation of commercial oil shale projects occur in the future in the areas identified as available for commercial leasing.

The visual resources that could be affected by the future construction and operation of commercial oil shale projects would be identical under the alternatives for similar projects located in potential lease areas common to the alternatives (i.e., where the lease areas would overlap). Under Alternative 1, BLM would designate 2,017,741 acres of public land available for application for commercial oil shale leasing. Under Alternative 4, the BLM would designate 1,963,414 acres available for application for leasing, or 62,451 fewer acres than the 2,017,741 acres available under Alternative 1. While Alternative 4 has fewer acres of land than Alternative 1, there is relatively little difference between the alternatives in the numbers and types of sensitive visual resource areas that could be affected by future commercial development.

Under Alternative 2, the BLM would designate 461,965 acres of public land available for application for commercial oil shale leasing, 1,555,776 fewer acres than under Alternative 1, and 1,501,449 fewer acres than under Alternative 4. Thus the numbers of sensitive visual resource areas that could be affected by future commercial development in or near these lands would be expected to be much smaller under Alternative 2 than under Alternatives 1 or 4. Under Alternative 3, the BLM would designate only about 32,640 acres of public land available for application for commercial oil shale leasing. Thus the number of sensitive visual resource areas that could be affected by future commercial development in or near these lands would be expected to be a small fraction of those under Alternative 1, 2, or 4.

#### 6.1.5.9 Cultural Resources

Table 6.1.5-9 identifies the amount of available acreage, the amount of acreage surveyed for cultural resources, and the current number of known cultural resource sites under each of the alternatives. Under Alternative 1, a total of 361,626 acres of the 2,017,741 acres available for application for commercial leasing have been surveyed for cultural resources. This acreage includes existing ACECs not closed to mineral development that contain important cultural

**TABLE 6.1.5-9 Available Acreage under Each Alternative with the Potential to Contain Cultural Resources**

| Parameter | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Acres available for application for leasing and development | 2,017,741 | 461,965 | 32,640 | 1,963,414 |
| Acres surveyed | 361,626 | 81,799 | 950 | 352,489 |
| Percentages of area surveyed | 18% | 18% | 3% | 18% |
| Approximate number of recorded sites | 7,200 | 1,820 | 17 | 7,000 |
| Acres of high or medium sensitivity to contain cultural resources | 1,652,869 | 406,658 | 1,406 | 1,619,376 |
| Percentages of area with high or medium sensitivity | 84% | 88% | 4% | 85% |

resources. Adverse effects on cultural resources, as described in Sections 4.10 and 6.1.2.9, could occur in these areas as a result of future commercial development.

Alternative 2 excludes areas with sensitive resources and special designations from consideration, resulting in 461,965 acres being available for application for leasing and development. Approximately 81,799 acres of the area identified under Alternative 2 has been surveyed for cultural resources. These surveys found approximately 1,820 sites.

Approximately 26,880 acres in Colorado and 5,760 acres in Utah could be impacted by the current and pending RD&D projects. Cultural resource surveys have examined only portions of the area in Colorado open to RD&D, while virtually no surveys have occurred in Utah. Only two of the six 160-acre tracts in Colorado contain archaeological sites (Section 6.1.3.9). Measures to avoid, minimize, or mitigate impacts on cultural resources are required under current authorities for the development of these projects. While these impacts are primarily discussed in the context of Alternative 3, the Research Lands Focus Alternative, these impacts from the RD&D activities, as well as the mitigation measures, would also occur under the other alternatives.

Under Alternative 4, the amount of acreage available for application for commercial leasing is reduced from that of Alternative 1 (2,017,741 acres) to 1,963,414 acres. The amount of land surveyed for cultural resources under Alternative 4 is comparable to that under Alternative 1. The relative amount of survey for the both areas is the same: 18%.

The four alternatives differ with regard to the greater or lesser degree to which cultural resources are likely to be considered during future leasing and development. Alternatives 2, 3, and 4 include exclusion areas that are not identified in Alternative 1 and are preferable to

Alternative 1 since more areas with known high-value cultural resources are protected from future consideration for development. Alternatives 2, 3, and 4 differ among themselves with regard to acreages and the likelihood that more or fewer cultural resources will be considered in compliance with existing laws, regulations, and policies for measures to avoid, minimize, or mitigate impacts from leasing or development.

#### 6.1.5.10 Indian Tribal Concerns

The potential impacts of the four oil shale land allocation alternatives vary more in scale than in kind. Under each alternative, some land is made available for application for leasing, and some lands are excluded from leasing and given some protection. In general, the more land that is available for leasing and the less excluded, the greater the likelihood that impacts on resources important to Native Americans would be considered during leasing and development. Table 6.1.5-9 shows how much land with a high or medium sensitivity for cultural resources would be available for application for leasing in each alternative. However, even on lands available for application, NEPA analyses and Section 106 cultural resource surveys would be required on a project-specific basis. These processes, combined with consultation with affected tribes, should result in efforts to avoid, minimize, and mitigate adverse effects. Alternative 1 makes the largest amount of land available for application for leasing (2,017,741 acres); Alternative 4 makes somewhat less land available (1,963,414 acres); Alternative 2 makes less than a quarter as much acreage available (461,965 acres); and Alternative 3 is the most restrictive, making only 32,640 acres available. Conversely, for the most part, the alternatives making the least amount of land available for application included the most area in land use categories in the most geologically prospective oil shale area with surface use restrictions that provide some protection for traditional resources. Alternative 2 affords the most protection, excluding all areas excluded under Alternative 1, as well as all areas containing wilderness characteristics, plus additional ACECs, all areas that the BLM identified has having wilderness characteristics, priority or core sage-grouse areas, and all of Adobe Town. Alternative 4 proactively protects more than Alternative 1, but less than Alternative 2. Under all alternatives except Alternative 3, split estate lands in the Hill Creek Extension of the Uintah and Ouray Reservation would be available for application. In the RD&D areas, Alternative 3 makes the most land available for application, while Alternative 2 makes the least RD&D lands available if current leaseholders relinquish their leases. Archaeological sites associated with Native Americans and features such as rock art would be identified in cultural resources surveys. All but Alternative 2 would allow surface mining, the potentially most destructive technology for resources of Native American concern.

In summary, based on the amount of land made available for application for leasing and the extractive technologies allowed, Alternative 3 has the least potential to result in adverse effects on resources important to tribes, followed by Alternative 2, Alternative 4, and Alternative 1.

#### 6.1.5.11 Socioeconomics

Under Alternatives 1 through 4, the proposed land use plan amendments could result in impacts on the socioeconomic environment, specifically in increases or decreases in property values (see Section 4.12.1.6).

The socioeconomic impacts of the RD&D projects and impacts on transportation systems and traffic levels at each of the RD&D locations are the same for each of the four alternatives as described in Section 6.1.1.11. Under Alternative 1, a total of 2,017,741 acres of land in Colorado, Utah, and Wyoming are allocated for commercial oil shale development, as compared to 461,965 acres under Alternative 2; 32,640 acres under Alternative 3 (all in Colorado and Utah) and 1,963,414 acres under Alternative 4. With the possible exception of impacts on property values (see Section 4.12.1.6), there are no socioeconomic or transportation impacts associated with this land use designation. Socioeconomic and transportation impacts could result, however, from post-lease construction and operation as described in Sections 4.12 and 5.12. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

The types of impacts on transportation systems and traffic levels would be identical under Alternatives 1, 2, 3, and 4 for similar projects located in areas common to the alternatives (i.e., in areas where land available for leasing is the same). Because of the difference in the areas identified as available for application for leasing under Alternatives 1 and 4, transportation systems and traffic levels could be affected by commercial development at more locations under Alternatives 1, 2, and 4 than under Alternative 3. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of the impacts of commercial oil shale development on transportation systems under Alternatives 1, 2, 3, or 4.

#### 6.1.5.12 Environmental Justice

Under Alternatives 1, 2, 3, and 4, no environmental justice impacts are associated with the previous designation of lands as available for application for oil shale development. Impacts could result, however, from post-lease construction and operation as described in Section 4.13. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

More lands would be made available for application for leasing under Alternatives 1, 2, and 4 than under Alternative 3. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of the potential environmental justice impacts of commercial oil shale development under Alternatives 1, 2, 3, or 4. Thus, it is not possible to differentiate among these alternatives regarding environmental justice impacts.

#### 6.1.5.13 Hazardous Materials and Waste Management

The amendment of land use plans to identify areas available for application for leasing for commercial oil shale development would not result in hazardous material and waste issues within or in the vicinity of the lease areas identified under Alternatives 2, 3 or 4. However, the construction and operation of commercial oil shale projects in the lease areas would use and generate hazardous materials and wastes under each of alternatives.

Because the use of hazardous materials and the generation of wastes are related to the specific design of a commercial oil shale project rather than project location, it is not possible to differentiate among the alternatives as to the hazardous materials and waste that could be used or generated during commercial oil shale construction and operation. For similar commercial oil shale projects (similar in design and operation), the hazardous materials and wastes associated with projects developed under Alternatives 1, 2, 3, and 4 would be similar. Because of the larger amount of land that would be made available for application for leasing under Alternatives 1 and 4, the use and/or generation of hazardous materials and wastes could occur at more locations under Alternatives 1 and 4 than under Alternatives 2 or 3. In any case, the impacts of hazardous material and waste handling (storage, use, and disposal) would be expected to be similar under each alternative (Section 4.14.1) regardless of project location.

#### 6.1.5.14 Health and Safety

The amendment of land use plans to identify areas available for application for leasing for commercial oil shale development would not result in health and safety issues within or in the vicinity of the areas available for application for leasing identified under Alternatives 2, 3, or 4. The future construction and operation of commercial oil shale projects would have identical health and safety concerns among all four alternatives for projects with identical plans of development located in areas available for application for leasing common to the alternatives (i.e., where the areas would overlap). Potential impacts could occur from accidents causing injuries and fatalities, possible hearing loss from high noise levels, and inhalation of particulates and/or volatile compounds emitted from the facilities. Construction and operation of individual facilities under any of the alternatives statistically would be expected to result in less than 1 fatality per year and approximately 125 injuries per year. Health impacts on the general public could occur from exposure to emissions from oil shale facilities, but in the absence of site-specific and process-specific data, no differences in health and safety impacts among Alternatives 1, 2, 3, or 4 can be identified.

Differences in health and safety concerns among the alternatives would be largely associated with differences in individual project designs and, to a lesser degree, differences in the locations of individual projects. For example, projects requiring longer transportation routes and longer utility and pipeline ROWs would have a greater potential for transportation accidents as well as ROW construction-related accidents. It is not possible to quantify differences in health and safety impacts from project construction and operation under Alternatives 1, 2, 3, or 4 in this PEIS. Under any of the alternatives, health and safety issues would be evaluated at the project level (i.e., as part of project-specific NEPA analyses), and a comprehensive facility health and safety plan and worker safety training would be required as part of the plan of development for every proposed commercial oil shale project.

### 6.1.6 Cumulative Impacts

In its regulations implementing the procedural provisions of NEPA (40 CFR Part 1508.7), the CEQ (1997) defines cumulative effects as follows:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

In this PEIS, the proposed action is to amend land use plans to allow certain lands to be considered for commercial leasing. That is, the decision made at the plan level does nothing more than remove (or leave in place) the administrative barrier (plan conformance) to the BLM considering any applications for leasing. The plan amendments would identify areas (as described above) as available or not available for application for commercial oil shale leasing. The phrase "available for application for leasing" is used above, and throughout the PEIS, rather than simply "available for leasing" to highlight that, unlike the BLM's practice with respect to oil and gas leasing, additional NEPA analysis would be required prior to the issuance of any lease of oil shale or tar sands resources. Amendment of the RMPs does not authorize any ground-disturbing activities and is not an irreversible or irretrievable commitment of resources under NEPA (see 40 CFR 1502.16). Moreover, amendment of RMPs does not constitute the granting of any property right. In this respect, the limited scope and scale of the proposed action of amending the land use plans—and any potential environmental impacts of these amendments—necessarily results in the need for only a limited cumulative effects analysis in this PEIS. Analysis of the cumulative effects in this PEIS will be qualitative to reflect the limited and highly speculative character of the information available, and the limited nature of the decision to be made on the basis of this PEIS.[10] At the leasing decision and at the decision to approve a plan of development, more specific cumulative effects analyses would be appropriate, and such analysis would be able to be completed, because specific technical and environmental information for those analyses should be available.

As stated above and in Sections 6.1.2 and 6.1.3, with the possible exception of a change in local property values, there would be no environmental or socioeconomic impacts under Alternatives 2, 3, and 4 from the amendment of land use plans to identify lands as available or not available for application for commercial oil shale leasing. Therefore, there would be no cumulative impacts from these alternatives. However, direct, indirect, and cumulative impacts could occur as a result of future commercial oil shale development that could be facilitated by such land use plan amendments. The focus of this cumulative impacts assessment, then, is the impacts from this future development, rather than the impacts from the land use plan amendment decision. That is, the purpose of this cumulative impacts assessment is to discuss, in a qualitative way, how the environmental and socioeconomic conditions within the study area might be

[10] Oil shale and tar sands development could not occur until a leasing decision has been made and implemented (leases issued). After leases are issued, additional permits and environmental analysis would be required before operations could begin.

incrementally affected over the next 20 years (the study period) by oil shale development that could occur on lands made available for application for commercial development in the land use plan amendments under Alternative 2, 3, or 4.

This section describes, in a preliminary way, the possible cumulative impacts of potential commercial oil shale development that could occur over the next 20 years. More specific information regarding impacts, including cumulative impacts, would be provided by the analysis conducted at any future leasing stage and at the review of any project-specific plan of development. The impacts presented here are in the context of other major activities in the study areas on both BLM-administered and nonfederal lands that could also affect environmental resources and the socioeconomic setting. The study areas considered usually include the lands managed by a BLM field office that contain oil shale resources and the ROI counties associated with them, as defined in Table 3.11.2-1. Larger areas are considered for certain resources (e.g., land, air, and water). This section considers five major categories of activities that could have cumulative impacts: oil and gas development, coal mining and preparation, other minerals development, energy infrastructure development, and other activities (e.g., tar sands development, grazing, fire management, forestry, and recreation). Section 6.1.6.3 presents the possible cumulative impacts of potential commercial oil shale development that could occur under Alternatives 2, 3, and 4, and addresses the same resources analyzed in Sections 4.2 through 4.15.

The current status of resources (including past and present actions) is described in Chapter 3. This section focuses on the cumulative impacts of the possible oil shale development that could occur under either Alternative 2, 3, or 4, when added to a set of reasonably foreseeable future actions that are projected to occur or that could occur over the next 20 years (as described in Section 6.1.6.2). These projections were drawn from a variety of sources, as indicated in the text, but include developments on both BLM-administered and nonfederal lands. The accuracy of such projections is greatest during the first few years of the 20-year period and decreases over the time frame assessed. In particular, future levels of commercial oil shale development are unknown. For the purposes of analysis, this cumulative impacts assessment examines the incremental impacts of a single oil shale facility (as described in Section 4.1), recognizing that more than one of these facilities may be brought into operation during the study period. While the cumulative impacts described in this section represent an initial estimate of impacts for activities projected to occur in the 20-year time frame, the assessment requires reevaluation if the planned level of development changes drastically in the future.

However, because under all alternatives there is a lack of information on the magnitude of future actions on public land, the number of projects that might be undertaken, and the likely locations for future development, the magnitude of the differences among the cumulative effects of the alternatives cannot be evaluated (i.e., the same level of future development might occur under each alternative).

### 6.1.6.1 Overview of Assumptions and Impact-Producing Factors for Major Activities in the Study Area

**6.1.6.1.1 Oil and Gas Development.** Associated with oil and gas development on both federal and nonfederal lands are impact-producing factors such as water use, the production of wastes and water, contaminant emissions to air and water, the use and alteration of land, and potential oil spills. The environmental impacts of oil and gas drilling are highly variable and dependent on the depth of drilling, drilling methods used, depressurization and dewatering of aquifers, and alteration of flow patterns and on factors such as construction techniques, degree of hydraulic fracturing, the hydrologic framework, and the depth of exploration. Table 6.1.6-1 summarizes the estimated impacts of oil and gas drilling on a per-well basis for select resource areas.

Rough estimates of overall resource requirements for oil and gas drilling are available from several sources. The BLM is continuing to improve the way it manages oil and gas operations, in particular, establishing BMPs to minimize environmental effect. Many of these specific mitigation measures reduce surface impacts and are applied as conditions of approval prior to operations on a lease. For wells on federal lands, the amount of surface disturbance for each well has been decreasing from about 3 acres to 1.5 acres per well or less. It is expected that standard industry practices in accordance with existing regulations are used for installation of oil and gas wells on private lands.

**TABLE 6.1.6-1 Assumptions Associated with Oil and Gas Drilling**

| Impact-Producing Factor | Values Used in Impact Analysis (per well drilled) | Reference |
|---|---|---|
| Surface disturbance (acres) | 2.5–15 | Thompson 2006a; DOE 2006; BLM 1994, 2002a, 2005a, 2006i |
| Water use (ac-ft/yr) | 0.55 | BLM 2006i |
| Drilling waste (bbl) | 4,100 | DOE 2006 |
| Regulated emissions ($CO$, $SO_2$, $NO_x$) (tons) | 0.37 | DOE 2006 |
| $CO_2$ emissions (tons) | 97 | DOE 2006 |
| Other nonregulated emissions ($CH_4$, non-$CH_4$ hydrocarbons) (tons) | 0.17 | DOE 2006 |
| Amount of oil spilled (gal) | 24 | DOE 2006 |
| Employment (direct FTEs) | 3 | BLM 2006i |

For the purpose of analysis, it is assumed that the amount of land disturbed for oil and gas well installation on either federal or nonfederal lands varies from 2.5 to 15 acres per well. The higher end of the range is certainly an overestimate in locations where multiwell pads would be used (e.g., the Roan Plateau RMP amendments call for 17 wells per pad atop the plateau) (BLM 2006i). In addition, only about 60% of the initially disturbed area would have long-term surface disturbance, with the other 40% generally being revegetated within 2 years (BLM 2006i).

**6.1.6.1.2 Coal Mining and Preparation.** Impact-producing factors for coal mining and preparation (e.g., removal of sulfur) on either federal or nonfederal lands include water use, contaminant emissions to air and water, use and alteration of land, and occupational hazards. These factors are discussed in the DOE Environmental Information Handbook *Energy Technologies and the Environment* (1988) and summarized for select resource areas in Table 6.1.6-2. As is the case with oil and gas operations, the BLM is improving its management of coal operations by establishing BMPs to minimize environmental effects. Many specific mitigation measures reduce surface impacts and are applied as conditions of approval prior to operations on a lease.

**6.1.6.1.3 Other Minerals Development.** Although several metals and minerals are mined in the three states (e.g., clay, copper, gilsonite, gold, iron, lead, lime, molybdenum, potash [potassium-based compounds], sand, gravel, silver, sodium minerals [e.g., nahcolite, trona], uranium, vanadium, and zinc), most are not mined in the counties that might experience oil shale development. The predominant materials currently mined in these areas are sand and gravel.

Sand and gravel deposits are found in river and stream terraces, floodplains, and channels, both current and ancient. These deposits are a type of salable minerals. Extraction of instream sand and gravel deposits could result in adverse environmental impacts, such as changes in streamflow and increased turbidity, which would affect fisheries and recreational use. Extraction of sand and gravel from floodplains or low terraces could create new channels and alter sediment deposition, again adversely affecting the ecology of the nearby river or stream. Other general impacts from sand and gravel mining on either federal or nonfederal lands could include land disturbance, changes in groundwater quality, noise, dust, and visual changes. The proper management of sand and gravel mining and the application of mitigation could decrease impacts such that there would be minimal adverse impacts. For example, siting mining locations high up in the landscape (on floodplains and terraces rather than in stream channels) would decrease adverse impacts on stream hydrologic processes (Langer 2002).

Other materials mined in the potential oil shale development area include clay, gilsonite, gold, lime, sandstone, sodium minerals, uranium, and vanadium. These metals and minerals may be obtained through underground mining, surface (open pit) mining, or solution mining. Gold is obtained through both surface and underground mining. Mining of these substances can cause a variety of adverse environmental impacts, including the production of high volumes of solid and potentially hazardous waste, the contamination of surface water and groundwater, uncontrolled releases of produced water, land subsidence, physical instability of mine units, and air quality degradation, especially from particulate emissions. Uranium has an added potential for

**TABLE 6.1.6-2 Assumptions Associated with Coal Mining and Preparation[a]**

| Impact-Producing Factor | Impact: Per Million Tons of Surface-Mined Coal | Impact: Per Million Tons of Underground Mined Coal |
|---|---|---|
| Surface disturbance (acres) | | |
| Area for facilities | 4.3 | 4 |
| Strip mining | 20 | NA[b] |
| Waste storage | 2.6 | 1 |
| Water use (million gal) | | |
| Coal preparation | 20 | 20 |
| Dust control | 35 | 35 |
| Air emissions (tons)[c] | | |
| CO | 15 | 6.3 |
| $SO_2$ | 4.9 | 0.59 |
| $NO_x$ | 76 | [d] |
| Particulates | 4 | 0.48 |
| Fugitive dusts[e] | 1,870 | [d] |
| Hydrocarbons | 4.8 | 0.48 |
| Aldehyde | 1.2 | [d] |
| Diesel fuel use ($10^3$ gal) | 3,021 | 38 |
| Electricity use ($10^6$ MWh) | 6 | 39 |
| Employment (direct FTEs) | 180 | 460 |
| Occupational hazards (deaths per 100,000 workers, disabling injuries per 100 workers) | 0.07, 8 | 0.37, 45 |

[a] Coal is prepared to increase its quality and heating value by removing sulfur and ash-forming constituents.

[b] NA = information not available.

[c] Surface mining values are for the western United States; underground values are for the eastern United States.

[d] Unquantified or negligible.

[e] Based on estimates for an Illinois surface mine with the following controls: paved access roads, watered and unpaved haul roads, and enclosed coal dumps with baghouse. Without these controls, estimated fugitive dust emissions would be 3,030 tons.

Source: DOE (1988).

radiologically contaminating environmental media, leading to the subsequent possibility of exposures of biota and humans.

Metal mining historically has also caused contamination of surface water. The sources of contamination have included waste rock disposal, tailings, leaching sites (locations where valuable metals are collected by running solutions through the ore), and mine water. Depending on the local geology, the waste rock may contain other naturally occurring minerals toxic to biota, including arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and nickel. In addition, cyanide (a highly toxic substance composed of carbon and nitrogen) is used extensively in the mining industry to aid in metal extraction. Serious adverse impacts on surface water from metal mining have occurred when runoff from waste sources has entered nearby water bodies; these impacts have included degradation of aquatic habitat and contamination of drinking water supplies. Additional adverse impacts would occur as a result of erosion and increased sedimentation of surface water.

An environmental impact from metal mining is the large volume of waste generated. The product-to-waste ratio can be very high; for example, in gold mining, almost all of the material removed from the earth (99.99%) is waste rock and tailings. Another area of concern is air quality degradation. Many metal-mining operations generate large volumes of fugitive dust from ore crushing and loading, blasting, and, over time, dried-up tailings ponds.

Many of the adverse impacts from mining discussed above occurred primarily in the past, and mitigation measures have been adopted to minimize their occurrence in present practice. Because of the wide variety of possible contaminants and impacts from mining of metals and other minerals, generic impacts (e.g., on a “per-ton mined” basis) are not discussed in this section. Cumulative impacts are discussed in Section 6.1.6.3 on the basis of the specific types of minerals being developed in each region.

#### 6.1.6.1.4 Energy Infrastructure Development

***Energy Corridors.*** An extensive infrastructure of oil and gas pipelines and electricity transmission ROWs exists in the western states. Most of the existing ROWs cross public lands (National Energy Policy Development Group 2001). As of 2010, Colorado had 6,738, Utah had 6,040, and Wyoming had 18,852 ROWs crossing public lands (BLM 2010a). These ROWs serve as either long-distance paths or subregional and local distribution lines. It is projected that the growing demand for additional energy and electricity will result in an increased number of ROWs across public lands in the future (National Energy Policy Development Group 2001). Other federal agencies authorized to grant ROWs for electric, oil, and gas transmission include the USFS, the NPS (electric only), the USFWS, the BOR, and the Bureau of Indian Affairs (BIA).

The BLM, along with DOE, issued a PEIS (DOE and DOI 2008) to support designation of public lands for potential use for long-distance energy transmission corridors in the West. This was an effort to expedite permitting of transmission systems, such as oil and gas pipelines and power lines. The ROD for that PEIS (BLM 2009) designates federal energy corridors on public lands in areas that would be beneficial for energy development, but excludes sensitive lands (such as National Parks and National Monuments, ACECs, and roadless areas) to the extent practicable. Consideration is given to the locations of oil shale deposits, and possible corridor locations have been designated relatively near to these areas for future use if the oil shale is developed. The designation of public lands for potential use in energy transmission ROWs under the West-Wide Energy Corridor PEIS would not have direct impacts, with the possible exception of affecting current land use within the corridors and property values on private lands adjacent to or between corridor segments.

The eventual construction and operation of energy transmission ROWs, whether within federally designated energy corridors, within energy corridors on federal lands currently identified in land use plans, or at locations on nonfederal lands identified by industry and evaluated and authorized by appropriate agencies (e.g. BLM, USFS, tribes), could result in adverse environmental impacts on federal and nonfederal lands. The specific types, magnitudes, and extents of project-specific impacts would be determined by the project type (transmission line, pipeline) and its length and location on federal and nonfederal lands; thus, the impacts could be evaluated only at the project level. However, general potential impacts typical of project construction and operation include the use of geologic and water resources; soil disturbance and erosion; degradation of water resources; localized generation of fugitive dust and air emissions from construction and operational equipment; noise generation; disturbance or loss of paleontological and cultural resources and traditional cultural properties; degradation or loss of fish and wildlife habitat; disturbance of resident and migratory fish and wildlife species, including protected species; degradation or loss of plant communities; increased opportunity for invasive vegetation establishment; alteration of visual resources; land use changes; accidental release of hazardous substances; and increased human health and safety hazards. Construction and operation of energy transmission ROWs could also affect minority and low-income populations in the vicinity of the projects on both federal and nonfederal land as well as local and regional economies.

***Electric Power Plants.*** Electric power plants are generally sited on private lands. Impacts from electric power–generating plants include emissions of air pollutants, water use, production of large volumes of solid waste (e.g., coal combustion products [ash] and flue-gas cleanup waste), use and alteration of land, emissions and accidents associated with the transportation of raw materials and wastes, and socioeconomic impacts. Air emissions differ depending on the quality of feed coal utilized. Table 6.1.6-3 summarizes the estimated impacts on various resource areas from the construction and operation of electric power plants. In the near term, low-sulfur Wyoming coal would most likely be utilized for power plants in the study area. Additional electric power might be required over the study period to support new development.

***Renewable Energy.*** The BLM and USFS have proposed a program to facilitate geothermal leasing on lands administered by the BLM and the USFS that have geothermal potential in 12 western states, including Alaska. Under the proposal, the BLM and USFS would identify public and NFS lands with geothermal potential as being legally open or closed to

**TABLE 6.1.6-3 Assumptions Associated with Coal-Fired Power Plants[a]**

| Impact-Producing Factor | Assumed Values: A 1,500-MW Plant (BLM 2007d) | Assumed Values: A 360-MW Current Design Plant and a 425-MW NSPS Plant (Spath et al. 1999)[b] |
|---|---|---|
| Land use (acres) | 3,000 total (includes construction acreage) | NA[c] |
| Water use | 8,000 ac-ft/yr | NA |
| Fuel source and composition | Wyoming-grade low-sulfur coal (0.47% sulfur, 6.4% ash); heat of combustion = 8,220 Btu/lb (representative data from Powder River Basin coal; Ellis et al. 1999) | Illinois No. 6 bituminous (4% sulfur, 0.1% chlorine, 1.1% nitrogen, 10% ash dry basis); heat of combustion = 10,800 Btu/lb |
| Fuel requirements | 3.75 million tons/yr (2,330 tons/yr/MW)[d] | Current plant, 1.6 million tons/yr (4,320 tons/yr/MW); NSPS plant, 1.7 tons/yr (3,950 tons/yr/MW) |
| Coal combustion products (ash)[e] | NA | Current plant, ~36,000 kg/GWh; NSPS plant, ~33,000 kg/GWh |
| Solid waste (flue-gas cleanup) | NA | Current plant, ~86,000 kg/GWh; NSPS plant, ~92,000 kg/GWh |
| Emissions | | |
| $SO_2$ | Meet NSPS standards: 258 g/GJ heat input (0.6 lb/million Btu) | Current plant, 6,400 kg/GWh; NSPS plant, 2,229 kg/GWh |
| $NO_x$ | Meet NSPS standards: 258 g/GJ heat input (0.6 lb/million Btu) | Current plant, 3,039 kg/GWh; NSPS plant, 2,041 kg/GWh |
| CO | NA | Current plant, 134 kg/GWh; NSPS plant, 123 kg/GWh |
| $CO_2$ | NA | Current plant, ~970,000 kg/GWh; NSPS plant, ~890,000 kg/GWh |
| Particulates | Meet NSPS standards: 13 g/GJ heat input (0.03 lb/MMBtu) | Current plant, 135 kg/GWh; NSPS plant, 123 kg/GWh |
| VOCs | NA | Current plant, 16 kg/GWh; NSPS plant, 14 kg/GWh |
| Employment (direct FTEs)[f] | Construction: 800 average over 4 yr (1,200 peak); operations: 135 | NA |
| Transportation | 12 trains/week; 100 cars/train; 10,000 tons/train[d] | 13−14 trains/week; 17 cars/train; 1,445 tons/train |

**Footnotes on next page.**

**TABLE 6.1.6-3 (Cont.)**

[a] Power plants are assumed to operate at 60% efficiency; thus, a 1,500-MW plant generates approximately 7,900 GWh/yr; a 325-MW plant generates 1,900 GWh/yr; and a 425-MW plant generates 2,200 GWh/yr.

[b] NSPS = new source performance standard.

[c] NA = information not available.

[d] Sources for fuel requirement and transportation assumptions: Thompson (2006b,c).

[e] Coal combustion products may not require disposal in landfills; the EPA sponsors a beneficial reuse program (EPA 2008).

[f] Source for FTE employment values is Thompson (2006b).

Sources: BLM (2007d); Ellis et al. (1999); Spath et al. (1999); Thompson (2006b,c).

leasing; issue or deny geothermal lease applications pending as of January 1, 2005; identify public lands that are administratively closed or open, and under what conditions; develop a comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands; and amend BLM land use plans to adopt the resource allocations, stipulations, BMPs, and procedures. The program is described and analyzed in the Final PEIS for Geothermal Leasing in the Western United States published in October 2008 (BLM 2008g). A ROD for the program was issued in December 2008 (BLM 2008g).

On March 11, 2009, the Secretary of the Interior issued Secretarial Order 3285, which announced a policy goal of identifying and prioritizing specific locations best suited for utility scale production of solar energy on public lands (Secretary of the Interior 2010). The Secretarial Order directs the DOI to work with individual states, tribes, local governments, and other interested stakeholders to identify appropriate areas for generation and necessary transmission of solar energy, to develop BMPs for renewable energy and transmission projects on public lands to ensure the most environmentally responsible development and delivery, and to establish clear policy direction for authorizing the development of solar energy on public lands. The proposed Solar Energy Development Program has been designed to meet these requirements and to serve as an analytical tool to assist the BLM in considering replacement of its current solar energy development policy with a comprehensive Solar Energy Development Program that would allow the permitting of future solar energy projects to proceed in a more standardized and efficient manner. The program is described and analyzed in the Draft Solar PEIS published in December 2010 (BLM and DOE 2010) and the Supplement to the Draft Solar PEIS published in October 2011 (BLM and DOE 2011).

#### 6.1.6.1.5 Other Activities

***Other Oil Shale Development.*** The leases associated with the RD&D projects (described under Alternative 1) grant the lessees the right to develop oil shale on the designated PRLAs if they are able to meet certain requirements (see Section 1.4.1). At this time, it is not known whether the lessees will be able to meet these requirements; if they are met, the lessees will be allowed to develop these lease areas (Figure 2.3-2), totaling 30,720 acres, with the same basic technologies demonstrated during the RD&D process. Therefore, the five Colorado PRLAs could be developed using in situ technologies, and the Utah PRLA could be developed using underground mining. It is assumed that the impacts from these projects would fall within the range of impacts for similar oil shale facilities as summarized in Chapter 4. Because of the incomplete stage of the RD&D projects, such commercial development is not expected in the near term (e.g., within the next 5 years).

As described in Chapters 1 and 2, the BLM may issue new RD&D leases where the land use plans allow for oil shale leasing. As with future commercial oil shale leasing, it is not known where the industry would seek to locate the most promising RD&D projects. It is also not known what new technologies would be demonstrated; however, it is most probable that the types of technologies, as well as their possible effects, would be qualitatively similar to the three kinds of processes analyzed in the PEIS, although smaller in scale prior to any conversion to commercial leases and expansion to preference right acreage. Furthermore, it is not known how many RD&D leases, if any, would be issued pursuant to a call for expressions of interest, or in what sequence. The environmental impacts of such RD&D leases will be analyzed in lease-specific NEPA documents. The BLM published in the *Federal Register* a new call for nominations for RD&D leases in November 2009. Three proposals were selected for further consideration and are currently undergoing NEPA analysis. These proposals were limited to a 160-acre lease, with potential expansion under a preference right lease to a maximum area of 640 acres. The RD&D leases are described in more detail in Section 2.3

Nonfederal lands (e.g., state lands, private lands) overlie about 40% of the most geologically prospective oil shale area (see Section 3.1). These lands could also support oil shale development in the future. Because extensive R&D and environmental studies are required to attain permits, it is not anticipated that such development would occur in the next 10 years; it may, however, occur within the next 20 years.

***Tar Sands Development.*** This PEIS addresses the environmental and socioeconomic impacts of land use plan amendments and potential development for both oil shale and tar sands, and thus, potential tar sands development is considered in the cumulative impact assessment. Because the level of tar sands development over the next 20 years is unknown, this assessment has assumed that one tar sands facility would be constructed and operated in any one of the Utah STSAs during the study period. Impact-producing factors for such a tar sands facility include surface disturbance, water use, waste generation, and local changes in employment and population density. The assumptions used for these factors are given in Section 5.1.

***Grazing.*** Public and private lands in the study area are used extensively for livestock grazing. Environmental impacts of note associated with livestock grazing include potential degradation of soil, vegetation, wildlife habitat, and surface water quality (Krueger et al. 2002; BLM 2006k). For example, overgrazing could result in increased rates of erosion and topsoil losses. Allowing grazing during the nesting seasons of some species could result in trampling of the eggs and decreased viability of those species in the study area. Livestock could also degrade surface water quality if their manure and urine were deposited directly into the water or on land nearby. Good management practices can eliminate or mitigate many of these impacts. On BLM lands, grazing permits are required that specify the species allowed to graze, amount of grazing permitted, and other requirements to minimize environmental impacts. Today, the BLM manages livestock grazing in a manner aimed at achieving and maintaining public land health. To achieve desired conditions, the agency uses rangeland health standards and guidelines that the BLM developed in the 1990s with input from citizen-based Resource Advisory Councils across the West. Standards describe specific *conditions* needed for public land health, such as the presence of stream bank vegetation and adequate canopy and ground cover. Guidelines are the management *techniques* designed to achieve or maintain healthy public lands, as defined by the standards. These techniques include such methods as seed dissemination and periodic rest or deferment from grazing in specific allotments during critical growth periods.

***Fire Management.*** Fire management is used on public and private lands to aid in wildfire suppression. Underbrush is burned at regular intervals to avoid the buildup of large amounts of fuel on these lands. Fire is considered to have a natural role in the ecosystems and is used as a tool in managing those ecosystems. However, fires have potential environmental impacts that should be considered, particularly impacts on air quality and on threatened and endangered species (BLM 2002b). In general, impacts would be lower from more frequent, less intense, controlled fires than from infrequent wildfires.

***Forestry.*** In Colorado, Utah, and Wyoming, the BLM administers approximately 14.2 million acres of forested lands of various types. Forested land is defined as being 10% stocked with live trees and at least 1 acre in size and 120 ft wide. According to a 2006 report on the status and condition of these forests, the national priorities for them include “maintaining and restoring forest health, salvaging dead and dying timber, providing high-quality wildlife and fish habitat, and providing economic opportunities in rural communities by making timber and other forest products, including biomass, available from vegetation management treatments” (BLM 2006l). Management techniques for BLM-administered forest lands include grazing restrictions, selective thinning of undergrowth and dead wood, prescribed burns, and selective harvesting of trees. Adverse environmental impacts on air quality, water quality, habitat, and threatened and endangered species could occur as a result of these management practices. For example, increased erosion after land clearing could cause siltation in streams and decrease water quality.

***Recreation.*** One mission of the BLM is to accommodate recreational use of public lands, such as fishing, hiking, horseback riding, mountain biking, camping, and OHV use. However, these uses can have adverse environmental impacts. For example, OHV use can result in soil compaction, increased erosion, and the proliferation of non-native plant species. Overuse of trails in primitive areas can also result in erosion and disturbance of threatened and endangered species habitat. Other ways by which recreational visitors can affect the environment include producing waste, emitting air pollutants from motorized vehicles, and using water. However, recreational use also has benefits, including allowing visitors to enjoy outdoor wilderness areas and reduce their stress, and stimulating economic growth in the area. The BLM works to minimize the adverse environmental impacts of recreational use by managing the activity. Examples of plan requirements include habitat improvement projects in recreational areas, construction of recreational use facilities that lead to decreased random use and degradation of wild areas, and waste management (BLM 2006m).

### 6.1.6.2 Projected Levels of Major Activities in the Study Area

Data on past, current, and planned future activities on BLM-administered lands and also on nonfederal lands were obtained mainly from various BLM RMPs and EISs available through the field offices to obtain their best current estimates for projected activities in the areas of oil and gas development (both on public and private lands), coal development, other minerals development, energy development, and other activities (e.g., grazing, fire management, forestry, and recreation) over the 20-year time period between 2012 and 2032. Field office staff were also contacted. The projected levels of major activities are summarized in Table 6.1.6-4 for Colorado, Table 6.1.6-5 for Utah, and Table 6.1.6-6 for Wyoming.

#### 6.1.6.2.1 Colorado

***Oil Shale Development.*** As stated in Section 6.1.6.1.5, five PRLAs with a total area of 25,600 acres may be eligible for in situ oil shale developments in the future, based on the assumption that the RD&D leaseholders can meet BLM requirements. In 2009, the BLM issued a second round of solicitations and received two new RD&D lease proposals for the Piceance Basin in Colorado, which are currently being evaluated. In addition, an unknown level of oil shale development could occur on nonfederal lands in the future.

***Oil and Gas Development.*** In the Colorado study area, it is projected that a large amount of new oil and gas drilling and production would occur over the 20-year planning horizon. The largest amount is projected for the White River Field Office, for which a maximum of 1,060 wells drilled per year is predicted; the total projected new oil and gas wells for applicable field offices in the state is 1,700 per year (see Table 6.1.6-4), which includes wells on both federal and nonfederal lands (projections for nonfederal lands not available for all field offices).

***Coal Mining.*** The largest coal reserves are in the Little Snake and Grand Junction Field Offices, with smaller amounts in the Colorado River Valley and White River Field Offices (see Table 6.1.6-4). Predicted production for all field offices combined is about 25 million tons/yr. About half of this production would be from surface mines, and half would be from underground mines.

**TABLE 6.1.6-4 Projected Levels of Major Activities on BLM-Administered and Nonfederal Lands Considered in the Cumulative Impacts Assessment for Oil Shale Development in Colorado[a]**

| | Level of Activity | | | | | |
|---|---|---|---|---|---|---|
| Type of Activity | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
| ***Oil Shale*** | | | | | | |
| Oil shale development on PRLAs (federal lands) | None | None | Up to 5 in situ projects on 5,120 acres of PRLAs (total of 25,600 acres); up to2 additional RD&D projects (total of 320 to 1,280 acres) | None | None | See White River |
| Oil shale development on nonfederal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown | Potential unknown | Potential unknown; development unlikely to occur within next 10 years due to R&D and permitting requirements |
| ***Oil and Gas*** | | | | | | |
| Recoverable oil and gas reserves | NA | 15.4 TCF gas (9 TCF on federal lands); oil ~15 BB (BLM 2006i) | 86.7 MMCF gas, 11.5 MB oil over 20 yr (1997–2016) (BLM 1996) | 9.94 TCF federal lands gas; 24.4 MB federal oil (BLM undated) | NA | >25 TCF gas; >15 BB oil |
| Potential oil and gas wells drilled per year over next 20 yr (2012–2032)[c] | 60 wells/yr (BLM 2011a) (based on 5,318 total over 20 yr [2011–2031]; assume same annual rate) | 185 wells/yr (based on 3,691 total over 20 yr [2005–2024]; 1,570 on federal lands, 2,121 private) (BLM 2006i) | 1,060 wells/yr (Hollowed 2007) (based on 21,200 total over 20 yr) | 152 wells/yr (BLM 2010b) (based on 3,031 total over 20 yr) | 50 wells/yr (based on 1,000 over 20 yr (1986–2005); assume same annual rate) | ~1,700 wells/yr |

TABLE 6.1.6-4 (Cont.)

| Type of Activity | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
|---|---|---|---|---|---|---|
| | Level of Activity | | | | | |
| ***Oil and Gas (Cont.)*** | | | | | | |
| Annual surface disturbance over next 20 yr (2012–2032) (acres/yr)[d] | 665–4,000 | 460–2,800 | 2,650–16,000 | 380–2,300 | 125–750 | 3,800–23,000 |
| Wells to be abandoned annually over next 20 yr (2012–2032)[e] | 66 wells/yr | 46 wells/yr | 265 wells/yr | 38 wells/yr | 13 wells/yr | ~430 wells/yr |
| Geophysical (seismic) exploration projects[f] | NA | NA | NA | NA (Ernst 2006) | NA | NA (~3,200–6,400 acres/yr of temporary vegetation and habitat disturbance) |
| ***Coal*** | | | | | | |
| Recoverable reserves (million tons) | 1,600 (BLM 2011a)—Grand Hogback field | Not economically recoverable (BLM 2004a) | 740 (BLM 1994b) | 5,800 (BLM 2010b) | 4,900 | 13,000 |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | None (BLM 2011a) | None | 2–2.5 (Thompson 2006a) | 15 (BLM 2010b) | 0.3 initially, increasing to 4–6 (Thompson 2006a) | ~24 |

**TABLE 6.1.6-4 (Cont.)**

| Type of Activity | Level of Activity: Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
|---|---|---|---|---|---|---|
| ***Coal (Cont.)*** | | | | | | |
| Surface area potentially leasable (acres) | 18,000–29,000 (BLM 2011a) | None | 118,000 (surface and subsurface) (BLM 1997a) | 624,000 (includes surface and subsurface acres); (BLM 2010b) | 150,000 (Thompson 2006a) | At least 910,000 |
| Surface mining area potentially disturbed annually (acres/yr) | None (BLM 2011a) | None | None (Thompson 2006a) | 200 (based on current activity) (Thompson 2006a) | None (Thompson 2006a) | 200 |
| Surface area potentially disturbed for underground mine support facilities (total, 2012–2032) (acres) | None (BLM 2011a) | None | 500 | 500 (in addition to 1,000 currently disturbed) (Thompson 2006a) | 500 (in addition to 100 currently disturbed) (Thompson 2006a) | 1,500 |
| Other coal impacts | None known | None known | None known | None known | None known | None known |
| ***Other Minerals (Sodium, Locatable and Salable Minerals)*** | | | | | | |
| Sodium reserves (billion tons) | Not known to occur | Not known to occur | 32 (nahcolite); 19 (dawsonite) (BLM 1994b) | Not known to occur | Not known to occur | 51 |

**TABLE 6.1.6-4 (Cont.)**

| | Level of Activity | | | | | |
|---|---|---|---|---|---|---|
| Type of Activity | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
| ***Other Minerals (Sodium, Locatable and Salable Minerals) (Cont.)*** | | | | | | |
| Sodium production rate over next 20 yr (2012–2032) (tons/yr) | Not known to occur | Not known to occur | Unknown; current pilot scale at 6 tons/h nahcolite (BLM 1994b); leases have stipulation not to damage commingled/ overlying oil shale | Not known to occur | Not known to occur | Unknown |
| Surface disturbance from sodium production (acres/yr) | None | None | 20 (Thompson 2006a) | None | None | 20 |
| Locatable minerals (e.g., precious metals/gems, uranium, bentonite, gypsum, salt, limestone) | Numerous claims, no significant activity (BLM 2011a); potential for limestone production for rock dust and power plant scrubbers (Thompson 2006a) | Not known to occur | Uranium/vanadium, post-WWII mining, none current (BLM 1994b) | Uranium, several areas favorable for deposits: gold—low placer gold potential; juniper limestone—46,000 tons/yr (BLM 2010b) | Uranium, high potential for renewal of mining in Uravan Mineral Belt; currently a surge of activity in staking and exploration (Thompson 2006a) | Expected increase in uranium/vanadium exploration and development; ongoing limestone production |

**TABLE 6.1.6-4 (Cont.)**

| | Level of Activity | | | | | |
|---|---|---|---|---|---|---|
| Type of Activity | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
| ***Other Minerals (Sodium, Locatable and Salable Minerals) (Cont.)*** | | | | | | |
| Salable minerals (gravel, sand, clay) | Limited, localized production expected | Limited, localized production expected (BLM 2004a) | Demand is high in Rangely area (BLM 1994b) | Limited, localized production expected (BLM 2010b) | Limited, localized production expected | Limited, localized production expected |
| ***Energy Development*** | | | | | | |
| Energy corridors (acres) | NA | NA | NA | NA | NA | Estimated 430 mi (261,000 acres) in Colorado; substantial portion in these field offices (DOE 2008) |
| Electric generating utilities | NA | NA | NA | NA | NA | ~1,600 MW currently produced in region (90% from coal (EIA 2011a). |
| Wind power | No planned projects | No planned projects; area not rated high in wind potential (BLM 2004a) | No planned projects | No planned projects; Little Snake Field Office wind rankings poor to fair (EIA 2006b) | No planned projects | Colorado currently produces 1,238 MW of wind power; no current plans for further development in this part of the state (EIA 2011b) |

**TABLE 6.1.6-4 (Cont.)**



| Type of Activity | Level of Activity | | | | | |
|---|---|---|---|---|---|---|
| | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
| ***Other*** | | | | | | |
| Forestry | NA | NA | Annual allowable harvest from 45 to 890 acres/yr (BLM 1994b) | Long distances to utilization centers make traditional commercial harvesting of timber un-economical (BLM 2010b);200 acres/yr Ponderosa pine, 50 acres/yr lodgepole pine, and 500 acres/yr pinyon-juniper woodland to be restored (BLM 2007e) | NA | Assume >300,000 board ft/yr production; total acres disturbed unknown |
| Fire management | NA | NA | 5,400 acres/yr prescribed burn (based on total for 1995−2009 [BLM 1994b]) | NA | 1,800 acres/yr prescribed burn (based on total for 1985−1999) | NA (>7,200 acres/yr prescribed burn) |
| Geothermal (leasable) | NA (but 254 $mi^2$ with high potential) (BLM 2011a) | Area not rated high in geothermal potential (BLM 2004a) | NA | Low geothermal resource potential for commercial development; utilization local and limited (BLM 2010b). | NA | Geothermal development not expected |

**TABLE 6.1.6-4 (Cont.)**

| | Level of Activity | | | | | |
|---|---|---|---|---|---|---|
| Type of Activity | Colorado River Valley | Roan Plateau within Colorado River Valley but Assessed Separately | White River | Little Snake[b] | Grand Junction (BLM 1985)[a] | Summary for Colorado Field Offices |
| ***Other (Cont.)*** | | | | | | |
| Land and realty | NA | Lands on top of plateau would be retained (BLM 2006i) | NA | NA | NA | NA |
| Grazing and rangeland management | NA | Managed using combination of administrative, project, and best management practices (e.g., pasture and rest rotation, livestock exclusion, fences, and ponds) (BLM 2004a) | NA | NA | NA | NA |
| Special management areas, recreation | NA | Of 259 mi of routes, 163 mi to be designated for motorized use, 28 mi closed and reclaimed, 68 mi for administrative use. Hubbard Mesa open to OHV use (BLM 2006i) | NA | Developed recreation sites with established campgrounds, boat ramps, or other developed recreational facilities would be protected by a 40-acre NSO stipulation (BLM 2007e) | NA | NA |
| Vegetation | NA | NA | NA | NA | NA | NA |
| Noxious/invasive weeds | NA | NA | NA | NA | NA | NA |

**Footnotes on next page.**

TABLE 6.1.6-4 (Cont.)

Abbreviations: BB = billion barrels; MB = million barrels; MMCF = million cubic feet; NA = information not available; NSO = No Surface Occupancy; OHV = off-highway vehicle; TCF = trillion cubic feet.

[a] Activities listed are those considered in addition to potential oil shale and tar sands development on federal lands. For the Grand Junction Field Office, the main reference citation is given in the title field. Other references are given with specific data. In general, values are rounded to two significant figures.

[b] The Little Snake Field Office does not contain potential oil shale development areas; however, it is included in this summary because of its proximity to the potential project area and extensive related potential future development.

[c] Includes projections for federal lands and, where available, nonfederal lands.

[d] Assumes a range of 2.5 to 15 acres/well for well pads, roads, and pipelines (representative range based on 2.5 acres/well from DOE (2006), 13 acres/well from White River RMP (BLM 1994), net disturbance of 9.3 acres/well for Little Snake (Thompson 2006a), disturbance of 3.4 acres/well for Roan Plateau (BLM 2006i), 3 acres/well from Vernal Utah Planning Area (BLM 2002a), and 15 acres/yr from Moab Utah Planning Area (BLM 2005a).

[e] Assumes 25% of new wells would be abandoned annually (based on estimate for the Rawlins Wyoming Field Office) (Allison 2006). All surface disturbance is assumed to be reclaimed within 10 yr of abandonment.

[f] If information not available, assume approximately 1 to 2 geophysical exploration projects/50 wells drilled annually (based on Wyoming estimates); 100 acres disturbed/project (this is short-term disturbance such as crushed vegetation, uprooted brush, and minor soil disturbance; disturbance is generally unidentifiable within 1 yr). At 1,600 wells drilled/yr, expect 32 to 64 projects/yr for Colorado overall.

**TABLE 6.1.6-5 Projected Levels of Major Activities for Seven Planning Areas Considered in the Cumulative Impacts Assessment for Oil Shale Development in Utah[a]**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Oil Shale*** | | | | |
| Oil shale development on PRLAs (federal lands) | Potential for one underground mining project on 5,120 acres of PRLA; up to1 additional RD&D project (total of 160 to 640acres). | | None | None |
| Oil shale and tar sands development on nonfederal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown |
| ***Oil and Gas*** | | | | |
| Recoverable oil and gas reserves | NA | NA | NA | NA |
| Potential oil wells drilled per year over next 20 yr (2012–2032)[b] | 76 wells (based on 2,055 total in VPA, 1,130 in DM only over 15 yr [2003–2017] as projected by BLM [2005b]) | 62 wells (based on 2,055 total in VPA, 925 in BC only over 15 yr [2003–2017] as projected by BLM [2005b]) | 30 wells total in RPA; 3 in HM only (includes oil, gas, and CBNG; based on 454 total over 15 yr [2005–2020]; 3/yr in HM only, as projected by BLM [2005c]) | Few (based on only 8 currently producing wells), discussion that no significant oil production expected in the future (BLM 2004b; Appendix 21) |
| Potential gas wells drilled per year over next 20 yr (2012–2032)[b] | 147 wells (based on 4,035 total in VPA, 2,195 in DM only over 15 yr [2003–2017] as projected by BLM [2005b]) | 143 wells (based on 4,035 total in VPA, 2,150 BC only over 15 yr [2003–2017] as projected by BLM [2005b]) | Included with potential oil wells drilled for HM PA | 55–95 wells (includes CBNG; based on 1,100–2,000 over 20 yr [2005–2024] as projected by BLM [2004b; Table 4-2, BLM 2008b]) |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Oil and Gas (Cont.)*** | | | | |
| Potential CBNG wells drilled per year over next 20 yr (2012–2032)[b] | 4 wells (based on 130 total in VPA, 50 in DM over 15 yr [2003–2017] as projected by BLM [2005b]) | 6 wells (based on 130 total in VPA, 80 in BC over 15 yr [2003–2017] as projected by BLM [2005b]) | Included with potential oil wells drilled for HM PA. HM coal field not likely to be developed for CBNG in the next 15 yr (2005–2020) (BLM 2005d) | Included with potential gas wells drilled for San Rafael PA; numbers above include Price Project, 545 wells/10 yr on 1,609 acres, 20–70 jobs; Ferron Project, 335 wells/5 yr, acres unknown. Impacts on mule deer populations and winter habitat (BLM 2004b) |
| Annual surface disturbance over next 20 yr (2012–2032)[c] | 570–3,400 acres/yr total (190–1,100 oil; 370–2,200 gas; 10–60 CBNG) | 540–3,200 acres/yr total (160–930 oil; 360–2,100 gas; 15–90 CBNG) | 75–450 acres/yr RPA total; 9–45 HM (includes oil, gas, and CBNG) | 140–1,400 acres/yr (includes gas and CBNG) |
| Wells to be abandoned annually over next 20 yr (2012–2032)[d] | 57 wells total (19 oil; 37 gas; 1 CBNG) | 54 wells total (16 oil; 36 gas; 2 CBNG) | 8 wells in RPA total, 1 in HM (includes oil, gas, and CBNG) | 14–24 wells (includes gas and CBNG) |
| Seismic exploration projects[e] | 2–3 projects per yr (based on 45–75 total for Vernal, assume half in DM) over 15 yr (2003–2015) (BLM 2002a); 200–300 acres/yr disturbance | 2–3 projects per yr (based on 45–75 total for Vernal, assume half in BC) over 15 yr (2003–2015) (BLM 2002a); 200–300 acres/yr disturbance | 340 acres/yr disturbance (based on 5,100 total over 15 yr as projected by BLM [2005c]) | 150 acres/yr disturbance (based on 2,236 total over 15 yr as projected by BLM [2004b]) |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Coal*** | | | | |
| Recoverable reserves | Tabby Mountain Coal Field, ~320 million tons (BLM 2002a) | No known reserves (BLM 2002a) | Includes south part of Wasatch Plateau Coal Field: ~6,000 million tons; HM Coal Field, 20 million tons (Jackson 2006); Emery Coal Field, reserve information not available | Includes northern part of Wasatch Plateau Coal Formation, ~690 million tons; Book Cliffs Coal Field, ~280 million tons; Emery Coal Field, ~240 million tons (BLM 2004b; Section 3.3.5.2) |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | None (BLM 2002a) | None (BLM 2002a) | Wasatch Plateau Coal Field, 25; no production planned for HM (Jackson 2006). Emery Coal Field, no production information available | Lila Canyon, 0.8–1; North Horn, 2–4; Willow Creek, 2–4 (BLM 2004b; Chapter 4) |
| Surface area potentially leasable (acres) | NA | None | NA | NA |
| Surface mining area potentially disturbed annually (acres/yr) | None | None | None | None |
| Surface area potentially disturbed for underground mining support facilities (total acres, 2012–2032)[f] | None projected | None projected | 500 acres | Most coal would be mined through underground mining methods (BLM 2004b; Section 3.3.5.2); 500 acres |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Coal (Cont.)*** | | | | |
| Other coal impacts | None known | None known | None known | Lila Canyon, 5-mi road, 550 round-trips/day on U.S. 6, 150–200 jobs; North Horn, roads, power line, and infrastructure construction, EIS ongoing, start of operations unknown; Willow Creek, not currently leased, if operations begin, 250–300 jobs, surface disturbance, safety issues (BLM 2004b; Chapter 4) |
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals)*** | | | | |
| Phosphate production over next 20 yr (2012–2032) | 5,800 acres on BLM-administered land; 14,000 acres on private land (BLM 1993 and 2002a); assume 50% surface mining (i.e., 10,000 acres) | None (BLM 2002a) | None | None |
| Gilsonite production rate over next 20 yr (2012–2032) (tons/yr) | None (BLM 2002a) | 60,000 (based on BLM projections for 2003–2017) (BLM 2002a) | None | None |

TABLE 6.1.6-5 (Cont.)

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals) (Cont.)*** | | | | |
| Locatable minerals (e.g., precious metals/gems, uranium, bentonite, gypsum, limestone, salt) | Minor to no activity (BLM 2002a) | Minor to no activity (BLM 2002a) | Uranium, vanadium, gold, copper: high potential for occurrence and development in HM area; exploration for economic quantities is continuing (BLM 2005d). One salt mine on west side of RPA to continue operations. Gypsum and salt production unlikely in next 15 yr, especially in HM area (BLM 2005d) | Gypsum, fairly large areas in southern and central parts of PA have high potential for development over the next 15 yr (2005−2020) (BLM 2004b, Section 3.3.5.1). Number of acres: NA |
| Salable minerals (gravel, sand, clay) | Stone, 30 tons/yr (based on 60 tons/yr total for VPA, 2003−2017 (BLM 2002a). Limestone, 30,000 tons/yr (based on USFS land production, most in DM) (BLM 2002a). Sand and gravel, some production, quantity unknown (BLM 2002a) | Stone, 30 tons/yr (based on 60 tons/yr total for VPA), 2003−2017 (BLM 2002a). Sand and gravel, some production, quantity unknown (BLM 2002a) | For planning period of 2006−2020: 57 active sand and gravel disposal sites on BLM land; likely to continue producing ~20,000 $yd^3$/yr, additional sites on public land (BLM 2005d). Assume 2 permits at 6 acres/permit, 12 acres/yr. Clay, only small-scale development. Stone, continue at current rate of about 1−1,000 tons/yr (BLM 2005d). Humate production to continue on small scale at Factory Butte in HM (BLM 2005d) | Clay, current areas of active mining will continue over next 15 yr (2005−2020), unlikely that new deposits would be developed (BLM 2004b, Section 3.3.5.1). Sand and gravel, stone, humate, high potential areas near major paved roads would be developed 2005−2020 (BLM 2004b; Section 3.3.5.3) |

**TABLE 6.1.6-5 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Energy Development*** | | | | |
| Energy corridors | NA | NA | NA | NA |
| Electric generating utilities | NA | NA | NA | NA |
| Existing power plants | NA | NA | NA | Hiawatha Cogeneration Plant, Questar Pipeline Dewpoint Plant, Sunnyside Cogeneration Facility, coal-fired PacifiCorp Hunter, Huntington and Carbon plants all provide employment, emit $NO_X$, use water, decrease water quality. Planned PacifiCorp Hunter expansion will add 350 long-term jobs, increase $NO_x$ and $SO_x$ emissions, use and degrade water (BLM 2004b) |
| ***Other*** | | | | |
| Forestry | NA | NA | NA | Logging on private lands (not quantified) (BLM 2004b, Section 4.2.2) |

**TABLE 6.1.6-5 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Other (Cont.)*** | | | | |
| Fire management | 5,500–7,800 acres/yr prescribed burns annually based on 11,000 acres total in VPA as projected by BLM for 2002–2006 (BLM 2005b, Section 3.4) or 156,425 acres/ decade total in VPA (BLM 2005b; Table 2.3) | 5,500–7,800 acres/yr prescribed burns annually based on 11,000 acres total in VPA as projected by BLM for 2002–2006 (BLM 2005b, Section 3.4) or 156,425 acres/ decade total in VPA (BLM 2005b; Table 2.3) | NA | One prescribed burn of 5,000 acres every 2 yr (based on last 20 yr of data) (BLM 2004b, Section 3.2.10.4) |
| Land and realty | NA | NA | NA | Utah Department of Transportation road improvements between 2006 and 2025 on U.S. 6 between Green River and Spanish Fork (~3-mi widening, 12 mi of new asphalt). Also SR-10 corridor (5 mi) (BLM 2004b; Section 4.2.2) |
| Livestock | NA | NA | NA | NA |
| Special management areas, recreation | 4–27 mi/yr nonmotorized recreational trails, and 54 mi/yr motorized trails would be developed total in VPA (between 2006 and 2020) (BLM 2005b, Table 2.3); assume half in DM | 4–27 mi/yr nonmotorized recreational trails, and 54 mi/yr motorized trails would be developed total in VPA (between 2006 and 2020) (BLM 2005b, Table 2.3); assume half in BC | NA | NA |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Other (Cont.)*** | | | | |
| Vegetation | 2,300–3,400 acres/yr vegetation treated total in VPA (between 2006 and 2020) (BLM 2005b, Table 4.18.2); assume half in DM | 2,300–3,400 acres/yr vegetation treated total in VPA (between 2006 and 2020) (BLM 2005b, Table 4.18.2); assume half in BC | NA | NA |
| Soils/watersheds | NA | NA | NA | NA |
| Miscellaneous | NA | NA | NA | NA |

| | San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
|---|---|---|---|---|
| ***Oil Shale*** | | | | |
| Oil shale development on PRLAs (federal lands) | None | None | None | See Vernal |
| Oil shale and tar sands development on federal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown |
| ***Oil and Gas*** | | | | |
| Recoverable oil and gas reserves | NA | >270 million bbl (Allison 1997) | NA | NA |

**TABLE 6.1.6-5 (Cont.)**

| Type of Activity | Level of Activity: San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
|---|---|---|---|---|
| ***Oil and Gas (Cont.)*** | | | | |
| Potential oil wells drilled per year over next 20 yr (2012–2032)[b] | 5–21 wells (includes gas, average of 13/yr, 195 total 2005–2020 (BLM 2005e) | Few (only 47 exploratory wells currently in GSENM; ~200,000 acres of old leased land is under review) (BLM 1999) | 12–40 wells (includes gas, average of 26/yr, 390 total 2005–2020 (BLM 2005a) | 190–230 oil wells drilled per year |
| Potential gas wells drilled per year over next 20 yr (2012–2032)[b] | Included with potential oil wells drilled for San Juan PA | None (BLM 1999) | Included with potential oil wells drilled for MOAB PA | 350–390 gas wells drilled per year |
| Potential CBNG wells drilled per year over next 20 yr (2012–2032)[b] | None (BLM 2005f) | None (BLM 1999) | 1 well (based on three 5-spot well clusters 2006–2020 [BLM 2005g]; assume same annual rate) | 11 CBNG wells drilled per year |
| Annual surface disturbance over next 20 yr (2012–2032)[c] | 13–320 acres/yr (includes oil and gas) | NA | 33–620 total (30–600 [oil and gas]; 3–15 CBNG (similar to 225 total acres CBNG between 2006 and 2020) (BLM 2005g) | 1,400–9,400 |
| Wells to be abandoned annually over next 20 yr (2012–2032)[d] | 2–8 wells (includes oil and gas) (BLM 2005e) | NA | 6–20 wells (BLM 2005a) | 140–170 wells abandoned per year |
| Seismic exploration projects[e] | 150-acres/yr disturbance (based on 2,236 total over 15 yr as projected by BLM [2005e]) | NA | 240-acres/yr disturbance (based on 3,600 total over 15 yr [2005–2020] as projected by BLM [2005a]) | NA (~1,300–1,500 acres/yr of temporary vegetation and habitat disturbance) |

**TABLE 6.1.6-5 (Cont.)**

| Type of Activity | Level of Activity: San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
|---|---|---|---|---|
| ***Coal*** | | | | |
| Recoverable reserves (million tons) | San Juan Coal Field (530,000 acres; 60% privately owned) (BLM 1991a), 77 million tons available to surface mining; no current production because of poor quality/lack of rail transport (BLM 2005f) | NA | NA (Sego Formation produced ~3 million tons up through the 1950s) (BLM 2005g) | ~7.6 billion tons |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 30–34 million tons/yr (approximately 87% from underground mining; 17% from surface mining) |
| Surface area potentially leasable (acres) | NA | NA | NA (Sego Formation may be attractive for future production because of low sulfur content, close to railway) | NA |
| Surface mining area potentially disturbed annually (acres/yr) | NA | NA | NA | NA |
| Surface area potentially disturbed for underground mining support facilities (total acres, 2012–2032)[f] | None projected | None projected | None projected | 1,000 acres total 2007–2027 |
| Other coal impacts | None known | None known | None known | See San Rafael PA |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
| ***Other minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals)*** | | | | |
| Phosphate production over next 20 yr (2012–2032) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 10,000 acres surface disturbance (see DM) |
| Gilsonite production rate over next 20 yr (2012–2032) (tons/yr) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 60,000 tons/yr gilsonite (see BC) |
| Locatable minerals (e.g., precious metals/gems, uranium, bentonite, gypsum, limestone, salt) | Uranium/vanadium, 4.2 million-ton reserves in Four Corners area, estimated disturbance of 20 acres/yr for next 15 yr (2005–2020) (BLM 2005f); gold, 5–20 acres total disturbed for next 15 yr in Recapture Creek and Johnson Creek (BLM 2005f); limestone, 20–30 thousand tons/yr, 20–50 acres total disturbed for next 15 yr (BLM 2005f) | Uranium/vanadium, deposits present (Allison 1997), not to be developed (BLM 1999); alabaster, ongoing production of 300 tons/yr, from surface, not usually quarried | Uranium/vanadium, >1-million ton ore reserves; estimated disturbance of 10 acres/yr for next 15 yr (2005–2020) (BLM 2005g); copper, Lisbon Valley Project, produce for 10 yr (2006–2015); disturb 110 acres/yr (1,103 total, includes 266-acre pad for leaching, processing plant, ponds, 11-mi power line); salt/potash, 3.3 acres/yr (50-acres disturbance total over next 15 yr [2005–2020] BLM 2005g) | Uranium/vanadium, high potential for development with at least 30 acres/yr surface disturbance; gold, at least 5 acres/yr disturbed. Limestone, at least 20 acres/yr disturbed. Gypsum, high potential for development, acres NA; alabaster, 300 tons/yr, acres NA; salt, at least 3 acres/yr disturbed; copper, at least 110 acres/yr disturbed; total, at least 170 acres/yr disturbed |

**TABLE 6.1.6-5 (Cont.)**

| Type of Activity | Level of Activity: San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
|---|---|---|---|---|
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals) (Cont.)*** | | | | |
| Salable minerals (gravel, sand, clay) | Sand and gravel, 4 permits/yr producing ~127,000 $yd^3$/yr, 6 acres/permit, thus 24 acres/yr disturbed over next 15 yr (2005–2020) (BLM 2005f). Building stone, 5–10 acres/yr over next 15 yr (2005–2020) (BLM 2005f) | Sand and gravel, limited production for local use (Allison 1997) | Sand and gravel, 4 permits/yr producing ~60,000 $yd^3$/yr, 6 acres/permit; thus 24 acres/yr disturbed over next 15 yr (2005–2020) (BLM 2005g); building stone, ~0.5 acres/yr over next 15 yr (1 new facility, producing 5,000–10,000 tons/yr for 5 yr between 2006 and 2020) (BLM 2005g) | Sand and gravel, at least 60 acres/yr disturbed; stone, at least 6 acres/yr disturbed; clay, no new deposits to be developed |
| ***Energy Development*** | | | | |
| Energy corridors | NA | NA | NA | Estimated 690 mi (370,000 acres) in Utah; a portion of the corridor is expected to be sited near the oil shale resource (DOE 2008) |
| Electric generating utilities | NA | NA | NA | 3,300 MW currently produced in region (98% from coal) (EIA 2011a) |
| Existing power plants | NA | None | NA | See San Rafael PA |
| ***Other*** | | | | |
| Forestry | NA | NA | NA | See San Rafael PA |
| Fire management | NA | NA | NA | NA (at least 13,500 acres/yr prescribed burn) |

**TABLE 6.1.6-5 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | San Juan (Area Similar to Monticello PA | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
| ***Other (Cont.)*** | | | | |
| Land and realty | NA | NA | NA | See San Rafael PA (roadwork planned) |
| Livestock | About 1.8 million acres used for grazing (BLM 2008i) | NA | NA | NA (About 1.8 million acres used for grazing in Monticello PA) |
| Special management areas, recreation | NA | ~6 acres/yr disturbed (total of 85 acres over 15 yr [2000–2014] for recreation and campsites (BLM 1999) | NA | NA (motorized and nonmotorized trails and campsites to be developed) |
| Vegetation | NA | 1,000–3,000 acres/yr for vegetation restoration through burning (20,000 acres total for 2000–2014) | NA | At least 3,300 acres/yr vegetation treatment or burning for restoration |
| Soils/watersheds | NA | <1 acre/yr (10 sites at 1 acre/site) (BLM 1999) | NA | NA (at least 1 acre/yr disturbance) |
| Miscellaneous | NA | ~17 acres/yr for utility and road ROWs and communications sites (260 acres total over 15 yr [2000–2014] [BLM 1999]) | NA | NA (at least 17 acres/yr disturbance) |

**Footnotes on next page.**

**TABLE 6.1.6-5 (Cont.)**

Abbreviations: BC = Book Cliffs; BCF = billion cubic feet; CBNG = coal bed natural gas; DM = Diamond Mountain; GSENM = Grand Staircase–Escalante National Monument; HM = Henry Mountain; NA = information not available; PA = planning area; RPA = Richfield Planning Area; STSA = Special Tar Sand Area; USFS = Forest Service; VPA = Vernal Planning Area.

[a] Activities are those considered in addition to potential oil shale and tar sands development on federal lands. In general, values are rounded to two significant figures.

[b] Includes projections for federal lands and, where available, nonfederal lands.

[c] Assumes a range of 2.5 to 15 acres/well for well pads, roads, and pipelines (representative range based on 2.5 acres from DOE (2006), 3 acres from Vernal Mineral Potential Report (BLM 2002a), and 15 acres from Moab PA (BLM 2005a). The 2.5 to 15-acre range encompasses estimates for San Rafael of 7.9 acres/well + 20-acres/ancillary facility (BLM 2004b; Appendix 21); Henry Mountain (4 acres/well + 8 acres/well for roads) (BLM 2005c); and Monticello (9.6 acres/well) (BLM 2005e).

[d] Generally assumes that 25% of new wells would be abandoned (based on estimate for the Rawlins Wyoming Field Office [Allison 2006]). Assumes 50% for Moab (BLM 2005a) and 40% for Monticello (BLM 2005e). All surface disturbance is assumed to be reclaimed within 10 yr of abandonment.

[e] If information not available, assume approximately 1 to 2 geophysical exploration projects/50 wells drilled annually (based on Wyoming estimates); 100 acres disturbed/project (this is short-term disturbance such as crushed vegetation, uprooted brush, and minor soil disturbance; disturbance is generally unidentifiable within 1 yr). At 550 to 630 wells drilled/yr, expect 11 to 26 projects/yr for Utah overall.

[f] For areas where coal mining is ongoing and subsurface, a limited amount of surface disturbance over the 20-year study period was assumed (i.e., 500 acres).

**TABLE 6.1.6-6 Projected Levels of Major Activities Considered in the Cumulative Impacts Assessment for Oil Shale Development in Wyoming[a]**





| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
| ***Oil Shale*** | | | | |
| Oil shale development on nonfederal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown |
| ***Oil and Gas*** | | | | |
| Recoverable oil and gas reserves | 20–60 BCF gas; 63–260 MB oil (Easley 2006) | NA | 31–47 TCF gas; 55 MB oil; 748 MB natural gas liquids (Allison 2006) | >31–47 TCF gas; ~120–320 MB oil; ~750 MB natural gas liquids |
| Potential oil and gas wells drilled per year over next 20 yr (2012–2032)[b] | 100 wells/yr (BLM 2008j) (includes natural gas; based on 2,040 total over 20 yr). | 140 wells/yr (based on 4,207 wells over 20 yr for Hiawatha project, 66% in Wyoming [BLM 2006n]; also 61 wells total for Bitter Creek [BLM 2005h]) | 482 wells/yr (Continental Divide/Creston, 8,850 wells; Desolation Flats, 592 wells; Atlantic Rim, 200 wells; over 20 yr) (Allison 2006) | ~720 wells/yr |
| New CBNG wells drilled per year over next 20 yr (2012–2032)[b] | 32 wells/yr (based on 640 total over 20 yr [2001–2020] projected by BLM [2008j]) | Included with oil and gas above | 157 wells/yr (Continental Divide/Creston, 100 wells; Atlantic Rim, 1,800 wells; Seminole Rd, 1,240 wells; over 20 yr) (Allison 2006) | ~190 wells/yr |
| Annual surface disturbance over next 20 yr (2012–2032) acres/yr[c] | 462–858 (based on 132 wells/yr) | 350–2,100 (based on 140 wells/yr) | 1,600–9,600 (based on 640 wells/yr) | 2,300–14,000 |
| Wells to be abandoned annually over next 20 yr (2012–2032)[d] | 20–33 wells/yr (15% [Easley 2006] to 25%) | 35 wells/yr | 160 wells/yr | 220–230 wells/yr |

**TABLE 6.1.6-6 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
| ***Oil and Gas (Cont.)*** | | | | |
| Geophysical (seismic) exploration projects[e] | 2–4 projects per year within the Kemmerer Field Office area (Easley 2006) | 3 projects per year: Hay River, South Jonah (subsurface data on 400 $mi^2$), LaBarge 3D (BLM 2004c) | 4–5 projects per year within the Rawlins Field Office area (Allison 2006) | 9–12 projects per year; ~900–1,200 acres/yr of temporary vegetation and habitat disturbance[d] |
| Monell enhanced oil recovery project | NA | A total of 126 wells drilled 2006–012 (80 on non-BLM-administered lands); total initial disturbance 1,100 acres; net disturbance after 20–25 yr 260 acres (BLM 2006o) | NA | Land disturbance, 1,100 acres gross, 260 acres net |
| ***Coal*** | | | | |
| Recoverable reserves (million tons) | 66 (BLM 1986) | NA (35 for Black Butte Coal Co. Pit 14, surface mining site only [BLM 2006c]; 122 for Ten Mile Rim subsurface, includes private [BLM 2004f]) | 2,489 (surface mineable) (BLM 2004e) | >2,700 |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | 4–5 current; annual 0.8% increase (based on predictions for 2005–2015 [BLM 2004d]) | 6–9 (based on projection for Sweetwater County through 2010 [Lyman and Jones 2005]). Individual projects, 1.5–3 tons/yr (permitted for 7) for 20 yr from Black Butte (BLM 2006p); 4.5–5.5 tons/yr for 15–20 yr from Ten Mile Rim (BLM 2004f) | None (Allison 2006) | 10–14 |
| Surface area potentially leasable (acres) | NA | 453,000 (30,000 of this already leased) (BLM 1997b) | 56,000 (5,000 Carbon Basin only) (BLM 2004e) | NA (at least 510,000 acres) |

**TABLE 6.1.6-6 (Cont.)**

| Type of Activity | Level of Activity: Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
|---|---|---|---|---|
| ***Coal (Cont.)*** | | | | |
| Project area (acres) | 8,600 (Easley 2006) | 4,500 (2,200 at Black Butte [BLM 2006p], 2,242 total at Ten Mile Rim but only 124 disturbed [BLM 2004f]) | None (Allison 2006) | ~13,000 |
| Subsurface area potentially disturbed (acres) | 6,900 (BLM 1986) | 2,200 (BLM 2004f) | None (Allison 2006) | ~9,100 |
| Surface mining area potentially disturbed annually (acres/yr) | 430 (project area over 20-yr project duration) | 120 (project area over20-yr project duration) | 0 (Allison 2006) | 550 |
| ***Sodium/$CO_2$*** | | | | |
| Known sodium reserves (billion tons) | 114 | NA | NA | NA (at least 114 billion tons) |
| Sodium production rate over next 20 yr (2012–2032) (million tons/yr) | 12 (underground mines—rate in 2002, BLM projects no new leasing, permits, or off-lease drilling over life of plan [BLM 2004d]) | 6 (underground mines) (Nara-Kloepper 2006) | None | 18 (all from existing underground mines) |
| New sodium facilities | 2006, subsurface solution mine and processing plant (BLM 2004d) | NA | None | One subsurface solution mine and processing plant |
| Sodium production surface disturbance (acres/yr) | Minimal surface disturbance over next 20 years (Easley 2006) | Minimal surface disturbance over next 20 years (Nara-Kloepper 2006) | None | Minimal surface disturbance over next 20 years |

**TABLE 6.1.6-6 (Cont.)**

| Type of Activity | Level of Activity: Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
|---|---|---|---|---|
| ***Sodium/$CO_2$ (Cont.)*** | | | | |
| $CO_2$ production | Shute Creek Gas Plant, 435 M $ft^3$/day in 2001 (BLM 2004d) | None known | None known | ~160 BCF $CO_2$ production per year |
| ***Locatable Minerals (e.g., precious metals/gems, uranium, bentonite)*** | | | | |
| Uranium | None projected | Uranium production potential low (BLM 2004c) | Little, if any, production expected (Allison 2006); reserves, >58 million lb (BLM 2004e) | Limited, if any, uranium exploration and development expected |
| Magnetite | None projected | None projected | Little, if any, production expected (Allison 2006); reserves, ~30 million tons massive ore, 148 million tons disseminated ore (BLM 2004e) | Limited, if any, magnetite production expected |
| Gold | Limited deposits have been identified; very limited if any activity expected (BLM 2008j) | Potentially present; current activities disturb less than 5 acres/yr (BLM 2004c) | Little, if any, production expected (Allison 2006); reserves, >100 million tons of Fe-gold ore at 28–68% Fe (BLM 2004e) | Limited gold production expected, although reserves are present |
| Diamonds | No current production, although diamond potential is rated as high (BLM 2004d) | Potentially present, but not recovered to date (BLM 2004c) | None projected | Limited, if any, diamond production expected |
| Bentonite | Known to occur, not produced because of co-placement with coal (BLM 2004d) | None projected | None projected | Limited, if any, bentonite production expected |

**TABLE 6.1.6-6 (Cont.)**

| Type of Activity | Level of Activity: Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
|---|---|---|---|---|
| ***Locatable Minerals (e.g., precious metals/gems, uranium, bentonite) (Cont.)*** | | | | |
| Salable minerals (gravel, sand, clay) | Assume 475,000 tons/yr mined (based on 475,283 tons sold in 2002; demand expected to continue [BLM 2004d]); two clay-producing companies, one on private land | One 4-acre borrow area for sand and gravel in use; clay uneconomical for production (BLM 2004c) | Assume 2.5 million tons/yr mined (based on current contracts that allow 21 million tons over 10 yr (2005–2014) [BLM 2004e] and anticipated increase [Allison 2006]) | NA (>3 million tons/yr mined) |
| ***Energy Development*** | | | | |
| Energy corridors | NA | NA | NA | Estimated 440 mi (186,000 acres) in Wyoming; substantial portion in these field offices |
| Electric generating utilities | NA | NA | NA | ~3,600 MW currently produced in the region (85% from coal) (EIA 2011a) |
| Wind power | One 80-turbine facility operating in Uinta County; other proposals exist (BLM 2008j) | One 1–6 turbine facility proposed (BLM 2004c) | One 1,000-turbine facility, to disturb 6,020 acres, 45% to be revegetated, 100 additional acres/yr for miscellaneous (BLM 2004e) | Wyoming currently produces 1,104 MW of wind power (EIA 2011c); additional development expected |

TABLE 6.1.6-6 (Cont.)

| Type of Activity | Level of Activity | | | |
|---|---|---|---|---|
| | Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
| ***Energy Development (Cont.)*** | | | | |
| Pipelines | 300 acres/yr short-term disturbance (over <5 yr) from pipelines, all to be reclaimed (Easley 2006) | NA | Overland Pass Pipeline, 780 mi from Opal Wyoming to Kansas; through all three field offices; would disturb total of 4,619 acres, 2,903 acres farmland; 10 acres surface facilities; employ 325–650 workers, 80% nonlocal (BLM 2007f) | NA (at least 300 acres/yr disturbed for pipeline construction) |
| ***Other*** | | | | |
| Forestry | 125 acres/yr (100% reclaimed) | NA | 300 tons biomass removal/10 yr; 6,000 trees/yr thinned (BLM 2004e) | NA (>125 acres/yr) |
| Fire management | 2,000 acres/yr prescribed burn (99% reclaimed) (Easley 2006) | NA | 1,500–10,000 acres/yr prescribed burn (BLM 2004e) | NA (>3,500–12,000 acres/yr prescribed burn) |
| Land and realty | NA | Proposed Haul Road (includes 6 pipelines and 1 fiber optic cable; ROW = 400 ft construction; 200 ft operations) (BLM 2004c) | 78 acres/yr disturbed—ditch and communications construction (BLM 2004e) | NA (at least 78 acres/yr disturbed) |
| Livestock | NA | 2 projects to increase game fish populations (BLM 2004c) | 46 acres/yr (BLM 2004e) | NA (land disturbance: at least 50 acres/yr) |
| Special management areas, recreation | NA | Recreation activities assumed to require 290 wells over 20 years (BLM 2004c) | 480-acre OHV area with 5 mo/yr use (BLM 2004e) | NA (disturb at least 500 acres total) |

**TABLE 6.1.6-6 (Cont.)**

| Type of Activity | Level of Activity: Kemmerer | Green River/Rock Springs | Great Divide/Rawlins | Summary for Wyoming Field Offices |
|---|---|---|---|---|
| ***Other (Cont.)*** | | | | |
| Vegetation | Vegetation manipulation proposed for 82,610 acres (~4,100 acres/yr) to improve wildlife habitat (BLM 1986) | New riparian enclosures to mitigate sheep to cattle conversion impacts (BLM 2004c) | 16,400 acres/yr treated (BLM 2004e) | ~21,000 acres/yr vegetation treated |
| Noxious/invasive weeds | NA | NA | 800–8,000 acres/yr treated | NA (at least 800–8,000 acres/yr treated) |
| Soils/watersheds | NA | Eden/Farson Irrigation Project (supply for 17,000 acres) (BLM 2004c) | 25 stream mi restored, 50 groundwater and precipitation monitoring sites | NA (various projects) |

Abbreviations: AUM = animal unit month; BCF = billion cubic feet; Fe = iron; MB = million barrels; MW = megawatts; NA = information not available; OHV = off-highway vehicle; ROW = right-of-way; TCF = trillion cubic feet.

[a] Activities listed are those considered in addition to potential oil shale and tar sands development on federal lands. In general, values are rounded to two significant figures.

[b] Includes projections for federal lands and, where available, nonfederal lands.

[c] Assumes a range of 2.5 to 15 acres/well for well pads, roads, and pipelines (representative range based on Rawlins, 7 acres/well [BLM 2004e]; Rawlins Mineral Occurrence and Development Report, 5 to 22 acres/well [BLM 2003], Kemmerer, 3.5 to 6.5 acres/well [Easley 2006], Moab Utah Planning Area, 15 acres/well [BLM 2005a], and 2.5 acres/well [DOE 2006]). The 22 acres/well estimate is not included in the range because it is for deep wells; very few deep wells are planned.

[d] Assumes that 25% of new wells would be abandoned annually (based on estimate provided for the Rawlins Field Office [Allison 2006]). All surface disturbance is assumed to be reclaimed within 10 yr of abandonment.

[e] Assumes 100 acres disturbed/project. This is short-term disturbance such as crushed vegetation, uprooted brush, and minor soil disturbance; disturbance is generally unidentifiable within 1 yr.

***Other Minerals Development.*** Metals produced in Colorado include copper (two mines), gold (seven mines, 1.2% of U.S. production), lead (two mines), molybdenum (two mines), silver (four mines), and zinc (one mine) (EPA 1997). In the ROI counties (i.e., Moffat, Rio Blanco, and Garfield), only sand and gravel and sodium bicarbonate are produced. Sand and gravel are produced in the Colorado River valley in Garfield County (Widmann 2002), just south of the oil shale area, and sodium bicarbonate is produced by Natural Soda, Inc., in Rio Blanco County (USGS 2004a). The sodium bicarbonate is solution-mined in the Piceance Basin; the plant produced 72,000 tons of sodium bicarbonate in 2004. Currently, uranium and vanadium are mined in Montrose County, to the south of the oil shale area. Although there are currently no operating mines, it is projected that uranium and vanadium mining would increase in the Grand Junction and Little Snake Field Offices over the study period, because there has been a recent increase in exploration.

***Energy Development.*** Table 6.1.6-7 presents the projected miles and total acres of energy corridors on federal lands in Colorado designated under the proposed action of the West-wide Energy Corridor PEIS (DOE and DOI 2008). As of 2010, there were 6,738 existing ROWS crossing public lands in Colorado (BLM 2010a).

Table 6.1.6-8 summarizes the electric generating units operating in oil shale ROI counties in Colorado in 2008, including the primary fuel source for each plant and its electric power generating capacity. Of the 1,562 MW of nameplate power available from 24 generating units, 90% was from five coal-fired generators. As of 2000, there were also three new plants proposed for Colorado with a total generating capacity of 2,840 MW (EPA 2002).

***Other (Grazing, Forestry, Fire Management, and Recreation).*** Prescribed burns are used for fire management in the study area; a total of 7,200 acres per year are burned under current management practices. The BLM manages more than 5 million acres of forest lands in Colorado; the majority are in the western half of the state. Most (80%) of the forests are

**TABLE 6.1.6-7 Energy Corridors on Public Lands in the Three-State Area[a]**

| | Area of Proposed Action | |
|---|---|---|
| State | mi | acres |
| Colorado | 430 | 261,000 |
| Utah | 690 | 370,000 |
| Wyoming | 440 | 186,000 |

[a] Source: DOE (2008).

**TABLE 6.1.6-8 Electric Power–Generating Units in ROI Counties in the Three-State Area in 2005[a]**

| State | Primary Fuel | No. of Generating Units | Combined Power (MW-nameplate) |
|---|---|---|---|
| Colorado | Coal | 5 | 1,414 |
| | Gas | 8 | 113 |
| | Oil | 3 | 0.3 |
| | Water | 8 | 35 |
| | Total | 24 | 1,562 |
| Utah | Coal | 9 | 3,214 |
| | Waste coal | 1 | 58 |
| | Water | 5 | 5.4 |
| | Total | 15 | 3,277 |
| Wyoming | Coal | 9 | 3,055 |
| | Gas | 1 | 1.3 |
| | Wind | 20 | 552 |
| | Water | 10 | 99 |
| | Oil | 3 | 1.9 |
| | Total | 43 | 3,709 |

[a] ROI counties include Delta, Garfield, Mesa, Moffat, and Rio Blanco Counties in Colorado; Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, and Wayne Counties in Utah; and Carbon, Lincoln, Sweetwater, and Uinta Counties in Wyoming.

Source: EIA (2011a).

woodlands (forests dominated by low-stature trees such as pinyon-juniper). The net annual growth in forest lands has been estimated as 29 million ft$^3$ (BLM 2006l); the major causes of tree mortality have been insect damage and fires. Timber is harvested on BLM lands in the White River and Little Snake Field Offices.

#### 6.1.6.2.2 Utah

***Oil Shale and Tar Sands Development.*** As stated in Section 6.1.6.1.5, in the future one PRLA with an area of 4,960 acres may be eligible for oil shale development using underground mining techniques, based on the assumption that the RD&D leaseholder can meet BLM requirements. In 2009, the BLM issued a second round of solicitations and received one new RD&D lease proposal for the Uinta Basin, which is currently being evaluated. In addition, an unknown level of oil shale and tar sands development could occur on nonfederal lands in the future. Potential tar sands development would predominantly affect resources in Utah in the

Monticello, Price, Richfield, and Vernal Field Offices, where the STSAs are located. The assumptions used for impact-producing factors for a single tar sands facility are given in Section 5.1.

***Oil and Gas Development.*** In the Utah study area, far less oil and gas production is expected over the next 20 years than in Colorado. The largest amount is projected for the Vernal Planning Area, for which about 440 wells per year are predicted; the total projected maximum number of new oil and gas wells for applicable field offices in the state is 620 wells per year (see Table 6.1.6-5), which includes wells on both federal and nonfederal lands (projections for nonfederal lands are not available for all field offices).

***Coal Mining***. The largest coal reserves are in the Henry Mountain Planning Area, with smaller amounts in the San Rafael Planning Area (see Table 6.1.6-5). Predicted production for all field offices combined is about 30 to 34 million tons/yr. About half of this production would be from surface mines, and half would be from underground mines.

***Other Minerals Development.*** Metals produced in Utah include copper (one mine), iron (two mines), phosphate (one mine), molybdenum (one mine), potash (three mines), silver (four mines), and uranium (one mine) (EPA 1997). In the ROI counties (Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, and Wayne), only sand and gravel, gilsonite, clay, gypsum, dimension sandstone, lime, helium, and gold are produced (USGS 2004b). Phosphate production occurs in the Diamond Mountain area, and gilsonite production in the Book Cliffs area. Uranium/vanadium has a high potential for development in the Henry Mountain and San Juan Planning Areas; it would result in at least 30 acres/yr of surface disturbance. A limited amount of other minerals development is expected (see Table 6.1.6-5).

***Energy Development.*** Table 6.1.6-7 gives the miles and total acres of energy corridors in Utah designated under the West-wide Energy Corridor PEIS (DOE and DOI 2008). As of 2010, there were 6,040 existing ROWS crossing public lands in Utah (BLM 2010a).

Table 6.1.6-8 summarizes the electric power–generating units operating in oil shale ROI counties in Utah in 2008, including the primary fuel source for each plant and its electric generating capacity. Of the 3,277 MW of nameplate power available from 15 generating units, 98% was from nine coal-fired generators.

***Other (Grazing, Forestry, Fire Management, and Recreation).*** Although information is not available for every planning area, at least 13,500 acres/yr are planned to be used for prescribed burns under current management practices. Large tracts of land are used for grazing in the Monticello Planning Area.

The BLM manages more than 8 million acres of forest lands in Utah; the majority are in the southern half of the state, including the planning areas addressed in this PEIS. Most (more than 90%) of the forests are woodlands. The net annual growth in forest lands has been estimated as 9.2 million $ft^3$ (BLM 2006l). The major cause of tree mortality has been fires, followed by insect damage.

#### 6.1.6.2.3 Wyoming

***Oil Shale Development.*** There are no RD&D projects in Wyoming; thus, there are no PRLA lands that could be developed. As in Colorado and Wyoming, an unknown level of oil shale and tar sands development could occur on nonfederal lands in the future.

***Oil and Gas Development.*** In the Wyoming study area, it is projected that a large amount of new oil and gas drilling and production would occur over the 20-year planning horizon. The total number of new oil and gas wells for applicable field offices in the state is projected to be 910 wells per year, with the largest amount, 635 wells per year, projected for the Great Divide/Rawlins Field Office (see Table 6.1.6-6), which includes wells on both federal and nonfederal lands (projections for nonfederal lands not available for all field offices).

***Coal Mining.*** Most of the coal reserves are in the Great Divide/Rawlins Field Office (i.e., about 2,500 million tons); however, no coal mining is currently planned in that field office over the study period (see Table 6.1.6-6). Predicted production for the Kemmerer and Green River/Rock Springs Field Offices is about 10 to 14 million tons/yr. Production from the Black Butte Coal Pit would be from surface mines, and production from the Ten Mile Rim area would be from underground mines.

***Other Minerals Development.*** Wyoming is a large producer of uranium (two mines; >12% of U.S. production) (EPA 1997). In the ROI counties (Carbon, Lincoln, Sweetwater, and Uinta), only sulfur, helium, clay, sand and gravel, crushed stone, and sodium carbonate are produced (USGS 2004c). The largest projected development is for salable minerals (sand and gravel and clay) in Kemmerer County, which has ongoing production of about 480,000 tons/yr of these minerals. A very limited amount of other minerals development is expected (see Table 6.1.6-6).

***Energy Development.*** Table 6.1.6-7 gives the miles and total acres of energy corridors in Wyoming designated under the West-wide Energy Corridor PEIS (DOE and DOI 2008). As of 2010, there were 18,852 existing ROWS crossing public lands in Wyoming (BLM 2010a).

Table 6.1.6-8 summarizes the electric generating units operating in oil shale ROI counties in Wyoming in 2005, including the primary fuel source for each plant and its electric-generating capacity. Of the 3,709 MW of nameplate power available from 43 generating units, 82% was from nine coal-fired generators. Wyoming also currently has a capacity of 1,104 MW of wind power, and more development is expected. Extensive short-term disturbance from pipeline construction could occur in association with planned projects (see Table 6.1.6-6).

***Other (Grazing, Forestry, Fire Management, and Recreation).*** The BLM manages only about 1.7 million acres of forest lands in Wyoming. Almost half (47%) of the forests are juniper pine woodlands. Of Wyoming's forest lands, a large amount is classified as forest area (forests with primarily tall-stature trees such as limber and ponderosa pine) in contrast to woodland area (low-stature trees); forest areas make up about 50% of the total forest lands. The net annual growth in all forest lands has been estimated as 11 million $ft^3$ (BLM 2006p). The major cause of mortality for all tree types has been fires, followed by insect damage; however, insect damage caused a higher percentage of mortality in the tall-stature trees.

There is a small amount of BLM forest land in the three field offices addressed in this PEIS. Approximately 125 acres/yr of forest land is planned to be used for reclamation in the Kemmerer Field Office area during the study period.

Up to 12,000 acres/yr of planned burning is projected for all the field offices combined. Varying amounts of land disturbance are also projected for activities such as the management of livestock, recreation, vegetation, and weeds (Table 6.1.6-6).

#### 6.1.6.3 Cumulative Impacts Assessment for Possible Oil Shale Development That Could Occur under Alternatives 2, 3, and 4

As stated above and in Sections 6.1.2, 6.1.3, and 6.1.4, with the possible exception of a change in local property values, there would be no environmental or socioeconomic impacts under Alternatives 2, 3, and 4 from the amendment of land use plans to identify lands as available or not available for application for commercial oil shale leasing. Therefore, there would be no cumulative impacts from these alternatives. However, direct, indirect, and cumulative impacts could occur as a result of future commercial oil shale development that could be facilitated by such land use plan amendments. The focus of this cumulative impacts assessment then is the impacts from this future development, rather than the impacts from the land use plan amendment decision. That is, the purpose of this cumulative impacts assessment is to discuss, in a qualitative way, how the environmental and socioeconomic conditions within the study area might be incrementally affected over the next 20 years (the study period) by oil shale development that could occur on lands made available for application for commercial leasing by the land use plan amendments under Alternative 2, 3, or 4.

Potential impacts on resources associated with a single future commercial oil shale facility (whether the facility is on a PRLA associated with an RD&D project, on federal land within the footprint of any of the Alternatives, or on nonfederal lands), in conjunction with past, present, and reasonably foreseeable future other actions in the study area, are preliminarily assessed in this section. If and when applications to lease oil shale resources for commercial development are received and accepted by the BLM, where information is less speculative, a reasonably foreseeable development scenario (RFDS) will provide a broad and generalized effects analysis for the type and extent of effects from more than one facility. When individual project-level plans of development are received, these will provide specific technical information for analyzing the cumulative impacts of specific proposed oil shale facilities.

**6.1.6.3.1 Land Use.** Potential land use impacts associated with a single future commercial oil shale facility include the exclusion of grazing, recreation, and other mineral development land uses from lands used for oil shale development facilities and associated off-lease facilities (e.g., employer-provided housing, ROWs, and power plants if needed). Oil shale development could also alter the quality of lands with wilderness characteristics. Oil shale development facilities would disturb 1,650 to 5,760 acres of public lands for the facilities themselves, and up to an additional 8,200 acres of lands for ROWs, employer-provided housing, and power plants (locations where these ancillary facilities will be sited are unknown, but they are not expected to be on public lands). While the total amount of ground disturbance for an oil shale facility using in situ technology could equal that of facilities using mining technologies, the surface acreage disturbed at any one time might be considerably less depending on the cycle of preparation, production, and reclamation.

Table 6.1.6-9 presents estimates of the amount of land needed for other major industrial activities in the study area over the 20-year study period. These lands may be federal or nonfederal lands. As this table shows, land use in the three-state study area is characterized by an extensive amount of industrial activity, which is expected to continue into the future. Depending on the number and types of oil shale facilities constructed and operating, future commercial oil shale development could contribute a substantial increment to the cumulative land use and disturbance impacts. Over a 20-year time horizon, a single oil shale facility could contribute 3 to 33% of total surface disturbance for the activities considered in each state (i.e., up to about 14,000 acres for a single oil shale project compared with the range of other disturbances of 69,000 to 470,000 acres, depending upon the state). If several oil shale leases relatively close to one another are eventually granted, this amount of leasing within a small area would result in substantial changes in land use in that area. Tar sands development, if it occurs, would also contribute to cumulative land disturbance impacts. Note that the projections given in Table 6.1.6-9 are very sensitive to the assumptions on amount of disturbance due to oil and gas development that will occur in the three states; the particularly large range of possible disturbance in Colorado makes the oil and gas land use estimates quite uncertain for Colorado.

As discussed in Section 6.1.6.2, many public lands are currently used as ROWs for short- and long-distance energy transmission. The approved ROD for the Designation of Energy Corridors on Bureau of Land Management Administered Lands in the 11 Western States (BLM 2009) designated additional regional corridors on public lands for long-distance energy transmission ROWs. The ROD amended 92 BLM land use plans, including plans in Colorado, Utah, and Wyoming. Within these three states a total of 1,340 mi of long-distance corridors were established, of which 1,074 were new corridors and 266 mi were already designated as local corridors. Not all lands designated as energy corridors will be developed and/or disturbed; however, the percentage of potential disturbance is currently unknown. In each of the three

**TABLE 6.1.6-9 Summary of Cumulative Long-Term Land Use for Oil Shale Development and Other Major Industrial Activities**

| | Estimated Area Disturbed[a] | | |
|---|---|---|---|
| Activity | Colorado | Utah | Wyoming |
| Existing RD&D leases | 800 | 160 | 0 |
| Commercial oil shale development on federal lands or nonfederal lands (acres)[b] | Up to 14,000 per project | Up to 14,000 per project | Up to 14,000 per project |
| Commercial tar sands development on federal or nonfederal lands (acres)[c] | 0 | Up to 9,500 per project | 0 |
| Oil and gas development (acres/yr) | 3,800–23,000 | 1,400–9,400 | 2,300–14,000 |
| Coal development (acres/yr) | 280 | 50 | 550 |
| Sodium minerals (nahcolite and dawsonite) development (acres/yr) | 20 | 0 | 0 |
| Phosphate development (acres) | 0 | 10,000 | 0 |
| Proposed power plants (acres)[d] | 5,700 | 3,100 | 12,000 |
| Annual total by state, excluding oil shale and tar sands development (acres) | 10,600–29,000 | 15,000–23,000 | 15,000–27,000 |
| 20-year totals, excluding oil shale and tar sands development (acres) | 89,000–470,000 | 42,000–200,000 | 69,000–300,000 |
| Three-state total acres disturbed | 200,000–970,000 | | |
| Single oil shale facility (percentage of 20-year total by state) | 3–16 | 7–33 | 5–20 |

[a] Except where otherwise indicated, acreage estimates are the maximum projected totals from Tables 6.1.6-1, 6.1.6-2, and 6.1.6-3.

[b] Acreage estimates represent the maximum possible disturbance for commercial or RD&D projects, which includes 4,800 acres for a new electric power–generating plant, if needed by a commercial operation.

[c] Acreage estimates represent the maximum possible disturbance for tar sands facilities (see Section 5.1).

[d] The acreages represent the estimated footprint of projected new power plant development in each state as discussed in Section 6.1.6.2, assuming that all would be coal-fired plants requiring 3,000 acres per 1,500 MW of capacity.

states, a portion of these proposed corridors falls within the potential oil shale development area. Should these proposed corridors be fully developed for energy-related ROWs, additional land use impacts in the region could be substantial.

**6.1.6.3.2 Soil and Geologic Resources.** Oil shale development could result in impacts on soil and geologic resources by increasing soil removal, soil compaction, and erosion. Erosion of exposed soils could also lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust, which could affect local air quality. Project areas would remain susceptible to these impacts until completion of construction, mining, oil shale processing, and site stabilization and reclamation activities (e.g., revegetation of pipeline ROWs, surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as areas where associated off-site infrastructure (such as access roads, utility ROWs, and power plants) would be located.

Oil and gas development, other minerals development, tar sands development, and construction of additional power plants would cause similar impacts on soil and geologic resources in the three-state study area. Table 6.1.6-9 gives estimates of the amount of land that could be disturbed for these activities over the 20-year study period. In each state, additional types of land use could also disturb soil. These disturbances would include, but not be limited to, agricultural development, grazing, recreation, forestry, and residential development. The potential impacts from these have not been quantified. Also as discussed in Section 6.1.6.3.1, large areas might be designated as energy corridors in each state, and their development would also contribute to total soil disturbance. All these activities could result in soil being displaced, stockpiled, eroded, or compacted. The disturbance could yield more sediment to surface waters; also, in areas with high salinity in the soils, the salt content in surface water could increase.

As shown in Section 6.1.6.3.1, impacts on soil and geologic resources from oil shale development could add a substantial increment to cumulative impacts on this resource. Impacts would increase with increasing numbers of oil shale facilities. A single facility could be associated with soil disturbance of up to about 14,000 acres.

**6.1.6.3.3 Paleontological Resources.** Disturbances from oil shale development, in combination with other surface- and subsurface-disturbing activities in the region, could uncover and/or destroy fossils on BLM-administered land and on other lands. Given the land disturbance projected from oil shale facilities and from other activities in the study area during the 20-year period (Table 6.1.6-9), it is likely that many sites would require paleontological evaluations and mitigation measures. Based on the assumption that these evaluations and mitigation measures are conducted in accordance with existing regulations and BLM policies, there would be increased knowledge about paleontological resources in the region and increased protection of resources based on this knowledge. Adverse cumulative impacts therefore are not expected.

**6.1.6.3.4 Water Resources.** Ground disturbance along ROWs and near construction sites, mining sites, access roads, and river crossings could increase sediment and dissolved solid loads of streams downstream from disturbed sites. After the protective layers of soils are disturbed, the soils become vulnerable to soil erosion by surface runoff. Leaching of mine tailings and waste, overburden piles, and source rock piles would potentially bring organic and metal contaminants to nearby streams. Potential leaks (or spills) of oil or other petroleum products from pipelines are additional risks for contamination of surface water resources. Modification of surface drainage and water extraction could cause flow regime and morphological changes of stream channels. Most of the impacts would occur in the vicinity of the water bodies close to project sites and would be incremental. Other potential impacts on water resources are described in Section 6.1.5.4.

If oil and gas development, mining activities, and power plant construction continue to grow as projected from 2007 to 2027, the disturbed areas are estimated to increase by a total of 200,000 to 970,000 acres in Colorado, Utah, and Wyoming (Table 6.1.6-9). If a single oil shale facility is developed, it is projected to contribute about 3% to 16%, 7% to 33%, or 5% to 20% additional ground disturbance in Colorado, Utah, or Wyoming, respectively (Table 6.1.6-9). The incremental impacts on water resources caused by oil shale development in each state could be significant relative to these other activities. While the total amount of ground disturbance from oil shale development using in situ technologies could equal that of facilities using mining technologies, the surface acreage disturbed at any one time might be considerably less depending on the cycle of preparation, production, and reclamation.

The water uses and losses in the Upper Colorado Basin states of Colorado, Utah, and Wyoming are shown in Figures 6.1.6-1 to 6.1.6-4. From the 1970s to the 1990s, the water uses increased, reflecting growth in agricultural and in municipal and industrial water uses (Figures 6.1.6-1 and 6.1.6-2, respectively). The export of Colorado River water to outside the Upper Colorado River Basin also increased gradually with time (Figure 6.1.6-3). From 1990 to 2008, the combined water use and losses in Colorado, Utah, and Wyoming within the Upper Colorado Basin fluctuated between about 3,500 to 4,400 thousand ac-ft/yr (Figure 6.1.6-4). This includes water losses from major and minor reservoirs, agricultural, and municipal and industrial water uses, and water transfers out of the basin. Fluctuations were primarily due to variation in export and declining agricultural water uses) because of drought conditions (BOR 2004, 2005, 2006, 2010).

To preliminarily assess cumulative water use in the study area over the next 20 years and the potential impacts of oil shale development, water use projections for oil and gas development, coal mining, and power generation were compared with water use for individual oil shale facilities and with available water in the Upper Colorado River Basin (see Table 6.1.6-10). The sustainable, annually available water in the Upper Colorado River Basin was assumed to be 6,000 thousand ac-ft/yr (SWCA 1997) (a prolonged drought condition may decrease this water availability). The total amount of legally apportioned water available to Colorado, Utah, and Wyoming is 5,280 thousand ac-ft/yr. The water transfer out of the Upper Colorado River Basin fluctuates but was assumed to remain in the same range (540 to 800 thousand ac-ft/yr) for 1990 to 2008 (Figure 6.1.6-3). Also, the currently combined water uses for agricultural, municipal, and industrial activities were assumed to remain at the same level as those found in 1990 to 2008 (i.e., 3,500 to 4,400 thousand ac-ft/yr; Figure 6.1.6-4).

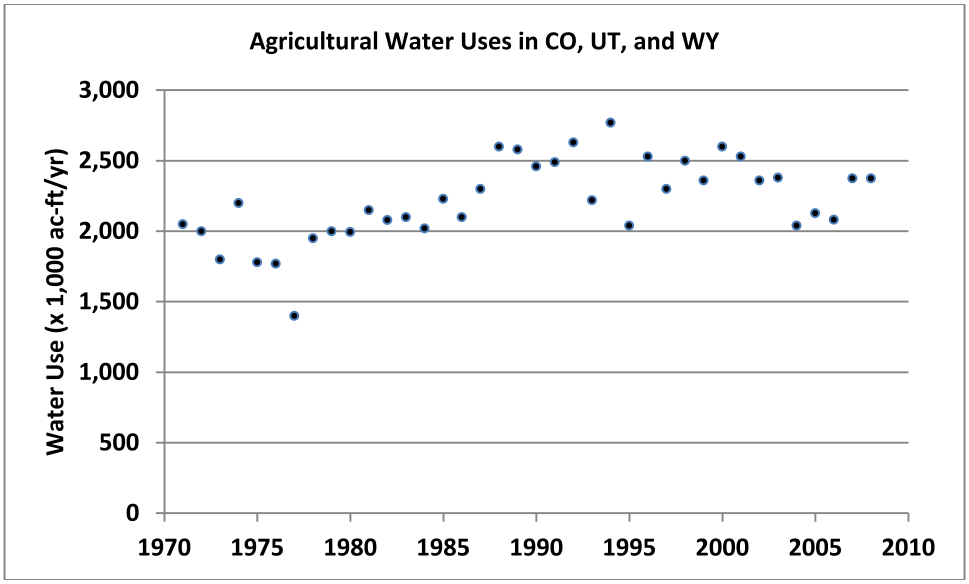


**FIGURE 6.1.6-1 Agricultural Water Uses in Colorado, Utah, and Wyoming in the Upper Colorado River Basin from 1970 through 2008 (Sources: BOR 2004, 2005, 2006, 2010)**

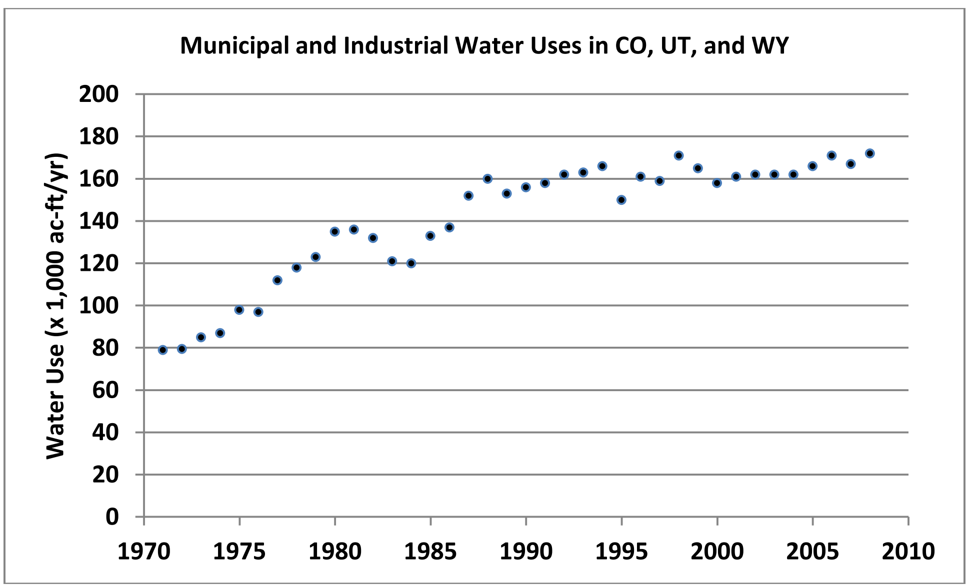


**FIGURE 6.1.6-2 Municipal and Industrial Water Uses in Colorado, Utah, and Wyoming in the Upper Colorado River Basin from 1970 through 2008 (Sources: BOR 2004, 2005, 2006, 2010)**

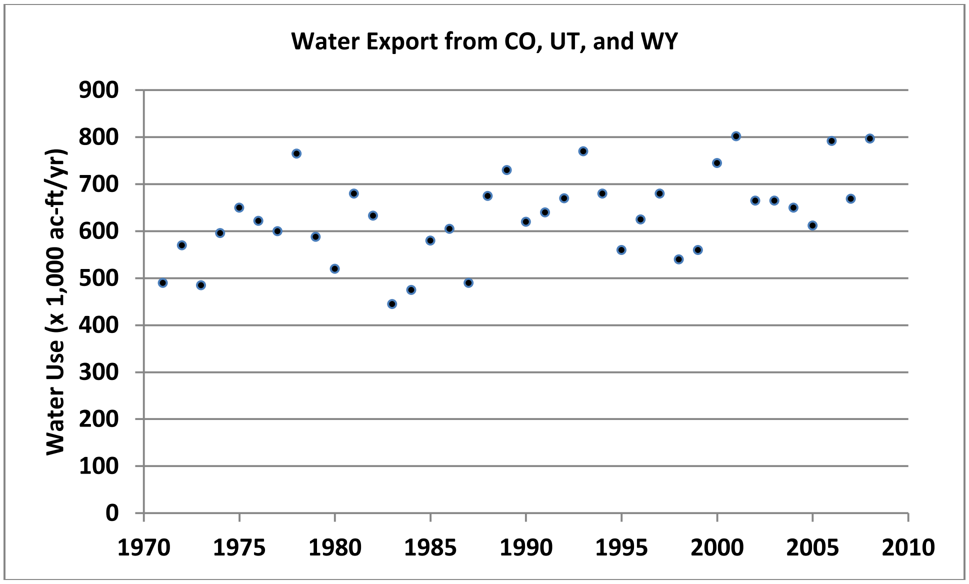


**FIGURE 6.1.6-3 Water Exports from the Upper Colorado River Basin in Colorado, Utah, and Wyoming from 1970 through 2008 (Sources: BOR 2004, 2005, 2006, 2010)**

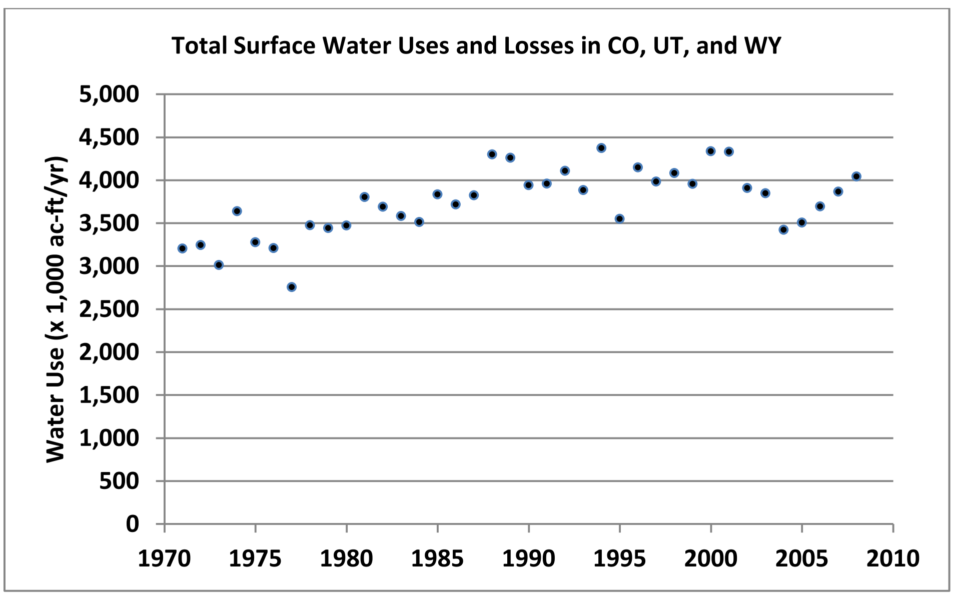


**FIGURE 6.1.6-4 Combined Water Uses and Losses in Colorado, Utah, and Wyoming in the Upper Colorado River Basin from 1970 through 2008 (Sources: BOR 2004, 2005, 2006, 2010)**

**TABLE 6.1.6-10 Major Water Uses in the Next 20 Years in the Three-State Study Area Compared with Use for Potential Oil Shale Development**

| Available Water and Water Use | Annual Volume (1,000 ac-ft/yr) |
|---|---|
| Amount of legally available water from the Colorado River | 5,280 |
| Consumptive uses, including export, agricultural, M&I, and evaporation | 4,140–5,200 |
| Range of net amount available | 80–1,140 |
| Water use estimates for oil shale and tar sands | |
| Commercial oil shale development on federal or nonfederal lands (individual 30,000 to 50,000 bbl/day in situ facility and ancillary facilities, including power plant)[a] | 14.0–18.6 |
| Commercial oil shale development on federal or nonfederal lands (individual 25,000 to 30,000 bbl/day surface mine/surface retort or underground mine/surface retort facility and ancillary facilities)[a] | 2.6–4.6 |
| Commercial tar sands development on federal or nonfederal lands (individual 20,000 bbl/day tar sands facility)[a,b] | <1–5.4 |
| Water use for other development | |
| Oil and gas[c] | 1.6 |
| Coal mining | 13.4 |
| Power plants[e] | 53 |
| Total other development | 68 |

[a] Includes processing and human consumption (see Table 4.5.2-1).

[b] See Table 5.5.2-1.

[c] Assumes that 3,000 wells are drilled per year and that each uses 0.55 ac-ft of water.

[d] Assumes 82 million tons of production per year; 20 million gal of water per million tons of coal mined is assumed for coal preparation and 35 million gal of water per million tons of coal mined is assumed for dust control.

[e] Assumes a total of 9,940 MW new production from coal-fired power plants; water consumption of 8,000 ac-ft/yr per 1,500 MW (see Section 6.1.6.1.4).

Sources for water availability: SWCA (1997); BOR (2004, 2005, 2006, 2010).

Therefore, currently available water would be between 80 and 1,040 thousand ac-ft/yr in the three states. The water requirement for individual commercial oil shale facilities is estimated to be about 5 to 35 thousand ac-ft/yr of water, depending on the technology being used, while the combined water needed for oil and gas, coal mining, and new power plants would be about 68 thousand ac-ft/yr (Table 6.1.6-10). Additional water will be needed to support regional population growth, potential water exports to areas outside the Upper Colorado River Basin, new instream flow water rights for protecting endangered species, and possibly for tar sands development. The level of oil shale development that could be supported by available water over the next 20 years depends on the type of technology used, the scale of the development, and the other competing uses of water at the time of development. Another alternative to make more water available is to transfer water from current agricultural use to industrial use. Any water transfer and new water development must meet different state and federal regulations. Eventually, whether enough water is available for oil shale development depends on the results of negotiations among various parties, including water right owners, state and federal agencies, and municipal water providers as well as the developers.

Meeting the water requirements also depends on how many facilities would be constructed, the technologies used, and the location of the sites. For example, the water demand in northwestern Colorado is more than twice its water consumption. Though the consumption is below the state's legally allocated water amount as specified by the Upper Colorado River Basin Compact, the current water demand already well exceeds the state's allocation. Alternatively, using water conservation practices and transferring agricultural water rights to industrial rights (including oil shale development) could make more water available if extensive oil shale development is desired. Currently, most of the water use in the Upper Colorado Basin is for agricultural purposes. The agricultural component ranges from 55% in the Upper Main Stem (Colorado River and its tributaries above the mouth of the Green River) to 87% in the San Juan–Colorado area (Colorado River and its tributaries below the mouth of the Green River and above Lee Ferry, Arizona) (BOR 2004, 2005, and 2006).

**6.1.6.3.5 Air Quality.** Air resources in and around the study area would be affected by commercial development of oil shale. Local, short-term air quality impacts could be incurred as a result of PM and exhaust emission releases during construction activities. Similar short-term impacts could also occur in other areas where electric transmission or oil pipeline ROWs and other infrastructure would be developed. Longer term impacts on local and regional air quality and AQRVs could occur during normal project operations, such as mining; processing of the oil shale; and construction and operation of off-lease infrastructure, including electric power plants, resulting in emissions of criteria pollutants and HAPs.

Oil and gas development, other minerals development, and other activities (e.g., agricultural development and residential development) would all involve impacts on local air quality during land clearing and construction because of increased PM emissions and exhaust emission from construction equipment. There could also be regional impacts on air quality and AQRVs if these activities involve long-term emissions of criteria pollutants or HAPs at substantial levels. GHG emissions from oil shale development could contribute to climate change to some extent. The incremental impact of oil shale development activities on total cumulative impacts would be assessed during future site-specific NEPA analyses.

**6.1.6.3.6 Noise.** Noise is a transient problem; its impacts do not accumulate in the environment as do air and water pollutants. Attenuation mechanisms, such as geometric spreading, ground effects, and air absorption, dissipate noise energy within short distances from noise sources. In general, except for extremely loud noise, noise can travel only a few miles even under nighttime temperature inversion conditions. However, cumulative noise impacts could occur with oil shale development on both federal and nonfederal lands, oil and gas development, surface and underground mining of coal, production of other minerals, and energy development (see Tables 6.1.6-4 through 6.1.6-6); such impacts would depend critically on site-specific considerations and the proximity of the operations being considered to each other. The cumulative impacts of sufficiently separated noise sources are essentially the same as the noise impacts of each source considered separately.

Cumulative impacts also depend upon which phases in the lifetime of the sources being considered are occurring simultaneously. For example, construction associated with an oil shale facility would cause only a slight cumulative increase in the preexisting noise levels associated with a pumping station on an oil pipeline, while operation of the oil shale facility could cause a large increase over the preexisting levels around the facility and along nearby roads.

The construction noise impacts discussed in Section 4.7.1.1 are based on general considerations and are applicable to a wide range of construction projects. For many oil shale development projects, the leased area is large enough that noise levels would be below EPA guideline levels at the site boundaries or at nearby sensitive receptors. Because of the probable large distance between projects, it is unlikely that construction of oil shale facilities will cause a substantial incremental increase in noise impacts over those associated with existing and reasonably foreseeable future projects. However, the construction of large-scale commercial oil shale projects involving drilling of many wells could produce higher noise levels with larger cumulative impacts. Also, if oil shale development is close to other projects and construction and worker vehicles from both projects use the same roads, there could be cumulative noise increases due to increased traffic on local roads. An estimate of cumulative impacts must be made during the assessment of site-specific impacts.

As noted in Section 4.7.1, adverse noise impacts could be associated with the operation of commercial oil shale facilities. Drilling and pumping in oil and gas recovery fields could also contribute to high cumulative noise levels, and mining operations could cause high noise levels in the vicinity of the mine. If these other activities occur close to oil shale development operations, the possibility of substantial cumulative impacts exists; however, these impacts cannot be estimated at this time given the lack of quantitative estimates for oil shale facilities and the lack of data on specific locations of other development activities. An estimate of cumulative impacts must be made during the assessment of site-specific impacts.

**6.1.6.3.7 Ecological Resources.** Cumulative impacts of commercial oil shale development on ecological resources in the three-state study area would result from the past, present, and future impacts of a wide variety of human activities, including agricultural development and production, grazing activities, range management, timber harvest and management, residential and commercial development, recreational activities, water resource development projects, mineral resource development, and energy development. The current status of ecological resources, as described in Section 3.7, reflects the cumulative impacts of past and present activities. This section focuses on the potential incremental impacts of the oil shale development alternatives and a set of reasonably foreseeable future actions that are expected to occur or that could occur over the next 20 years if commercial oil shale projects are developed. Reasonably foreseeable future projects include oil and gas development, coal mining, mining of metals and minerals, energy transmission, electrical generation, and other activities, such as grazing, fire management, forestry, and recreation as described in Section 6.1.6.2.

The cumulative impacts of greatest concern to ecological resources in the study area include loss or degradation of habitat and habitat fragmentation related to land disturbance; loss of individuals in populations (especially those of rare species); and changes in the amount, availability, and quality of surface water resources. All other factors described in Section 4.8.1 have the potential to contribute to cumulative impacts, but their contributions would be relatively minor and more localized.

Section 6.1.6.2 presents available information on the projected levels of development for major activities in the study area. Land disturbance from reasonably foreseeable future projects could increase to a total of approximately 1 million acres for the projected 20-year study period in the three-state area of interest (see Table 6.1.6-9). Land disturbance associated with individual commercial oil shale facilities could be up to about 14,000 acres.

Water depletions associated with reasonably foreseeable future actions over the next 20 years represent significant increases in cumulative water use in the three-state study area (more than 68,000 ac-ft/yr of the 80,000 to 1.1 million ac-ft/yr potentially available). Existing water use in the three-state area totals 4.1 to 5.2 million ac-ft/yr. Water consumption associated with individual commercial oil shale development facilities would range from 5,000 to 35,000 ac-ft/yr; water consumption associated with individual commercial tar sands development facilities would range from less than 1,000 to 5,400 ac-ft/yr (see Table 6.1.6-10).

Cumulative impacts on aquatic resources; plant communities and habitats; wildlife; and threatened, endangered, and sensitive species are discussed below.

***Aquatic Resources.*** The analysis of cumulative impacts on aquatic habitats and the organisms that inhabit those habitats considered the potential impacts of oil shale development in Colorado, Utah, and Wyoming, together with impacts from other anticipated development activities, as described in Section 6.1.6.2. The types of factors associated with these activities would be similar to those described in Section 4.8.1.1 for the direct and indirect effects of oil shale development, including (1) direct disturbance of aquatic habitats; (2) sedimentation of aquatic habitats as a consequence of soil erosion from nearby areas; (3) changes in water quantity or water quality as a result of changes in surface runoff patterns, depletions or discharges of water into nearby aquatic habitats, or releases of contaminants into nearby aquatic systems; or (4) changes in human access to aquatic habitats.

Direct disturbance of aquatic habitats could result from activities that occur within water bodies or within the active channel of streams and rivers. Such disturbance could occur as a result of mineral (e.g., gravel) extraction from streambeds; construction of stream crossings for pipelines, transmission lines, and roads; driving vehicles through or using heavy machinery within active channels; and from livestock that walk through waterways. There is a potential for all these activities to occur within oil shale areas, although it is generally anticipated that the related impacts would be relatively small and localized. Activities such as oil and gas development, mining, energy development, grazing, fires and fire management, and logging would affect erosion potential by disturbing soils and removing or altering vegetated cover. Such activities associated with other future projects are expected to result in a considerable increase in land disturbance over the 20-year project time frame in the three-state area and could result in a considerable increase in sediments entering aquatic habitats.

As described in Section 4.8.1.1, construction activities for oil shale development could also directly disturb aquatic habitats and alter the potential for erosion and sedimentation within affected areas, depending upon the specific locations of leased parcels, the routes selected for transmission lines, roads, and pipelines, and the configuration of structures used for crossing those habitats. Although the direct disturbance and sedimentation of aquatic habitats resulting from oil shale development would likely be somewhat localized, such development could contribute substantially to the cumulative level of such impacts within affected watersheds.

In the absence of project-specific information, it was assumed that the potential for direct habitat disturbance and soil erosion and the resulting sediment loading of nearby aquatic habitats is proportional to the amount of surface disturbance, the condition of disturbed lands at any given time, the proximity to aquatic habitats, and measures implemented to control erosion and sedimentation. Individual oil shale projects would contribute substantially to additional surface disturbance over the 20-year development period, compared with other activities planned within the evaluated oil shale regions, depending on location and size.

Activities within stream channels and the construction or placement of roads, culverts, and water diversion devices across or in waterways have a potential to fragment aquatic habitats by blocking upstream or downstream movements of aquatic organisms as identified in Section 4.8.1.1. From a cumulative standpoint, some roadways, dams, water diversion devices, pipeline crossings, and other structures associated with existing development activities in the drainages associated with the oil shale basins may already contribute to such habitat fragmentation, and a large increase in such infrastructure would likely increase aquatic habitat fragmentation in the future. Areas surrounding and within the oil shale areas for which future allocation alternatives are being considered in this PEIS currently contain a large proportion of oil and gas wells, and the associated structures (such as roads and pipelines) that occur within the overall Colorado and Green River Basins and the addition of oil shale development would be expected to further increase such fragmentation. The application of appropriate mitigation measures, such as controls on the designs of stream crossings, would reduce the potential for significant cumulative impacts to occur.

From a cumulative perspective, water quality within the oil shale regions would also be affected by many human activities that introduce excess nutrients or contaminants into water bodies, including oil and gas development, coal mining, construction of additional power plants, and grazing of livestock. Oil shale development has the potential to contribute to degradation of water quality through the introduction of contaminants, either as leachate from spent oil shale or from spills or releases of oil, lubricants, and herbicides.

Within the arid regions of Colorado, Utah, and Wyoming where oil shale development would occur, water availability is of great concern and results in conflicts over balancing water needs for current and future development with water needed to maintain ecological conditions in aquatic habitats. The anticipated water needs for individual oil shale production facilities would range from 5,000 to 35,000 ac-ft/yr. One or more oil shale facilities utilizing amounts of water at the higher end of the range could certainly contribute substantially to adverse cumulative impacts on water availability.

Cumulative impacts on fisheries could result from increased public access to remote areas via newly constructed access roads and utility corridors and from the increased population levels likely to occur over the 20-year project period as a combined result of reasonably foreseeable actions. As discussed in Section 6.1.6.3.11, substantial increases in population within the oil shale regions are projected over the next 20 years. Each state in the ROI (Colorado, Utah, and Wyoming) has designated management authority for fishery resources to the state's fish and wildlife agency. As part of their management activities, these agencies routinely monitor the condition of specific fisheries within the state and establish and enforce regulations to maintain or improve the condition of those fisheries. Examples of regulations include limits on open fishing seasons and on the numbers, sizes, and species of fish that can be harvested from specific bodies of water. On the basis of the assumption that the effects of such regulations are monitored and adjusted effectively, the overall incremental and cumulative impacts on fishery resources with increased access due to potential oil shale and other development would be expected to be minor.

***Plant Communities and Habitats.*** **S**ince the 1700s, wetland habitats have been severely impacted throughout the lower 48 states, including Colorado, Utah, and Wyoming, as a result of drainage and fill activities associated with agriculture, resource extraction, urban development, and other human activities. From the 1780s to 1980s, wetland losses in Colorado have been estimated to be approximately 50%, with 30% losses in Utah and 38% losses in Wyoming. However, the rate of loss is currently much lower than historic levels (Dahl 1990). Over the past several decades, federal agencies, such as the BLM, and state and private organizations have made considerable efforts to protect and restore wetlands and riparian habitats, and ongoing and planned wetland and riparian management programs are expected to continue to contribute to the improvement in wetland and riparian habitat function (BLM 2005i).

Human activities have also had an impact on terrestrial habitats in Colorado, Utah, and Wyoming for many years. Species composition and diversity have been affected by fire suppression, heavy grazing, introduction of invasive species, and other factors (BLM 2005i). Habitat losses, fragmentation, and degradation have historically resulted from oil and gas development, mining, and other resource extraction activities that disturb surface soils. Although the BLM and other land management agencies have made considerable advances in habitat protection and restoration, ongoing resource extraction and other land uses are expected to continue to result in losses or changes to plant communities and habitats.

The factors that would affect plant communities and habitats as a result of oil shale development activities are also associated with a number of other activities that occur both within and outside of the oil shale basins. The ecoregions and associated plant communities that include the oil shale basins extend well beyond the basin boundaries, and activities that occur outside the basins can also affect these habitats. Direct losses of habitat could occur as a result of oil and gas development, coal mining, mining of metals and minerals, energy development, and other activities. Approximately 1 million acres could be directly impacted by these future development activities. Native plant communities could also be indirectly impacted or degraded by these activities. Changes in water quality, surface water or groundwater flows, or air quality could adversely affect terrestrial or wetland plant communities, and changes in community characteristics, such as species composition or distribution, could result from vegetation disturbances related to some activities, such as grazing. Commercial oil shale development would constitute a substantial incremental increase to the impacts associated with other foreseeable activities.

***Wildlife.*** This section evaluates the potential cumulative impacts of oil shale development on wildlife, including wild horses and burros. The current status of wildlife and their habitats, as described in Section 3.7.3, reflects the cumulative impacts of past and present activities. This section focuses on the incremental impacts of oil shale development alternatives and a set of reasonably foreseeable federal and nonfederal activities, as described in Section 6.1.6.2, which could occur over the 20-year study period. In addition to these activities, natural events (e.g., floods, drought, and fires), disease, predation, and fluctuations in prey are among the natural phenomena that contribute to cumulative impacts on wildlife.

In general, the types of cumulative impacts on wildlife would be similar to the direct and indirect impacts associated with oil shale development (Section 4.8.1.3). Thus, cumulative impacts on wildlife resources would include (1) habitat loss, alteration, or fragmentation; (2) disturbance or displacement; (3) mortality; (4) obstruction to movement; and (5) exposure to contaminants. The effects of these actions could include (1) immediate physical injury or death; (2) increased energy expenditures or changes in physiological condition that could reduce survival or reproduction rates; or (3) long-term changes in behavior, including the traditional use of ranges. Potential differences between cumulative impacts on wildlife and impacts arising from oil shale development activities alone would depend on the intensity (magnitude), scale (geographic area), duration, timing, and frequency of development activities. Although habitat protection and restoration activities are incorporated into most projects, some losses or modifications to habitats are expected from most activities. Even without the potential impacts of commercial oil shale development, the projected major increases in land disturbance and water depletions resulting from other reasonably foreseeable future activities, taken together with the impacts of past and present actions, could result in significant cumulative impacts on wildlife.

Cumulative impacts of greatest concern to wildlife and their habitats include loss or degradation of habitat and habitat fragmentation related to land disturbance and changes in the availability and quality of surface water resources. The cumulative effects of numerous land use activities (e.g., livestock grazing, crop production, and energy development and associated infrastructure) have caused widespread habitat loss and fragmentation of sagebrush ecosystems (Knick et al. 2003). The avoidance by wildlife of areas near industrial developments that might otherwise be usable habitat (i.e., functional habitat loss) also contributes to the cumulative loss of habitat associated with facility development. Also, developments could further obstruct wildlife movements. Habitat loss and fragmentation can be particularly devastating to sagebrush-dependent species such as sage-grouse and to big game species or other wildlife that have large home ranges or that make annual migrations among various habitats. Factors can act synergistically, compounding the importance of cumulative impacts. For instance, developments could result in extensive fragmentation that leaves only small, isolated areas of native vegetation. These areas are often more prone to invasive plant species and to grazing by livestock, wild horses, or feral animals (BLM 2007g; Hobbs 2001).

Wildlife disturbance and mortality associated with activities such as recreation also could have significant and widespread impacts because of the high number of recreation use days. For example, more than 1.3 million visitor days were spent hunting, and nearly 1.6 million visitor days were spent snowmobiling or other winter motorized traveling on BLM-administered lands within Colorado, Utah, and Wyoming during FY 2004 (BLM 2007g). The other factors discussed above have the potential to contribute to cumulative impacts; their contribution, however, would be relatively minor and more localized.

Other industrial developments could result in more workers within remote areas and increased public access due to new roads and ROWs. Increased access could result in increased hunting pressure and illegal poaching depending on location and extent of the developments. Repeated intrusions (e.g., from recreationists) within a specific area have been shown to cause progressive declines in avian richness and abundance (Riffell et al. 1996). Traffic associated with industrial activities and recreation could result in additional roadkills. Also, structures associated with other industrial activities could increase the number of bird collisions. Increased densities of predators and scavengers attracted to areas of human activity could result in increased predation pressure on prey populations. Increased predation would be in addition to impacts associated with habitat loss, displacement, roadkills, collisions with structures and transmission lines, and other factors.

Site-specific mitigation, standard operating procedures, wildlife-related stipulations, reclamation and rehabilitation, and monitoring would minimize cumulative impacts and/or benefit wildlife and their habitats (BLM 2007g, 2006j; DOI and USDA 2006; WGFD 2004). These measures would reduce the contribution of oil shale impacts to cumulative impacts throughout the project area. Also, implementation of state comprehensive wildlife conservation strategies and regional conservation plans would provide means of proactively minimizing cumulative impacts on wildlife and their habitats. For example, some of these plans identify areas where habitat is critical for the continued viability of key species and communities and areas where development can occur with lower risk to the welfare of ecosystems (Jones et al. 2004). The plans also present means of restoring and maintaining the health and function of lands within the study region. Management of game populations and enforcement of hunting laws has reduced the risk of declines in the number of game species compared with historic levels (BLM 2007g).

***Threatened, Endangered, and Sensitive Species.*** In general, the cumulative impacts on threatened, endangered, and sensitive species would be similar to those described for other ecological resources. However, for many of the species, there would be a difference in the potential consequence of the impacts. Because of their small populations, threatened, endangered, and sensitive species would be far more vulnerable to impacts than more common and widespread species.

The current status and distribution of ESA-listed species, BLM-designated sensitive species, and state-listed species are presented in Section 3.7.4. Current status and distribution reflect the cumulative effects of past and present human activities and natural limiting factors. Some species are considered threatened, endangered, or sensitive in the area because cumulative impacts have resulted in a reduction in numbers, which has increased the chances the species would become extinct in the near future (e.g., black-footed ferret, Canada lynx, and whooping crane). Other species (e.g., Graham's beardtongue and Dudley Bluffs bladderpod) are considered vulnerable because their specific ecological requirements result in limited distributions and smaller population sizes, which are less resilient. For either group of species, any incremental addition to cumulative impacts could be considered significant.

The potential direct and indirect impacts of commercial oil shale development on threatened, endangered, and sensitive species are listed in Table 4.8.1-4 and discussed in Section 4.8.1.4. The evaluation indicates the potential for adverse impacts for most of the species in the study area. Potential contributions to cumulative impact are associated with direct effects (e.g., vegetation clearing, habitat fragmentation, and water depletion) and indirect effects (e.g., sedimentation from runoff, fugitive dust, and disruption of groundwater flow patterns). Even without the potential impacts of commercial oil shale development, the projected major increases in land disturbance and water depletions resulting from other reasonably foreseeable future activities, taken together with the impacts of past and present actions, could result in significant cumulative impacts on these species.

Each alternative would require adherence to BLM policy on the protection of sensitive species and appropriate project-specific ESA Section 7 consultation with the USFWS. These latter consultations must include a consideration of cumulative effects on listed species under the ESA. Adherence to BLM policy and consultation with the USFWS are expected to reduce, but not eliminate, the contribution of commercial oil shale development to cumulative impacts under both NEPA and the ESA.

**6.1.6.3.8 Visual Resources.** The construction and operation of commercial oil shale projects that may occur on federal and nonfederal lands in Utah, Colorado, and Wyoming would likely have cumulative visual impacts in the context of other development activities under way in the three-state study area, as described in Section 6.1.5.8. These development activities could have large visual impacts on locations where concentrated development activity occurred. Where construction and operation of a commercial oil shale project occurred in the same areas as these other development activities, the visual absorption capability of some landscapes might be exceeded. Incremental visual impacts could be of particular concern where oil shale facilities, related infrastructure, and other development activities would be located near sensitive visual resources in landscapes with low visual absorption capability, and/or where the oil shale and other development would be located in the viewsheds of visually sensitive linear features, such as scenic/historic trails, highways, or scenic rivers. Careful facility siting and application of mitigation measures along with conformance with BLM VRM classes would protect visual values in more sensitive areas from large impacts associated directly with oil shale development projects. However, the accumulation of small impacts from oil shale projects, together with impacts from other development activities, could potentially degrade visual qualities. For VRM Classes I through III, the classifications would likely change; Class IV areas would likely degrade further. Also, the VRM classes of surrounding areas within view of the facilities may change.

Further cumulative visual impacts could occur because the presence of oil shale projects would likely bring workers and their families to live in local communities and recreate in the surrounding areas, and because the roads and other infrastructure associated with oil shale development projects could cause increased visitation and usage of remote areas (e.g., OHV use). The increases in population and access could result in urbanized development that would contrast sharply with more natural-appearing existing landscapes, add to visual clutter around existing urbanized areas, increase visible human and vehicular activity in remote areas, degrade air quality (thereby negatively affecting long-distance views), and result in litter, erosion, and other visual changes that would not harmonize with the naturally occurring forms, lines, colors, and textures of existing landscapes.

**6.1.6.3.9 Cultural Resources.** Disturbances from oil shale development, combined with other surface-disturbing development activities, could uncover and/or destroy cultural resources on BLM-administered land and on other lands. Given the surface disturbance from oil shale development and from other activities (Table 6.1.6-9) projected in the study area during the 20-year study period, it is likely that many locations would require cultural resource evaluations and mitigations. Assuming that these evaluations and mitigations are conducted in accordance with existing regulations, there would be an increased knowledge about cultural resources in the region. However, there would inevitably be some loss of information about individual sites. Unless a concentration of unique resources was found to exist within a small area and that area was the location of oil shale development, these individual site losses from construction and operation of an oil shale facility would be unlikely to have a major incremental adverse impact on cultural resources in the area.

**6.1.6.3.10 Indian Tribal Concerns.** Oil shale development, combined with other development activities, could destroy, damage, or degrade resources important to Native Americans. Surface-disturbing activities could destroy or damage archaeological sites and burials (see Section 6.1.6.3.9) and plant, animal (see Section 6.1.6.3.7), mineral, and water resources important to Indian tribal culture and religious practices. The very presence of industrial development facilities could result in visual (see Section 6.1.6.3.8) and auditory (see Section 6.1.6.3.6) intrusions into sacred locations, landscapes, and viewsheds important to Indian tribes. The extent to which these resources would be disturbed would be dependent on their location relative to development. Given the amount of development projected for the study area in the next 20 years, it is likely that resources important to Native Americans could be affected. The incremental adverse effect of the construction and operation of an oil shale facility on these resources would depend on site-specific factors. Consultation with affected federally recognized tribes by the BLM and oil shale developers could result in the avoidance or amelioration of adverse effects. A major incremental impact on resources important to Native Americans from the construction and operation of an oil shale facility in the area is unlikely.

**6.1.6.3.11 Socioeconomics.** Economic impacts can be measured in terms of changes in employment in the three-state study area in which oil shale resources are located. Because of the relative economic importance of oil shale development in small rural economies, and the consequent lack of available local labor and economic infrastructure, oil shale development could mean a large influx of population. As population increases are likely to be rapid, with local communities unable to quickly absorb new residents, there would also be impacts on housing, local governments budgets, public infrastructure, social services, law enforcement, and other community impacts in the three-state study area.

The impacts of oil shale developments would include (1) wage and salary expenditures associated with the construction and operation of oil shale facilities and power plants, (2) material procurement and wage and salary expenditures associated with the construction of temporary housing in the ROI for oil shale facility and power plant workers and family members, and (3) wage and salary spending associated with indirect workers required to provide goods and services resulting from increases in economic activity in each ROI with oil shale development. Overall, oil shale development could produce a substantial number of jobs, depending on the scale of development (e.g., for an individual facility, about 100 to 300 jobs during the construction of temporary housing; 350 to 1,300 jobs during construction; and 125 to 1,650 jobs during operation, depending on the technology used, see Table 4.11.1-1).

Population in-migration would also occur with oil shale resource development; workers would be required to move into the three-state region during construction and operation of oil shale and power plant facilities. Workers would also be required to move into the region to facilitate the demand for goods and services resulting from the spending of oil shale, power plant, and housing construction worker wages and salaries.

A substantial number of oil and gas wells are projected for the area beginning in 2008, producing about 8,900 direct jobs and an estimated 23,000 total (direct and indirect) jobs in each year through 2027 (Minnesota IMPLAN Group, Inc. 2007). Development of coal resources in the three-state study area is also expected and would produce 15,000 direct jobs and 32,500 total jobs each year between 2008 and 2027. In the three-state region, oil and gas and coal development alone could result in an increase of about 10% to 20% in total employment in the region over 20 years and in a population increase of about 2% to 4%, if these activities would require population in-migration. It is not known whether development of oil and gas and coal resources in the three-state region would require the in-migration of construction and operations workers or the construction of additional temporary housing.

If oil shale development occurs, it could also add a substantial number of jobs in the ROIs, depending on the scale of development (e.g., for an individual facility, 550 jobs during the construction of temporary housing; 1,800 jobs during construction of tar sands facilities; and 750 jobs during operations.)

Rapid population growth in small rural communities hosting large resource development projects could also produce social and psychological disruption, together with the undermining of established community social structures (see Section 4.12.1.2). Various studies have suggested that social disruption may occur in small rural communities when annual population increases are 5% to 15% (see Section 4.12.1.3).

On the basis of employment estimates given above, reasonably foreseeable oil and gas and coal production in the study area is estimated to have a larger socioeconomic impact than a single oil shale facility. However, depending on the future level of oil shale development and given the estimated population increases due to construction and operation of a single oil shale facility, there may be substantial incremental socioeconomic impacts (e.g., interruption of community services, availability of housing, social disruption, decreases in property value, loss of employment and income in the recreation sector) from oil shale development when considered in conjunction with the other ongoing and reasonably foreseeable activities in the study area.

Cumulative impacts on transportation systems and traffic levels would be related to both employment and freight requirements to service projects. Overall, oil shale development could produce a substantial number of jobs, depending on the scale of development. Transportation impacts would be additive to other activities on private and public lands. Substantial increases in traffic flow and in transportation infrastructure maintenance requirements to support oil shale operations would be expected.

**6.1.6.3.12 Environmental Justice.** Construction and operation of oil shale facilities, employer-provided housing, and power plants (if required) could affect environmental justice if any adverse health and environmental impacts resulting from either phase of development were large and if these impacts disproportionately affected minority and low-income populations. Disproportionality is determined by comparing the proximity of high and adverse impacts on the locations of low-income and minority populations. As described in Sections 6.1.6.3.1 through 6.1.6.3.11, oil shale development in conjunction with other ongoing and reasonably foreseeable activities could potentially have high and adverse effects on several resources, including local demographics, social structures, property values, noise, landscape views, land use, water quality, and air quality.

In each of the three states potentially hosting oil shale development are a number of census block groups with low-income and minority populations, where the minority population exceeds 50% of the total population in each block group and where the minority share of total block group population exceeds the state average by more than 20 percentage points (see Section 3.12). Given the potential for high and adverse incremental impacts on a number of resource areas from oil shale development in conjunction with oil, gas, coal, and potential tar sands development, and given the existence of environmental justice populations in each state, impacts on these resources could disproportionately affect minority and low-income populations. Of particular importance would be the impact of large increases in population in small rural communities on social disruption, the undermining of local community social structures, and the resulting deterioration in quality of life. The impacts of facility operations on water quality and on the demand for water in the region could also be important. Impacts on low-income and minority populations could also occur with the development of transmission lines associated with oil shale and power plant facilities in each state, depending on the locations of these infrastructures. Land use and visual environmental justice impacts might be significant, depending on the locations of land parcels affected by all these activities. Cumulative impacts on environmental justice would be evaluated in future NEPA analyses when the locations and sizes of the projects in relation to low-income and minority populations are known.

#### 6.1.6.3.13 Hazardous Materials and Waste Management

***Wastes Associated with Oil and Gas Development.*** Oil and gas development can involve three basic stages: exploration, well development, and production. Exploring, locating, and characterizing the petroleum resource can involve the installation of a relatively small number of small-bore wells to collect geologic cores for inspection and analysis. Increasingly, exploration is conducted with nonintrusive technologies, and wastes associated with exploration are limited and inconsequential.

Well development produces the greatest volume and array of wastes. Wells drilled on BLM-administered lands would be subject to the requirements and BMPs contained in the BLM's Gold Book (DOI and USDA 2006) and to any additional requirements established as lease stipulations by the BLM field office. It is expected that waste management for wells installed on private property would be in accordance with accepted industry practice. Each well installed would generate well development fluid wastes and waste cuttings, some of which could be contaminated with oil from the formation being exploited. However, unless the well progressed through previously contaminated subsurface zones or encountered contaminated groundwater, the waste typically associated with well installation would not exhibit hazardous characteristics and would most likely be managed according to standard practices.

Well development fluids[11] would be collected on-site for reuse and/or disposal; free water would be separated from development fluids; drilling muds would be verified as being free of unexpected contamination and released to the ground surface; drilling muds such as bentonite clays would be accumulated on-site for recovery and reuse; and drill cuttings would be verified as being free of contamination and disposed of at the land surface, usually in the vicinity of the well.[12] Special management would be required for development fluids, drilling muds, and produced water that exhibited contamination from NORM or brackish characteristics. All NORM-contaminated wastes would be collected and delivered to properly permitted treatment and disposal facilities. Brackish water would be either reinjected down the well (or an injection well) or collected for delivery to treatment facilities. Likewise, downhole equipment removed from the well and found to have NORM contamination would be managed in the same manner. It is assumed that all the drill rigs used for well development would be portable and would not undergo routine servicing (except for maintenance of fluid levels) at the well site. No wastes associated with drill rig operation and maintenance (e.g., maintenance of the rig's diesel engine) would be expected to be generated at wellheads, but they might be generated elsewhere in the study area where the rigs are serviced.

Products recovered from oil and gas wells are typically complex mixtures of oil, hydrocarbon gases, other gases such as $H_2S$, water, suspended solids such as sand and silt, chemicals injected to enhance recovery, and water/oil emulsions. Actions to separate these phases are performed at the wellhead or at a central processing facility.

Oil and gas formation fracturing also produces large volumes of liquids wastes. Fracturing (known as "fracking" in the oil and gas industry) is a process that uses high hydraulic pressure to crack the hydrocarbon-containing formation. This process increases the flow rate and volume of hydrocarbon fluids that move from the producing formation into the wellbore and aids extraction of oil and gas deposits that might otherwise be left behind. Hydraulic fracturing is a 60-year-old process that is now being used more commonly as a result of advanced technology.

Fracturing fluids carry sand or other small particles of material (proppants) into the newly created crevices to keep the fractures open when the pressure is relieved. Hydraulic fracturing fluids generally consist of 90% water, 9.5% sand, and 0.5% chemical additives. The chemicals are used to enhance fracturing and to protect the well integrity (API 2010). As many as 750 different chemicals were used by the oil and gas industry for hydraulic fracturing between 2005 and 2009. A list of chemicals used is provided in *Chemicals Used in Hydraulic Fracturing*, prepared by the U.S. House of Representatives Committee on Energy and Commerce (2011).

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[11] Well development fluids are water-based (most frequently used), petroleum-based (used primarily in very deep wells where high temperatures may be encountered [usually >10,000 ft], or in directional drilling where greater lubricity is required for the drill bit), or they are composed entirely of synthetic chemicals (e.g., linear alkyl olefins, synthetic paraffins, and alkybenzenes). These fluids perform a number of functions, including cooling and lubricating the drill bit, carrying cuttings up the borehole to the surface, and temporarily filling the well bore with material that is sufficiently dense to prevent the premature inflow of groundwater, other fluids (e.g., oil), or subsurface materials that would collapse the borehole before casings are installed. Development fluids also typically contain various other chemicals, such as naturally occurring clays (referred to as drilling muds), dispersants, corrosion inhibitors, flocculants, surfactants, and biocides, to enhance their overall performance.

[12] Although drill cuttings are, in most cases, nonhazardous, care must nevertheless be exercised in their disposal so as not to significantly alter surface drainage patterns or release sediments to area surface waters.

To protect groundwater from potential contamination from oil and gas drilling on public lands, including fracking operations, the BLM approves and regulates all drilling and completion operations, and related surface disturbance. Prior to approving a drilling permit, a BLM geologist identifies all potential subsurface formations that will be penetrated by the wellbore and provides that information to a BLM petroleum engineer, who reviews proposed casing and cementing programs. During drilling, the BLM is on location during the casing and cementing of the groundwater surface and other critical intervals.

The 2005 Energy Policy Act exempted the injection of fracking fluids from the Safe Drinking Water Act's Underground Injection Control Program. The Act, however, did allow the EPA to continue regulating the use of diesel fuel in fracking fluids. In addition, the EPA is studying the potential impacts of hydraulic fracturing on drinking water resources while developing permitting guidance. A database of BMPs for hydraulic fracturing is available on the Intermountain Oil and Gas BMP Project Web site (University of Colorado Law School 2011).

Onshore Order No. 2 details national standards for levels of performance expected from lessees and operators when conducting drilling operations on federal and Indian lands, including casing and cementing requirements to ensure well integrity. The BLM's casing and cementing programs are conducted such that they protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. The State of Colorado, through the Colorado Oil and Gas Conservation Commission (COGCC), has established regulations that require wells to be cased with steel pipe and the casing to be surrounded by cement to create a hydraulic seal with the well bore. About 95% of new oil and gas wells in Colorado, Utah, and Wyoming are fractured. The majority of fluids used in the fracturing process are recycled, and no fluids are sent to wastewater treatment plants. Of the remaining fluids, 60% goes into deep waste injection wells, 20% evaporates from lined pits, and 20% is discharged as usable surface water under permits from the Colorado Water Quality Control Commission (BLM 2011b).

As of September 2010, the Wyoming Oil and Gas Conservation Commission (WOGCC) required disclosure of the types and amounts of chemicals used in fracking operations (University of Colorado Law School 2011). In Utah, oil and gas development would be subject to ongoing groundwater protections as outlined in BLM Instruction Memorandum UT 2010-055, *Protection of Ground Water Associated with Oil and Gas Leasing, Exploration and Development* (BLM 2010).

Produced water (water recovered from the oil- or gas-bearing formations or other subsurface formations) is by far the largest volume of waste produced during well production. Produced water is typically discharged back down the well or through a second injection well completed in the same formation. Produced water can also be used for nonpotable purposes such as fugitive dust control, provided it is free of contamination from polar organics (e.g., benzene, naphthalene, toluene, phenanthrene), inorganics (e.g., lead, arsenic, sulfide), or NORM, and provided it exhibits no brackish characteristics. Produced water can also require special management because of high concentrations of sodium, chloride, calcium, or magnesium. Discharge of high-salinity waters to the ground surface or surface waters would be prohibited, and capture and treatment or reinjection would be required.

The exact natures and volumes of well development-related wastes would depend on numerous site-specific factors; however, reliable approximations are possible. It is estimated that each well installed would result in the generation of an average of 4,100 bbl (172,200 gal) of well development fluids (DOE 2006). Over the study period, it is projected that many oil and gas wells would be installed in the study area, resulting in the generation of large volumes of development fluids and produced water. Some oil shale facilities might also generate large volumes of well-development wastes. If all the wastes are managed appropriately, incremental cumulative impacts from disposal of these wastes should be minimal.

***Wastes Associated with Mining of Coal and Other Minerals.*** Wastes associated with coal mining include landscape wastes from clearing active mine areas, solid industrial wastes resulting from the maintenance and repair of mining equipment, overburden soils (topsoils and subsoils) removed to gain access to the coal resource,[13] and domestic solid wastes resulting from support of the workforce,[14] produced water, and wastes from coal preparation (e.g., shale, coal fines, and other impurities). Produced water would likely require treatment as a result of the leaching of metals from the coal resource or to adjust its pH. Treatment might result in the generation of metal-bearing sludge that would require off-site disposal in most instances. Coal preparation wastes are typically disposed of on-site or stockpiled for later use in mine reclamation.

Coal production in the study area over the period 2007 to 2027 is projected to be about 78 to 86 million tons/yr (see Tables 6.1.6-4 through 6.1.6-6). The amounts of solid wastes generated would be proportional to total coal mined, but would vary significantly with the particular mining techniques employed and the extent of coal preparation occurring at the mine site. Oil shale development using surface or underground mining would generate waste streams similar to those produced during coal mining. At the PEIS level, it is not possible to equate the nature or volumes of solid wastes with the amount (tons) of coal or oil shale mined. Cumulative impacts of hazardous materials generation and waste management would be evaluated in future NEPA analyses when the locations and sizes of the projects are known.

Sodium minerals (e.g., nahcolite) are produced in Wyoming at a rate of 18 million tons/yr, and this production is expected to continue through the study period. Gilsonite, uranium, and vanadium would be mined within the study area over the period 2007 to 2027; estimated total production rates for these minerals are not available. Gold, lead, molybdenum, silver, and zinc have all been previously mined in Colorado, but no information on any projects or future activities involving these metals is available. Saleable minerals, such as

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[13] Although overburden must be managed carefully to avoid adverse impacts (primarily increased sediment loading to area surface water bodies as a result of erosion), it is not considered a waste; it is typically stockpiled over the active life of the coal mining operation and replaced (in the order of the original soil horizon) as part of mine reclamation.

[14] It is assumed that the workforce would not reside at or near the coal mine, but instead would live in nearby communities. Consequently, wastes related to workforce support would be minimal, consisting primarily of kitchen/food preparation solid wastes, small amounts of administrative (office) solid wastes, and small amounts of sanitary wastes.

sand and gravel, continue to be mined in small quantities, and that level of activity is expected to continue at the local level throughout the study period. In Utah, materials mined in the ROI include sand and gravel, gilsonite, clay, gypsum, dimensionless sandstone, lime, gold, uranium, vanadium, and phosphate. Materials mined in the Wyoming ROI include sand and gravel, crushed stone, and sodium carbonate.

Mineral (e.g., copper, gold, silver) mining and processing can generate wastes during recovery (i.e., mining), beneficiation (separation of mined material), and processing. Recovery can result in large volumes of overburden materials needing management, as discussed above for coal mining. Although those materials are generally not considered waste, they must be managed properly to avoid adverse impacts. Beneficiation can result in the generation of relatively large volumes of potentially hazardous material. This material, referred to as tailings, is processed through dump leaching, in which solutions containing strong acids or cyanides are sprayed onto the tailings to "leach" the metal of interest for capture. The tailings can be voluminous (EPA 1994) and hazardous. Processing of the mineral ore involves a variety of chemical and physical manipulations that produce a wide variety of wastes, many of them capable of producing significant adverse environmental impacts if not managed properly. In 1985, the EPA published a *Report to Congress* on the environmental aspects of non-coal-mining activities; the report provides relatively comprehensive discussions of possible environmental impacts, including the types of wastes resulting from typical recovery, beneficiation, and processing schemes for selected metals (EPA 1985).

As in the development of metallic ores, oil shale development could generate produced water and large volumes of overburden; however, tailings would not be generated. Cumulative impacts of hazardous materials generation and waste management would be evaluated in future NEPA analyses when the locations and sizes of the projects are known.

***Wastes Associated with Designation and Development of Energy Corridors.*** The designation of energy corridors within the study area would not, in and of itself, have any waste consequences. Waste would, however, be generated during actual corridor development for gas and liquid pipelines and for electric power transmission systems on public and private lands. Construction-related wastes would be similar in character to wastes generated during construction of gas and liquid pipelines.

Solid wastes associated with gas and liquid pipelines and with power transmission systems would be generated during construction, operation, and decommissioning. The majority of wastes would be generated during the construction phases. Construction wastes would include wastes generated during preparation of the ROW (these wastes would primarily consist of removed vegetation) and during installation of the pipeline or cables (primarily maintenance-related wastes for vehicles and equipment, dunnage, packaging, and some chemical cleaner wastes). Support of the workforce would result in the production of domestic solid wastes and sanitary wastewaters. It is expected that the majority of construction-related wastes would be nonhazardous and would be managed in existing local landfills or existing municipal or specially built sewage treatment facilities.

Operational wastes would result from the maintenance of equipment (e.g., change-outs of lubricating oils, coolants, and hydraulic fluids from equipment that uses such materials, and sludge from the periodic cleaning of the insides of the pipelines through the use of pigs). The frequency of cleaning and the amount of waste generated would be a function of the commodity being transported; the greatest amounts of pipeline cleaning–related wastes would be generated by pipelines that convey crude oil.

Solid wastes associated with the decommissioning of pipelines or power transmission systems would include wastes from cleaning equipment and some pipeline components. For pipelines it is expected that much of the underground pipeline might be abandoned in place, and for those pipeline components that were removed, the majority would be put into service in other pipeline systems or sold for scrap. As would occur during the construction phase, solid domestic and sanitary wastes would be generated in support of the workforce (albeit in lesser amounts, since it is expected that decommissioning would take substantially less time than initial construction); all such wastes would likely be managed or disposed of in existing facilities. Finally, a certain volume of remedial wastes would be expected to result from the cleanup of spills or leaks that were not removed during operation or occurred during decommissioning.

The construction of gas and liquid pipeline ROWs and transmission ROWs to support oil shale development would generate waste types similar to those discussed above. Large numbers of gas and liquid ROWs are already present on public lands in the study area, and many more areas may be designated as corridors for ROWs during the study period (see Section 6.1.6.2). Incremental impacts from waste generation and disposal would depend on the level of oil shale development and would be analyzed in future site-specific environmental evaluations.

***Wastes Associated with Construction and Operation of New Electric Power Generation Plants.*** Some new power plants are projected to be needed in the study area during the next 20 years. Wastes associated with power plant construction would primarily consist of wastes from maintenance of construction equipment and vehicles powered by internal combustion engines (e.g., used crankcase oil, hydraulic fluids, and coolants). Other major solid waste streams would result from the support of the workforce (e.g., domestic solid wastes and sanitary wastewaters). All such wastes are expected to be easily managed in local or regional landfills or existing or specially built sewage treatment facilities. Minor amounts of industrial solid wastes would also result from the use of various chemicals (paints, coatings, adhesives, and cleaning solvents) during facility construction.

Solid wastes generated during operations by coal-fired power plants would consist of fly ash and bottom ash. It is assumed that newly constructed units would be required to conform to new source production standards. Typical coal-fired power plants generate on the order of 500,000 tons/yr of fly and bottom ash and an additional 150,000 tons/yr of sodium sulfate solid waste (generated as a part of sulfur-capture).

If new power plants are required for oil shale development (e.g., to support in situ facilities), then they would generate waste types similar to those discussed above. Incremental impacts from power plant waste generation and disposal associated with oil shale development would depend on the level of that development and would be analyzed in future site-specific environmental evaluations.

***Wastes Associated with Tar Sands Development.*** Wastes generated from tar sands development would be of the same nature as those described in Section 5.14. Incremental impacts from waste generation and disposal due to oil shale development would depend on the level of oil shale development and would be analyzed in future site-specific environmental evaluations.

**6.1.6.3.14 Health and Safety.** Given the large amount of development for oil and gas, coal mining, and other mineral production projected in the study area over 20 years, many workers will be needed. The types of industries being developed, especially mining, have been associated with relatively high numbers of worker injuries and fatalities in the past (see Section 4.15). Oil shale production activities would add to worker injuries and fatalities in proportion to the level of development. Without more detailed information on future production levels for oil shale as well as the other industries, quantitative estimates of incremental health and safety impacts due to oil shale development are not possible. However, all these industries are required by law to protect worker health and safety by using adequate engineering controls and personal protective devices.

## 6.1.7 Other NEPA Considerations

### 6.1.7.1 Unavoidable Adverse Impacts

The amendment of land use plans to allocate public lands as available or not available for application for leasing for commercial oil shale development would not result in unavoidable adverse environmental impacts under Alternatives 2, 3, and 4, but there may be impacts on land values. Unavoidable adverse impacts on resources could occur under all four alternatives as a result of the ongoing RD&D projects. However, the mitigated environmental impacts (including unavoidable adverse impacts) of the RD&D activities are considered minimal, and all the EAs resulted in FONSIs.

Under all four alternatives, the future development of commercial oil shale projects could result in unavoidable adverse impacts on resources. The magnitude of these unavoidable adverse impacts, as well as the degree to which they could be mitigated, would vary by project type and location. Many of the project-specific impacts could be reduced through implementation of the mitigation practices identified in this PEIS (see Chapter 4).

**6.1.7.1.1 Land Use.** No adverse impacts on land use would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects within the areas identified as available for application for leasing under any of Alternatives 1 through 4. The principal land uses that could be affected by the construction and operation of commercial oil shale projects include livestock grazing, agriculture, oil and gas leasing, minerals extraction, and recreation.

**6.1.7.1.2 Soil, Geologic, and Paleontological Resources.** No adverse impacts on geologic and paleontological resources would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Project construction could result in unavoidable impacts on natural topography, soil erosion, drainage patterns, and slopes, as well as in damage to or destruction of paleontological resources within project footprints. Project construction could also result in the compaction, excavation, and removal of soil from the project area. The likelihood, magnitude, and extent of unavoidable impacts could be reduced under Alternatives 2, 3, and 4 through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.3 Water Resources.** No adverse impacts on water resources would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Impacts on water quality could occur as a result of soil erosion from construction sites; runoff from oil shale mine, processing, and waste storage locations; accidental spills of hazardous liquids (such as fuels, lubricating oils, solvents, and other industrial liquids); and accidental oil spills from project-related pipelines. Although there is a potential for unavoidable adverse impacts on water resources from construction under all four alternatives, the likelihood, magnitude, and extent of these impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.4 Air Quality and Ambient Noise Levels.** No adverse impacts on air quality or ambient noise would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Construction, clearing and grading, trenching, excavation and blasting, and construction vehicle traffic would result in fugitive dust and vehicle emissions, as well as increased ambient noise levels in construction locations. During project operations, unavoidable air impacts would occur primarily during operation of mining and oil shale–processing facilities and equipment and associated vehicular traffic. Noise impacts could also be incurred by these activities, as well as by the operation of pipeline compressor stations. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.5 Ecological Resources.** No adverse impacts on ecological resources would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future commercial development of oil shale projects in the areas identified under any of Alternatives 1 through 4. The construction and operation of project facilities, as well as maintenance of project-related utility, pipeline, and transportation ROWs, under each alternative could result in unavoidable temporary and permanent changes in aquatic resources, plant communities and habitats, wildlife, and threatened and endangered species.

Ecological resources immediately within a project footprint would be destroyed during clearing, grading, and construction activities. Unavoidable impacts on wildlife could include habitat loss, disturbance and/or displacement, mortality, and obstruction to movement. Increased noise during project construction and operation could disrupt local wildlife foraging and breeding of some wildlife. Aquatic biota and habitats could be affected by siltation resulting from runoff from areas of disturbed soils and from accidental releases of hazardous materials from construction and operations equipment (such as fuels) and from an accidental oil pipeline releases. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.6 Visual Resources.** No adverse impacts on visual resources would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Short-term impacts would occur during construction. Fugitive dust and the presence of construction equipment and crews would be visible in the vicinity of the construction site, potentially affecting local viewsheds and recreational experiences. Because project-specific ROWs and infrastructure (e.g., electricity transmission towers, pipelines and compressor stations, surface mines, and oil shale–processing facilities) would be visible throughout the life span of any project, there could be long-term unavoidable impacts on some viewsheds and the recreational experiences of visitors in those viewsheds. Major landforming activities such as recontouring and on-site disposal of spent oil shale could result in impacts lasting well beyond the life span of the project and, in some cases, might result in permanent visual impacts. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.7 Cultural Resources.** No adverse impacts on cultural resources would occur from the allocation of lands as available or not available for application for leasing under any of the alternatives and the associated land use plan amendments under Alternatives 2 through 4. Unavoidable impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Leasing itself has the potential to impact cultural resources to the extent that the terms of the lease could limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed commercial oil shale development on cultural properties. Cultural resources could also incur unavoidable adverse impacts as a result of the future development of commercial oil shale projects in areas identified as available for application for leasing under all four alternatives. Cultural resources could be destroyed by construction activities, such as clearing and grading, mining, facility construction, and pipeline trenching. Development of new ROWs could also increase access to previously inaccessible areas, which could lead to vandalism of both known and undiscovered cultural sites. The likelihood, magnitude, and extent of unavoidable adverse impacts on cultural resources could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.8 Indian Tribal Concerns.** No adverse effects on resources important to Indian tribes would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable impacts could occur as a result of the future development of commercial oil shale projects in areas identified under any of Alternatives 1 through 4, depending on the location of the project in relation to resources important to Indian tribes. Resources could be destroyed by construction activities, such as clearing and grading, mining, facility construction, and pipeline trenching. The visual and auditory context of sacred sites could be impaired. Development of new ROWs could also increase access to previously inaccessible areas, which could lead to vandalism of culturally important sites. The likelihood, magnitude, and extent of unavoidable adverse impacts on resources important to Native Americans could be reduced under each alternative through government-to-government consultation with the affected tribes and the implementation of appropriate project- and location-specific mitigation measures, but adverse impacts may not be entirely avoidable.

**6.1.7.1.9 Socioeconomics and Environmental Justice.** No adverse impacts on socioeconomics, transportation, or environmental justice would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4, with the exception noted regarding potential impacts on land values. Unavoidable social and environmental justice impacts could occur under all four alternatives as a result of the future construction and operation of commercial oil shale projects and associated power plants, coal mines, transportation infrastructure, and employer-provided housing. Rapid population growth could occur following the in-migration of construction and operations workers into communities; this could lead to the undermining of local community social structures with contrasting beliefs and value systems among the local population and in-migrants and, consequently, to a range of changes in social and community life, including increases in crime, alcoholism, drug use, and so forth. Impacts could also occur in association with the degradation of air quality, water quality, and visual resources; increases in traffic and congestion; and the removal of land from traditional uses during commercial project development. Many of these impacts would affect quality of life for the general population in many communities, in addition to that of low-income and minority populations residing in the vicinity of oil shale developments. Many locations of cultural significance to tribal groups may have been protected or identified. Nevertheless, with the alteration of, or restricted access to, water and visual resources and the degradation or migration of particular animal species, oil shale developments would have impacts on subsistence and traditional landscape-based activities important to tribal groups.

**6.1.7.1.10 Hazardous Materials and Waste Management.** No adverse impacts on hazardous materials and waste management would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable adverse impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Construction and operations of oil shale projects would result in the use of hazardous materials and the generation of hazardous and nonhazardous wastes, including materials typically utilized during construction and operations (e.g., fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, corrosion control coatings, and herbicides for vegetation clearing). During construction, nonhazardous landscape wastes would be generated. In general, the appropriate management of these materials would result in only minor impacts. Disposal of spent shale within the leased area could result in unavoidable adverse impacts. The likelihood, magnitude, and extent of unavoidable adverse impacts from hazardous materials and waste management could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.1.7.1.11 Health and Safety.** No adverse impacts on health and safety would occur from the allocation of lands as available or not available for application for leasing under all four alternatives and the associated land use plan amendments under any of Alternatives 2 through 4. Unavoidable adverse impacts could occur as a result of the potential future development of commercial oil shale projects in the areas identified under any of Alternatives 1 through 4. Hazards for workers at oil shale development facilities include risks of accidental injuries or fatalities, lung disease caused by inhalation of particulates and other hazardous substances, and hearing loss. A comprehensive facility health and safety plan and worker safety training would be required as part of the plan of development for every proposed commercial oil shale project. The likelihood, magnitude, and extent of unavoidable adverse impacts on health and safety could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

### 6.1.7.2 Short-Term Use of the Environment and Long-Term Productivity

The amendment of land use plans to allocate lands as available or not available for application for leasing for commercial oil shale development would not affect the short-term uses or long-term productivity of the environment. The impacts (short and long term) from utilization of resources associated with project development under all four alternatives are presented in Chapter 4. For this PEIS, *short-term* refers primarily to the period of construction of a commercial oil shale project; in general, it is during this time that the most extensive environmental impacts would occur. *Long-term* refers primarily to the 20-year time frame considered within this PEIS.

Within the 20-year time frame considered in this PEIS, the development of oil shale projects would not require the short-term disturbance or long-term alteration of a major amount of federal and nonfederal land under any of the four alternatives. Future development of commercial oil shale projects under any of Alternatives 1 through 4 would result in the local, short- and long-term disturbance of most resources. There would be little difference in the types of impacts that could result from project development under any of these alternatives. Under each of these alternatives, land clearing and grading and construction activities would disturb surface soils and wildlife and their habitats, and affect local air and water quality, visual resources, noise levels, and recreational activities within individual project footprints. Similar effects could be expected on other federal and nonfederal lands where project-related infrastructure (e.g., power plants, utility and pipeline ROWs, and worker residences) would be located. Short-term construction-related disturbance of biota (and their habitats) could result in long-term reductions in biological productivity within the project areas.

The long-term presence of commercial oil shale projects and associated ROWs could affect long-term land use within and in the vicinity of the lease areas, as well as on both federal and nonfederal lands where support infrastructure (power plants, ROWs, and employee housing) would be located, especially if previous land use activities in those areas are determined to be incompatible with commercial oil shale projects. The lands and surrounding areas associated with all four alternatives currently support a variety of land uses (depending on their specific locations), including livestock grazing, agriculture, recreation, oil and gas leasing, and minerals extraction. Under all four alternatives, commercial oil shale projects could also affect long-term quality and use of visual resources and use of recreational resources on federal and nonfederal lands. While some recreational activities (such as OHV use) could experience long-term increases in activity as a result of new ROWs in previously inaccessible areas, changes in the types and patterns of recreational usage can be positive or negative, depending on the subjective values of the interested and affected public.

#### 6.1.7.3 Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable commitments of resources associated with the implementation of the four alternatives evaluated in this PEIS. A resource commitment is considered *irreversible* when direct and indirect impacts from its use limit future use options. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and to those resources that are renewable only over long periods of time, such as soil productivity or forest health. A resource commitment is considered *irretrievable* when the use or consumption of the resource renders it neither renewable nor recoverable for future use. Irretrievable commitments apply to loss of production, harvest, or use of natural resources.

The amendment of land use plans to identify lands as available or not available for application for leasing for commercial oil shale development would not result in the irreversible or irretrievable commitment of resources. As a result of future commercial oil shale projects that are authorized, constructed, and operated on lands identified as available for such activities, however, irreversible and irretrievable commitments of resources could occur. The nature and magnitude of these commitments would depend on the specific location of the project development as well as on its specific design and operational requirements. The commitment of resources would be identical for any specific project located in the same lease area under all four alternatives.

In addition to the oil shale itself, the construction of future commercial oil shale projects under all four alternatives could result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials. Water resources could also be consumed during construction, although water use would be temporary and largely limited to on-site concrete-mixing and dust abatement activities.

In general, the impact on biological resources from future project construction and operation would not constitute an irreversible and irretrievable commitment of resources. During project construction and operation, individual animals would be impacted. Site- and species-specific analyses and mitigation conducted at the project level during authorization would make adverse impacts on entire populations unlikely. However, if adverse impacts on threatened or endangered species occurred, those impacts would likely contribute an irreversible commitment of resources.

The clearing of project areas (including off-lease locations where utility and pipeline ROWs, power plants, and employer-provided housing) would result in the direct loss of vegetation and habitats within the construction footprints, which would be irretrievable in areas where project infrastructure would be constructed and operated. While habitat would be impacted during project construction, implementation of project-specific mitigation measures (such as habitat restoration) would reduce these impacts over time. However, habitats within project infrastructure footprints (such as buildings and surface mines) would be irretrievably committed to the development and operation of commercial oil shale projects.

Cultural and paleontological resources are nonrenewable, and any disturbance of these resources would constitute an irreversible and irretrievable commitment of resources. However, consideration and implementation of mitigation could minimize the potential for impacts on these resources. Access to previously inaccessible areas could lead to vandalism of both known and unknown cultural and paleontological resources, thereby rendering them irretrievable. Impacts on visual resources could constitute an irreversible and irretrievable commitment of resources, but these impacts could also be lowered somewhat through the consideration and implementation of the mitigation measures.

#### 6.1.7.4 Mitigation of Adverse Effects

Following the amendment of land use plans to identify areas available for application for commercial leasing, any future development of commercial oil shale projects within the lease areas could result in adverse impacts on many resources (see Chapter 4 and Sections 6.1.2 and 6.1.3). The nature, extent, magnitude, and duration of any project-related impacts would be directly determined by (1) the project location, (2) the nature and quality of resources at and in the vicinity of the project site (and its associated infrastructure), (3) the technology used and the plan of development for the project. Many of the impacts could be reduced or avoided through the implementation of appropriate site- and project-specific mitigation measures. Development of individual commercial oil shale projects would require additional project-specific NEPA analyses and the identification of location-, project- and resource-specific mitigation measures. Mitigation measures would be identified as lease stipulations by the BLM for any authorized commercial development. Chapter 4 of this PEIS identifies many types of resource-specific mitigation measures that could be implemented during project construction and operation.

## 6.2 TAR SANDS ALTERNATIVES

This section presents the impacts associated with the four tar sands alternatives: Alternative 1 (the No Action Alternative) is discussed in Section 6.2.1; The impacts of Alternatives 2 (Conservation Focus), 3 (Pending Commercial Lease), and 4 (Moderate Development) are discussed in Sections 6.2.2, 6.2.3, and 6.2.4, respectively. Section 6.2.5 presents a comparison of the tar sands alternatives. Discussions of the cumulative impacts and other NEPA considerations associated with Alternatives 2, 3, and 4 are presented in Section 6.2.6.

The total acreage included within the 11 STSAs is about 1,026,266 acres, of which 653,809 acres are public lands. These public lands consist of 572,613 acres of surface and subsurface lands and 81,196 acres of subsurface mineral under nonfederal surface (see Table 2.4-1).

Information contained in Sections 6.2.2, 6.2.3, and 6.2.4 describes (1) the impact of the land allocation decisions proposed in Alternatives 2, 3, and 4, which is the focus of the PEIS, and (2) the potential impact of future commercial tar sands development on the public lands that would be made available for application for future leasing and development in each alternative. The bulk of the information provided in Sections 6.2.2, 6.2.3, and 6.2.4 addresses the effects of potential future commercial development. However, as has been explained previously in this PEIS, commercial leasing and development are not being approved at this time. The information on potential impacts is being presented to help agency decision makers and the public form an impression of the effects of potential future development. Together with the information contained in Chapter 5, this analysis and comparison of potential impacts of future development associated with each of the alternatives aids agency decision makers in making an informed decision regarding the relative merits of the alternative approaches to land allocation. It is also intended that these analyses will help identify information that will be needed to process future applications for commercial development.

On the basis of the analyses contained in this PEIS, the BLM has determined that with the exception noted in the socioeconomic analysis regarding potential impacts on land values, the land use plan amendments represented by Alternatives 2, 3, and 4 would not result in any impacts on the environment or socioeconomic setting. The future development of commercial tar sands projects that could be approved after subsequent NEPA analysis on lands identified in these alternatives as available for application for leasing, however, would have impacts on the environment and the socioeconomic setting. The bulk of the information presented in Sections 6.2.2, 6.2.3, and 6.2.4 identifies in a non-site-specific manner the potential impacts associated with future commercial tar sands development under each alternative. The magnitude of the impacts cannot be quantified at this time because key information about the location of commercial projects, the technologies that may be employed, the project size or production level, development time lines, and potential mitigation that might be employed are unknown.

### 6.2.1 Impacts of Alternative 1, the No Action Alternative (No Change to the 2008 Decision)

Under Alternative 1, no existing land use plans would be amended, and 430,686 acres would remain available for application for commercial tar sands leasing. These lands are included within 10 designated STSAs: Argyle Canyon, Asphalt Ridge, Hill Creek, Pariette, P.R. Spring, Raven Ridge, San Rafael, Sunnyside, Tar Sand Triangle, and White Canyon (see Figure 2.4.2-1 and Table 2.4.2-1). The eleventh existing designated STSA, Circle Cliffs, is not available for leasing under any alternative because the portion administered by the BLM is located entirely within the GSENM. The public lands available under Alternative 1 consist of 360,363 acres of BLM-administered lands and 34,852 acres of split estate lands. (See Section 2.4.2 for a complete description of Alternative 1.) Figure 2.4.2-1 shows the lands available for application for leasing under Alternative 1. In this alternative, any leasing or development of tar sands resources would be managed under the requirements of the four existing land use plans consistent with the ROD from the 2008 OSTS PEIS. Prior to approval of any commercial leasing or development of tar sands resources, additional NEPA analysis would be required.

On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with amending land use plans to make lands available or not available for application for commercial leasing in the three-state study area, but there may be impacts on land values. The development of commercial tar sands projects on lands identified as available for application for leasing, however, would impact resources on these lands.

In general, potential impacts of future commercial development on specific resources located within the 430,686 acres cannot be quantified at this time because key information about the location of projects, the technologies that will be employed, the project size or production level, and development time lines are unknown. While it is not possible to quantify the impacts of project development, it is possible to make observations and draw conclusions on the basis of certain lands being made available for application for leasing and their overlap with specific resources. The following sections describe the potential impacts on the environment and socioeconomic setting of subsequent commercial development that might occur on the lands identified as available for leasing in Alternative 1. Many of these potential impacts might be successfully avoided or mitigated, depending upon site- and project-specific factors and future regulations that will guide leasing actions.

The total amount of public land (including both surface and subsurface) within the 11 designated STSAs is 653,809 acres (Table 2.4-1). Under Alternative 1, about 66% of these lands would remain available for application for commercial leasing. Table 6.2.1-1 lists the acreages per STSA. The public lands that would not be available for application for leasing include all those areas that are excluded from leasing and development by virtue of existing laws and regulations, E.O.s, land use plan designations, and other administrative designations or withdrawals. These excluded lands (e.g., Wilderness Areas, WSAs, National Monuments, WSRs, and ACECs) encompass many of the areas where special resources are known to exist. In addition, the BLM has excluded all lands within the Circle Cliffs STSA (which is located inside the GSENM) and corridors along suitable WSR segments.

#### 6.2.1.1 Land Use

Under Alternative 1, 430,686 acres of public land in Utah would remain available for application for leasing for commercial development of tar sands. This availability is expected to have no impacts on other land uses, although there may be some effect on land values. Retaining these lands as available for application for leasing does not authorize or approve any ground-disturbing activities that could affect land uses; however, existing land uses could be adversely affected by future commercial tar sands development on these lands.

**TABLE 6.2.1-1 Amount of Land Available for Application for Commercial Tar Sands Leasing under All Alternatives[a,b]**

| | Acres Available | | | |
|---|---|---|---|---|
| STSA | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| Argyle Canyon | 11,226 | 0 | 0 | 11,226 |
| Asphalt Ridge | 5,435 | 0 | 2,100 | 5,435 |
| Hill Creek | 56,507 | 9,834 | 0 | 62,152 |
| Pariette | 10,161 | 830 | 0 | 10,161 |
| P.R. Spring | 152,617 | 42,304 | 0 | 152,617 |
| Raven Ridge | 14,364 | 9,118 | 0 | 14,364 |
| San Rafael Swell | 70,475 | 8,927 | 0 | 69,696 |
| Sunnyside | 77,962 | 19,888 | 0 | 68,200 |
| Tar Sand Triangle | 24,938 | 97 | 0 | 24,938 |
| White Canyon | 7,000 | 45 | 0 | 7,001 |
| Total | 430,686 | 91,045 | 2,100 | 425,790 |

[a] Acreage estimates were derived from GIS data compiled to support the PEIS analyses.

[b] Columns and rows may not add exactly due to rounding.

As discussed in Section 3.1, lands where commercial tar sands development might occur are currently used for a wide variety of activities, including recreation, mining, hunting, oil and gas production, livestock grazing, wild horse and burro management, communication sites, and ROW corridors (e.g., roads, pipelines, and transmission lines). Commercial tar sands development would have a direct effect on these uses depending upon the type of authorization they hold for the use of public lands and could displace them from areas that are developed for tar sands production. Tar sands development also will require off-lease construction of infrastructure, such as transmission and pipeline ROWs and possibly employer-provided housing, which also may have an impact on existing land uses. Some uses of public and nonpublic lands might also be indirectly affected by tar sands development.

Future indirect impacts of tar sands development could be associated with changing existing land uses, including conversion of land in and around local communities from existing agricultural, open space, or other uses to provide services and housing for employees and families that move to the region in support of commercial tar sands development. Increases in traffic, increased access to previously remote areas, and development of tar sands facilities in currently undeveloped areas would continue to change the overall character of the landscape. The value of private ranches and residences in the area affected by tar sands development or associated ROWs either may be reduced, because of perceived noise, traffic, or human health or aesthetic concerns, or may be increased by additional demand.

Transmission and pipeline ROWs associated with commercial tar sands development would not preclude other land uses but would result in both direct and indirect impacts. Direct impacts, such as the loss of land to physical structures, maintenance of ROWs free of major vegetation particularly in forested areas, maintenance of service roads, and noise and visual impacts on recreational users along the ROW, would last as long as the transmission lines and pipelines were in place. Indirect impacts of ROW development could include the introduction of new or increased recreational use to an area due to improved access, avoidance of the area for residential or recreational use for aesthetic reasons, and increased traffic.

The specific impacts on existing land use and the magnitude of those impacts would depend on project location; project size, technology employed, and scale of operations; and proximity to roads, transmission lines, and pipelines. Impacts on various land uses that could be caused by commercial development of tar sands are discussed in Section 5.2 and are summarized below.

- Commercial tar sands development, using any technology under consideration in this PEIS, is largely incompatible with other mineral development activities because each of the technologies would dominate the land area on which it is located. Oil and gas development is ongoing in many parts of the study area, and conflict between tar sands projects and oil and gas projects may occur. While it is possible that undeveloped portions of a tar sands lease area could be available for other mineral development, such development would be unlikely to occur on a widespread basis, except possibly in areas where a single company is developing multiple resources. Conflict between tar sands and oil and gas or other mineral development would cease when tar sands development and extraction have been completed.

- Where existing agricultural water rights are acquired to support tar sands development, existing irrigation-based agricultural uses of the land from which the water is acquired would be modified to support lower value dry land use of the lands and/or may result in a complete loss of agricultural uses in some areas. Conversion to nonfarm uses may be dependent upon local zoning decisions.

- Grazing activities would be precluded by commercial tar sands development in those portions of a lease area that were (1) undergoing active development; (2) being prepared for a future development phase; (3) undergoing restoration after development; or (4) occupied by long-term surface modifications and facilities, such as surface mine excavations, production facilities, office buildings, retorts, and parking lots. Depending on conditions unique to the individual grazing allotment, temporary reductions in authorized grazing use will likely be necessary because of the loss of a portion of the forage base. It is possible, depending upon how commercial leases would be developed, that some grazing uses might be accommodated on parts of the leases at various times during the lease period. Once surface restoration of tar sands development areas is complete, a resumption of grazing use would be possible.

  The impact of the removal of acreage from individual grazing leases would depend on site-specific factors regarding the grazing allotment(s) affected. The size and productivity of BLM grazing allotments varies greatly across the PEIS study area, and the loss of up to 5,760 acres for individual tar sands facilities from larger allotments may not be as significant as from smaller allotments. Smaller allotments could become completely unavailable for grazing use. Others would lose varying percentages of grazing area that may affect their overall economic viability. While lands might be available for grazing use after completion of tar sands development activities, individual permittees may not be able to withstand the economic impacts on their operations during the development period.

- Commercial tar sands development activities are largely incompatible with recreational land use (e.g., hiking, biking, fishing, hunting, bird-watching, OHV use, and camping). Recreational uses would be precluded from those portions of commercial lease areas involved in ongoing development and restoration activities. Impacts on vegetation, development of roads, and displacement of big game would degrade the recreational experiences and hunting opportunities near commercial tar sands projects. The impact of displacement of recreational uses from tar sands development lease areas would be highly dependent upon site-specific factors, especially the nature of existing uses on the site.

- Specially designated areas, including all designated Wilderness Areas, WSAs, other areas that are part of the NLCS (e.g., National Monuments, NCAs, WSRs, and National Historic and Scenic Trails) and existing ACECs would not be available for application for tar sands leasing and commercial development and would not be directly affected. They might, however, incur indirect impacts (e.g., degraded viewsheds) resulting from commercial tar sands development on adjacent lands or on areas within the general vicinity.

- This alternative excludes from leasing 50,967 acres of designated ACECs existing at the time the analysis for the 2008 PEIS was completed. However, there are four ACECs totaling 10,541 acres that were designated in the 2008 Utah land use plan revisions that are not excluded from leasing in this alternative. Table 6.2.1-2 shows these ACECs that are subject to potential development. If tar sands development occurs on these lands, depending on the nature of resources present in the ACECs, these resources would be lost.

  There are 179,985 acres of lands classified as potential ACECs under Alternative C in the 2008 OSTS PEIS in Utah that are available for application for leasing under this alternative. If tar sands development occurs on these lands, depending on the nature of resources present within the potential ACECs, these resources would be lost. The four ACECs that include 10,541 acres described in the preceding paragraph are included in the potential ACEC acreage described here.

**TABLE 6.2.1-2 ACECs That Overlap with Lands Available for Application for Commercial Tar Sands Leasing under All Alternatives and the Amount of Overlap[a]**

| | Amount of Overlap (acres) | | | |
|---|---|---|---|---|
| ACEC | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***San Rafael STSA*** | | | | |
| Lucky Strike | 575 | 0 | 0 | 0 |
| Wild Horse Canyon | 122 | 0 | 0 | 0 |
| Temple Mountain | 82 | 0 | 0 | 0 |
| ***Sunnyside STSA*** | | | | |
| Nine Mile Canyon | 9,762 | 0 | 0 | 0 |
| ***Total*** | 10,541 | 0 | 0 | 0 |

[a] Totals may be off due to rounding. Acreage estimates were derived from GIS data compiled to support the PEIS analyses.

- Lands available for application for lease contain all or portions of areas that were recognized by the BLM in Utah as LWC. Table 6.2.1-3 lists these areas. Most of these areas were not identified for long-term management to protect wilderness resources in the series of land use plans completed in Utah in 2008. Should commercial development of tar sands occur on these lands, the identified wilderness characteristics in both the areas that are developed and those that border the developed areas would be lost. Alternative 1 includes approximately 145,000 acres of these lands that could be subject to potential development.

#### 6.2.1.2 Soil and Geologic Resources

Under Alternative 1, no existing land use plans would be amended, and the 430,686 acres of public land in Utah designated in 2008 for commercial tar sands leasing would remain available (Section 2.4.2). Under this alternative, commercial tar sands leasing would not have any direct impacts on soil or geologic resources. Soil and geologic resources within the area, however, could be affected by future commercial tar sands development on these lands.

Soil and geologic resources could be affected during project construction as a result of removal or compaction (e.g., during site clearing and grading, foundation excavation and preparation, and pipeline trenching) and by erosion during project construction and operation (e.g., erosion of exposed soils in construction areas or of topsoil stockpiles (see Section 5.3.1). Erosion of exposed soils could also lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust, which could affect local air quality. Project areas would remain susceptible to erosion until completion of construction, mining, tar sands processing, and site stabilization and reclamation activities (e.g., revegetation of pipeline ROWs and surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as to areas where associated off-lease infrastructure (e.g., access roads, utility ROWs, and power plants) would be located.

Under Alternative 1, impacts on soil and geologic resources could occur wherever individual projects are located within the 430,686 acres available for application for commercial leasing. For any project, the erosion potential of the soils would be a direct function of the lease and project location and also the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

#### 6.2.1.3 Paleontological Resources

Under Alternative 1, no existing land use plans would be amended, and the 430,686 acres of public land in Utah designated in 2008 for commercial tar sands leasing would remain available (Section 2.4.2). Paleontological resources within these areas could be adversely affected if leasing and subsequent commercial development occur. Of the 430,686 acres available for application within the STSAs, a total of 335,396 acres (approximately 78% of the

**TABLE 6.2.1-3 Areas with Wilderness Characteristics That Overlap with Lands Available for Application for Commercial Tar Sands Leasing under All Alternatives and the Amount of Overlap[a,b]**

| Name of Area with Wilderness Characteristics | Amount of Overlap (acres) | | | |
|---|---|---|---|---|
| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Hill Creek STSA*** | | | | |
| Wolf Point | 937 | 0 | 0 | 937 |
| ***P.R. Spring STSA*** | | | | |
| Bitter Creek | 12,252 | 0 | 0 | 12,252 |
| Hideout Canyon | 1025 | 0 | 0 | 1,025 |
| Lower Bitter Creek | 514 | 0 | 0 | 514 |
| Mexico Point | 748 | 0 | 0 | 748 |
| Wolf Point | 5,149 | 0 | 0 | 5,149 |
| Flume Canyon | 19 | 0 | 0 | 19 |
| Westwater Creek | 1,468 | 0 | 0 | 1,468 |
| ***Raven Ridge*** | | | | |
| The Rim Rock B | 828 | 0 | 0 | 828 |
| ***San Rafael STSA*** | | | | |
| Devils Canyon | 1,113 | 0 | 0 | 1,113 |
| Hondu Country[c] | 4,206 | 0 | 0 | 4,206 |
| Mexican Mountain[c] | 17733 | 0 | 0 | 17,733 |
| Muddy Creek–Crack Canyon[c] | 10,883 | 0 | 0 | 10,597 |
| San Rafael Knob | 5,412 | 0 | 0 | 5,103 |
| San Rafael Reef[c] | 3,991 | 0 | 0 | 3,991 |
| Sids Mountain | 4,244 | 0 | 0 | 4,244 |
| Sids Draw | 3,560 | 0 | 0 | 3,560 |
| Block Mountain | 5,934 | 0 | 0 | 5,934 |
| Horseshoe-Wickiup | 5,834 | 0 | 0 | 5,834 |
| ***Sunnyside STSA*** | | | | |
| Big Sulfur Canyon | 280 | 0 | 0 | 280 |
| Cold Spring Draw East | 506 | 0 | 0 | 0 |
| Cold Spring Draw West | 5,343 | 0 | 0 | 5,343 |
| Cottonwood Ridge | 5,887 | 0 | 0 | 5,887 |
| Currant Canyon | 624 | 0 | 0 | 553 |
| Desolation Canyon | 6,936 | 0 | 0 | 2,019 |
| Horse Ridge West Unit 1 | 4,383 | 0 | 0 | 4,383 |
| Indian Swale | 2,763 | 0 | 0 | 2,763 |
| Sheep Canyon | 2,758 | 0 | 0 | 2,502 |
| ***Tar Sand Triangle STSA*** | | | | |
| Dirty Devil–French South | 24,272 | 0 | 0 | 24,272 |
| The Cove | 455 | 0 | 0 | 455 |

**TABLE 6.2.1-3 (Cont.)**

| Name of Area with Wilderness Characteristics | Amount of Overlap (acres) | | | |
|---|---|---|---|---|
| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***White Canyon STSA*** | | | | |
| Blue Notch | 39 | 0 | 0 | 39 |
| Dark Canyon | 218 | 0 | 0 | 218 |
| Fort Knocker Canyon | 71 | 0 | 0 | 71 |
| Gravel and Long Canyon | 1,727 | 0 | 0 | 1,727 |
| Red Rocks Plateau | 69 | 0 | 0 | 69 |
| Red Rocks Plateau A | 68 | 0 | 0 | 68 |
| White Canyon | 2,751 | 0 | 0 | 2,751 |
| ***Total*** | 144,998 | 0 | 0 | 138,653 |

[a] The key characteristics of wilderness that may be considered in land use planning include an area's appearance of naturalness and the existence of outstanding opportunities for solitude or primitive and unconfined types of recreation.

[b] Totals may be off due to rounding. Acreage estimates were derived from GIS data compiled to support the PEIS analyses.

[c] Indicates areas that were designated in the 2008 RMPs for long-term management to protect wilderness characteristics.

430,686 acres that would be available under Alternative 1) have been identified as overlying geologic formations having the potential to contain important paleontological resources (Murphey and Daitch 2007).

Impacts from tar sands development could include the destruction of paleontological resources and the loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development area, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. However, tar sands development could also result in scientifically beneficial discoveries that may not have otherwise been made. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 5.4.

#### 6.2.1.4 Water Resources

Under Alternative 1, the 430,686 acres of public land in Utah available for application for leasing for commercial development of tar sands (approximately 66% of the federal lands in the STSAs) would remain available. This land use allocation would not have direct impacts on water resources. Surface water and groundwater resources, however, could be adversely affected by subsequent commercial tar sands development on these lands. The amount of water that may be required for future commercial development and the potential mix required among surface water, groundwater, and treated process water is unknown.

The inability to predict specific locations for potential future commercial development and the lack of information regarding the type of technology that might be employed make it impossible to predict the specific impacts on water resources that could occur with commercial development. The magnitude of such impacts would depend on the specific location of the area being developed, as well as the design of the project and associated infrastructure.

Section 5.5 of this PEIS provides a generic description of the potential impacts on water resources. These impacts could occur anywhere within the 430,686 acres available for application for leasing under this alternative. The following is a summary of these generic impacts:

- Degradation of surface water quality caused by increased sediment load or contaminated runoff from project sites;
- Surface disturbance that may alter natural drainages by both diverting and concentrating natural runoff;
- Surface disturbance that becomes a non-point source of sediment and dissolved salt to surface water bodies;
- Withdrawal of water from a surface water body that reduces its flow and degrades the water quality of the stream downgradient from the point of the withdrawal;
- Withdrawals of groundwater from a shallow aquifer that produce a cone of depression and reduce groundwater discharge to surface water bodies or to the springs or seeps that are hydrologically connected to the groundwater;
- Construction of reservoirs that might alter natural streamflow patterns, alter local fisheries, temporarily increase salt loading, cause changes in stream profiles downstream, reduce natural sediment transport mechanisms, and increase evapotranspiration losses;
- Discharged water from a project site that could have a lower water quality than the intake water that is brought to a site;
- Mine tailings that might be sources of salt, metal, and hydrocarbon contamination for both surface and groundwater;
- Dewatering operations of a mine, or dewatering through wells that penetrate multiple aquifers, that could reduce groundwater discharge to seeps, springs, or surface water bodies if the surface water and the groundwater are connected;

- Degradation of groundwater quality resulting from the injection of lower quality water, from contributions of residual hydrocarbons or chemicals from retorted zones after recovery operations have ceased, and from spent shale replaced in either surface or underground mines; and

- Reduction or loss of flow in domestic water wells from dewatering operations or from production of water for industrial uses.

As noted in Section 6.2.1.2, lands available for application for leasing under Alternative 1 include lands that have been identified in BLM land use plans as having high potential for erosion due to steep slopes and/or highly erosive soils. Surface water quality could be adversely impacted by erosion from these lands and similar lands throughout the STSAs, which would contribute to increases in sediment and salinity loads.

In addition, lands available for application for leasing under Alternative 1 contain sensitive hydrologic areas identified by the BLM, including about 6,100 acres of watershed, floodplains, and other sensitive water resources in Utah. Impairment of the function of these areas by increased sedimentation from disturbance of sensitive soil areas or from runoff of contaminated water from project sites would also contribute to overall adverse effects on water quality.

There are approximately 272 mi of perennial streams in the STSAs. Alternative 1 contains approximately 185 mi (68%) of these perennial streams that could be adversely impacted, either directly or indirectly, by future commercial tar sands development.

#### 6.2.1.5 Air Quality

Under Alternative 1, 430,686 acres of public land would remain available within Utah for application for leasing for commercial development of tar sands (Section 2.4.2). Air resources would not be affected by this action. Air resources in and around these areas, however, could be affected by future commercial development of tar sands. Under Alternative 1, local, short-term air quality impacts could be incurred as a result of (1) PM releases (fugitive dust and diesel exhaust) during construction activities such as site clearing and grading in preparation for facility construction, and (2) exhaust emissions ($NO_x$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 5.6). These types of impacts would be of short duration and largely limited to specific project locations and the immediate surrounding area. Similar short-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the tar sands. Processing activities may also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, that could extend beyond the boundaries of the potential lease areas. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during tar sands excavation and processing (see Section 5.6). In addition, ozone precursors of

$NO_x$ and VOC from tar sands development could exacerbate wintertime high-ozone occurrences already prevalent in the study area, especially in Uintah County. Operational releases of HAPs (such as benzene, toluene, and formaldehyde) as well as diesel PM could also affect workers and nearby residences (if any are present); these impacts, however, would be localized to the immediate project location and subject to further analyses prior to implementation.

During all phases of tar sands development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustions sources could contribute to climate change to some extent.

#### 6.2.1.6 Noise

Under Alternative 1, 430,686 acres of public land in Utah are available for application for leasing for commercial development of tar sands. Ambient noise levels in these areas are not expected to be affected by this land allocation decision. Ambient noise levels could be affected, however, by future commercial development of tar sands. Under Alternative 1, local, short-term changes in ambient noise levels could occur during the construction, operation, and reclamation of tar sands projects (see Section 5.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Impacts on wildlife and recreational users are discussed in Sections 5.8.1.3 and 5.2.1.3, respectively.

Noise levels could be affected as a result of the operation of construction equipment (graders, excavators, and haul trucks) and as a result of any blasting activities. Increases in ambient noise levels during operations would be associated with mining and tar sands processing activities and would be more long-term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short-term and long-term impacts could also occur in other areas where electric transmission lines, oil pipelines, gas pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could also be increased in the immediate vicinity of any pipeline pump stations and could also be affected by project-related vehicular traffic at the project site and related locations such as access roads to the site.

Construction-related noise levels could exceed EPA guidelines (however, local jurisdictions have noise controls pertaining to construction). Similarly, operational noise associated with mining and retort activities could, in the absence of mitigation, exceed EPA guidelines at some project locations or nearby sensitive receptors. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline levels except for short durations and very close to road or high traffic areas.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes in ambient noise levels from project development could occur wherever a project is located within the 430,686 acres identified for application for leasing under Alternative 1.

### 6.2.1.7 Ecological Resources

Under Alternative 1, a total of 430,686 acres of land in Utah is available for application for commercial tar sands development. These lands support a wide variety of biota and their habitats (Section 3.7). Ecological resources in these areas are not expected to be affected by the availability of these lands for leasing; however, ecological resources could be affected by future commercial development of tar sands in and around the 430,686 acres of available lands. The following sections describe the potential impacts on ecological resources that may result with commercial tar sands development within the areas identified as available for application for commercial leasing under Alternative 1.

The magnitude of potential impacts on specific ecological resources that could occur from commercial tar sands development of areas identified as available for application for leasing in Alternative 1 would depend on the specific location of the future commercial projects as well as on the specific project design.

**6.2.1.7.1 Aquatic Resources.** Under Alternative 1, 430,686 acres of land in Utah are available for application for commercial tar sands development. There are no impacts on aquatic habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Potential impacts on aquatic resources from tar sands development could result primarily from increased turbidity and sedimentation, changes in water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 5.8.1.1. As described in Section 5.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals are occurring. Consequently, this analysis considers the potential for impacts on waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities are located more distant from waterways, the potential for negative effects on aquatic resources is reduced. For the analysis of potential impacts under each of the alternatives considered in the PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increases.

Under Alternative 1, there are nine perennial streams and about 28 mi of perennial stream habitat within the STSAs of Utah that are directly overlain by areas potentially available for tar sands development (Table 6.2.1-4). When an additional 2-mi zone surrounding these areas is considered, there are 20 perennial streams and about 185 mi of perennial stream habitat that could be affected by future development activities (Table 6.2.1-5). The development of commercial tar sands projects in the areas identified under Alternative 1 could affect aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 5.1.1.1, impacts from water quality degradation and water depletions could affect resources not only in areas within or immediately adjacent to leased areas, but also in areas farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

**TABLE 6.2.1-4 Perennial Streams Occurring in Utah within the Lease Areas Identified under Alternative 1**

| Stream | Length of Stream (mi) |
|---|---|
| Tabyago Canyon | 2.0 |
| Bitter Creek | 0.7 |
| Center Fork | 1.9 |
| Sand Wash | 0.5 |
| Sweetwater Canyon | 6.0 |
| Wells Draw | 1.1 |
| Cottonwood Canyon | 5.1 |
| Dry Creek | 5.9 |
| Nine-Mile Creek | 5.2 |
| Total | 28.4 |

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the STSAs are described in Section 3.7.1.2, and some of these aquatic habitats are known to, or are likely to, contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. Specific impacts would depend greatly upon the locations and methods of extraction used by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing to evaluate potential impacts in greater detail.

**6.2.1.7.2 Plant Communities and Habitats.** Under Alternative 1, 430,686 acres of land in Utah are available for application for commercial tar sands leasing. No impacts on plant communities and habitats associated with identifying lands as available for application for commercial leasing are expected. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Areas identified as available for application for commercial leasing under Alternative 1 support a wide variety of plant communities and habitats (see Section 3.7.2). These areas include approximately 6,874 acres that are currently identified in BLM land use plans for the protection of riparian habitats, floodplains, and special status plant species. Direct impacts on these resources would not occur in these areas. Direct and indirect impacts could be incurred in the remaining areas during project construction and operation extend over a period of several decades (especially within facility and infrastructure footprints) (see Section 5.8.1.2). Some impacts (e.g., habitat loss) could continue beyond the termination of tar sands production.

Direct impacts from future construction and operation activities would include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities, such as access roads, pipelines, transmission lines, and employer-provided housing,

**TABLE 6.2.1-5 Streams and Approximate Miles of Each Stream in STSAs and in the Vicinity[a] of Areas To Be Considered for Leasing under Alternatives 1, 2, and 4**

| | Length of Stream(mi) | | | |
|---|---|---|---|---|
| Stream | Within STSAs | Alternative 1 | Alternative 2 | Alternative 2 |
| Big Water Canyon | 9.4 | –[b] | – | – |
| Bitter Creek | 18.1 | 17.6 | 15.4 | 17.6 |
| Center Fork | 5.5 | 5.5 | 5.5 | 5.5 |
| Cliff Creek | 13.5 | 13.5 | 13.1 | 13.5 |
| Colorado River | 10.5 | – | – | – |
| Cottonwood Canyon | 15.1 | 15.1 | 13.2 | 15.1 |
| Deep Creek | 4.0 | 2.3 | – | 2.3 |
| Dirty Devil River | 22.0 | 13.9 | 7.5 | 13.9 |
| Dry Creek | 14.9 | 14.9 | 13.3 | 14.9 |
| Eagle Canyon | 3.2 | 0.4 | 0.1 | 0.4 |
| Green River | 9.7 | 4.8 | – | 4.8 |
| Halls Creek | 3.3 | – | – | – |
| Horse Canyon | 7.8 | – | – | – |
| Joe Hole Wash | 1.0 | – | – | – |
| Mosby Creek | 5.1 | 2.2 | – | 2.2 |
| Nine Mile Creek | 22.5 | 22.2 | 21.7 | 21.7 |
| No Name Available[c] | 1.4 | – | – | – |
| Pariette Draw | 7.0 | 4.4 | – | 4.4 |
| Pleasant Valley Wash | 5.7 | 4.8 | – | 4.8 |
| Right Fork Indian Canyon | 1.5 | – | – | – |
| San Rafael River | 37.2 | 26.6 | 14.3 | 26.7 |
| Sand Wash | 4.0 | 3.9 | 0.7 | 3.9 |
| South Fork Avintaquin Creek | 4.0 | 1.1 | – | 1.1 |
| Sowers Canyon | 2.9 | 2.8 | – | 2.8 |
| Sweetwater Canyon | 14.5 | 14.5 | 13.8 | 14.5 |
| Tabyago Canyon | 14.3 | 7.4 | – | 11.4 |
| Wells Draw | 7.3 | 6.8 | 6.5 | 6.8 |
| Whiterocks River | 6.9 | – | – | – |
| Total miles | 272.2 | 184.9 | 125.1 | 188.3 |

[a] Stream lengths for alternatives include portions of streams within each potential allocation area and a 2-mi zone surrounding the potential allocation area.

[b] A dash indicates that the stream does not fall within a potential allocation area or within a 2-mi buffer surrounding the potential allocation area under this alternative.

[c] No name was given for this stream in the GIS database used for analysis in this PEIS.

would be developed. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be local (occurring within construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction and facilities would occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The area available for application for commercial leasing under Alternative 1 includes locations that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of tar sands development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

The lands available under this alternative include one ACEC, Nine Mile Canyon. This ACEC includes sensitive plant species. Direct and indirect impacts on these sensitive species could occur. However, stipulations that are currently identified in BLM land use plans that address sensitive resources apply to this ACEC.

Three ACECs that include rare plant species and/or rare or important plant communities are located adjacent to the Alternative 1 footprint: Pariette Wetland, San Rafael Reef, and Leers Canyon. Three ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) the Alternative 1 footprint: Red Mountain-Dry Fork (3.1 mi), Raven Ridge (1.9 mi), and Cottonwood-Diamond Watershed (0.6 mi). Indirect impacts on the sensitive species or communities within these ACECs could occur.

**6.2.1.7.3 Wildlife.** Under Alternative 1, a total of 430,686 acres of lands in Utah is available for application for commercial tar sands leasing. While no impacts on wildlife species associated with lands identified as available for application for commercial leasing are expected, impacts could result from post-lease construction and operations as described in Section 5.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. These areas and surrounding locations support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations in the BLM RMPs provide protection for different wildlife species. These stipulations include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) subject to TL (where the BLM may allow specified activities but not during certain sensitive seasons, such as when raptors are nesting or when big game are on their winter ranges). Table 6.2.1-6 identifies the amount of habitat protected by these stipulations in areas available for application for tar sands leasing in Alternative 1. In most instances, the stipulations for wildlife are TLs. In the White Canyon STSA, there are stipulations listed as closed to leasing, CSU/TL, NSO, and TLs that total 7,000 acres (28.3 $km^2$); however, no information was available as to whether these stipulations applied to wildlife.

Areas available for application for leasing in Alternative 1 contain areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.2.1-1 and 6.2.1-2, respectively). Table 6.2.1-7 presents the amount of these habitats identified by the State of Utah that are included in the Alternative 1 areas available for application for commercial leasing and that could be impacted by potential future commercial tar sands development.

Several wild horse and burro HMAs overlap lands available for application for tar sands leasing, including the Hill Creek HMA (19,820 acres), which overlaps the Hill Creek STSA; the Muddy Creek and Sinbad HMAs (3,954 and 39,435 acres, respectively), which overlap with the San Rafael STSA; the Range Creek HMA (13,933 acres), which overlaps the Sunnyside STSA; and the Canyon Lands HMA (267 acres), which overlaps with the Tar Sand Triangle STSA (Figure 6.2.1-3). Any tar sands development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

**TABLE 6.2.1-6 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 1 Tar Sands Lease Areas**

| Habitat Description | Amount of Habitat (acres)[a] |
|---|---|
| ***Birds*** | |
| Raptor nests | 7 (18)[b] |
| ***Mammals*** | |
| Elk crucial winter range | 112,809 (147,676) |
| Elk calving habitat | 26,804 (30,387) |
| Mule deer crucial winter range | 96,564 (104,011) |
| Mule deer fawning habitat | 23,584 (25,574) |
| Mule deer migration corridor | 41,588 (42,332) |

[a] Acreages may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the wildlife habitat acreage identified for protection within the most geologically prospective lands.

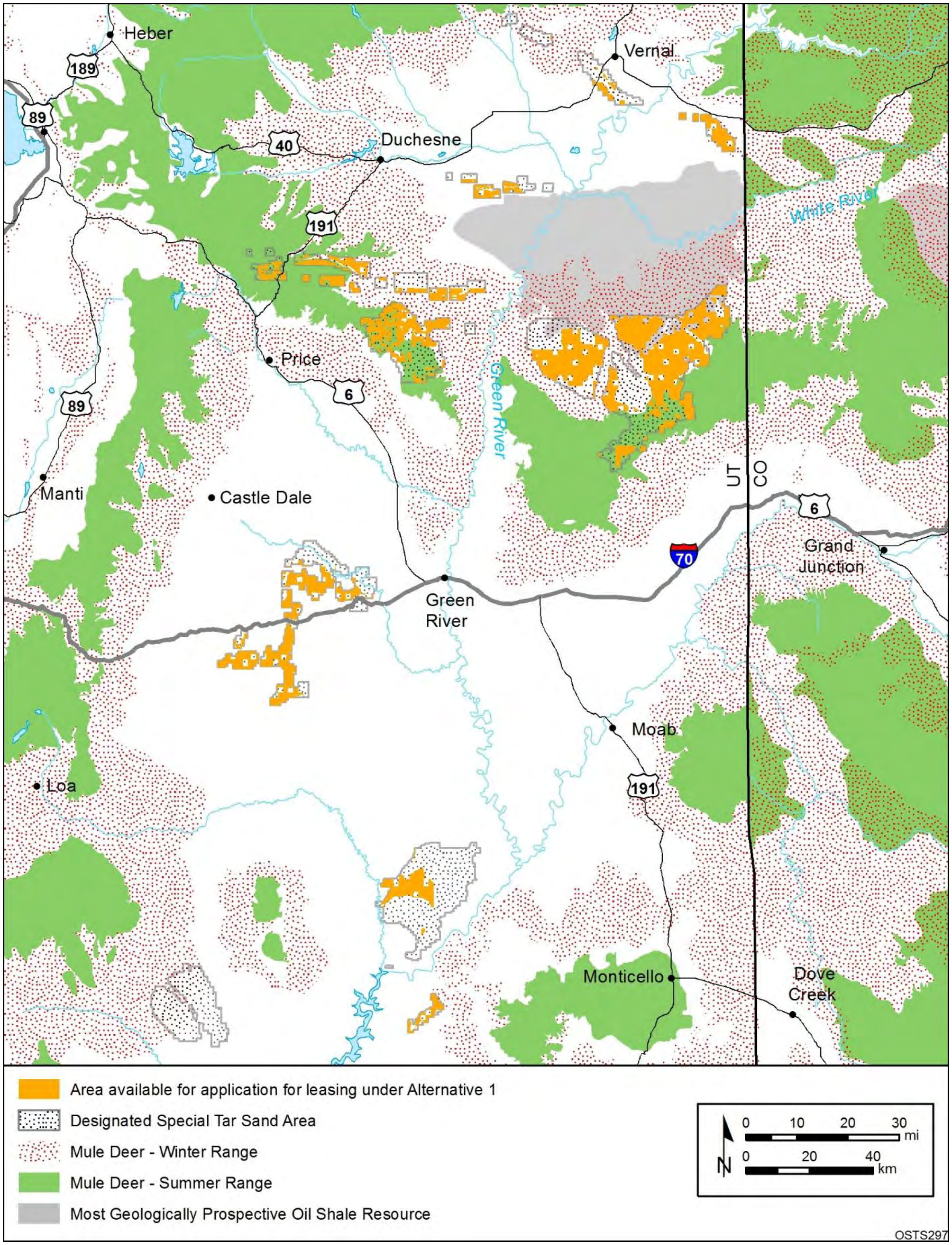


**FIGURE 6.2.1-1 Lands Available for Application for Tar Sands Leasing under Alternative 1 in Relation to the Summer and Winter Ranges of the Mule Deer**

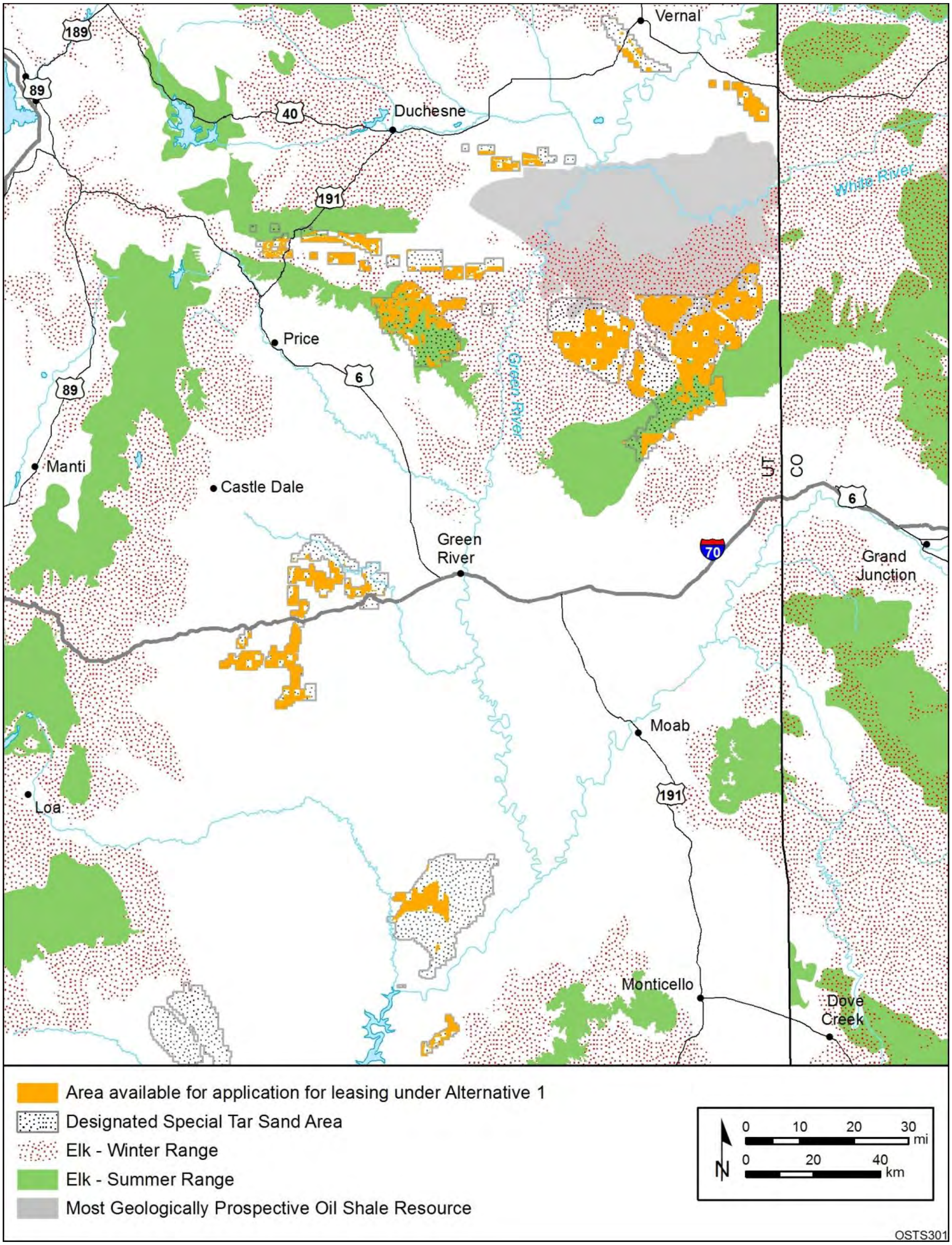


**FIGURE 6.2.1-2 Lands Available for Application for Tar Sands Leasing under Alternative 1 in Relation to the Summer and Winter Ranges of the Elk**

**TABLE 6.2.1-7 State-Identified Elk and Mule Deer Habitat Present in the Alternative 1 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres) |
|---|---|
| ***Mule Deer*** | |
| Winter habitat | 228,122 |
| Summer habitat | 77,172 |
| ***Elk*** | |
| Winter habitat | 194,354 |
| Summer habitat | 65,366 |

Impacts on wildlife (including wild horses and burros) from the construction and operation of future commercial tar sands projects could occur in a number of ways and could be related to (1) habitat loss, alteration, or fragmentation (as a result of construction); (2) disturbance and displacement of biota (by construction and operation activities and the presence of project infrastructure); (3) mortality (from construction activities and collisions with project infrastructure and vehicles); (4) exposure to hazardous materials; and (5) increase in human access. These impacts can result in changes in habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with commercial tar sands projects or workforces, but instead with the potentially increased human access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads may lead to increased human access into the area. Potential impacts associated with increased access include the disturbance of wildlife from human activities, including an increase in legal and illegal harvest; an increase of invasive vegetation; and an increase in the incidence of fires.

The potential for impacts on wildlife and their habitats by commercial tar sands development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. The magnitude of these impacts is also considered to be proportional to the amount of land disturbance.

**6.2.1.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative, 1, 430,686 acres of land in Utah would remain available for application for leasing for commercial development of tar sands. (See Section 2.3.2 for a full description of Alternative 1.). No impacts on threatened and endangered species associated with this land use plan amendment action are expected. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.4. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. In addition, the BLM would require all projects to comply with ESA regulations and those policies provided under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Various stipulations are included in the BLM RMPs that provide protection for different threatened, endangered, and sensitive species. These include (1) lands designated as NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would

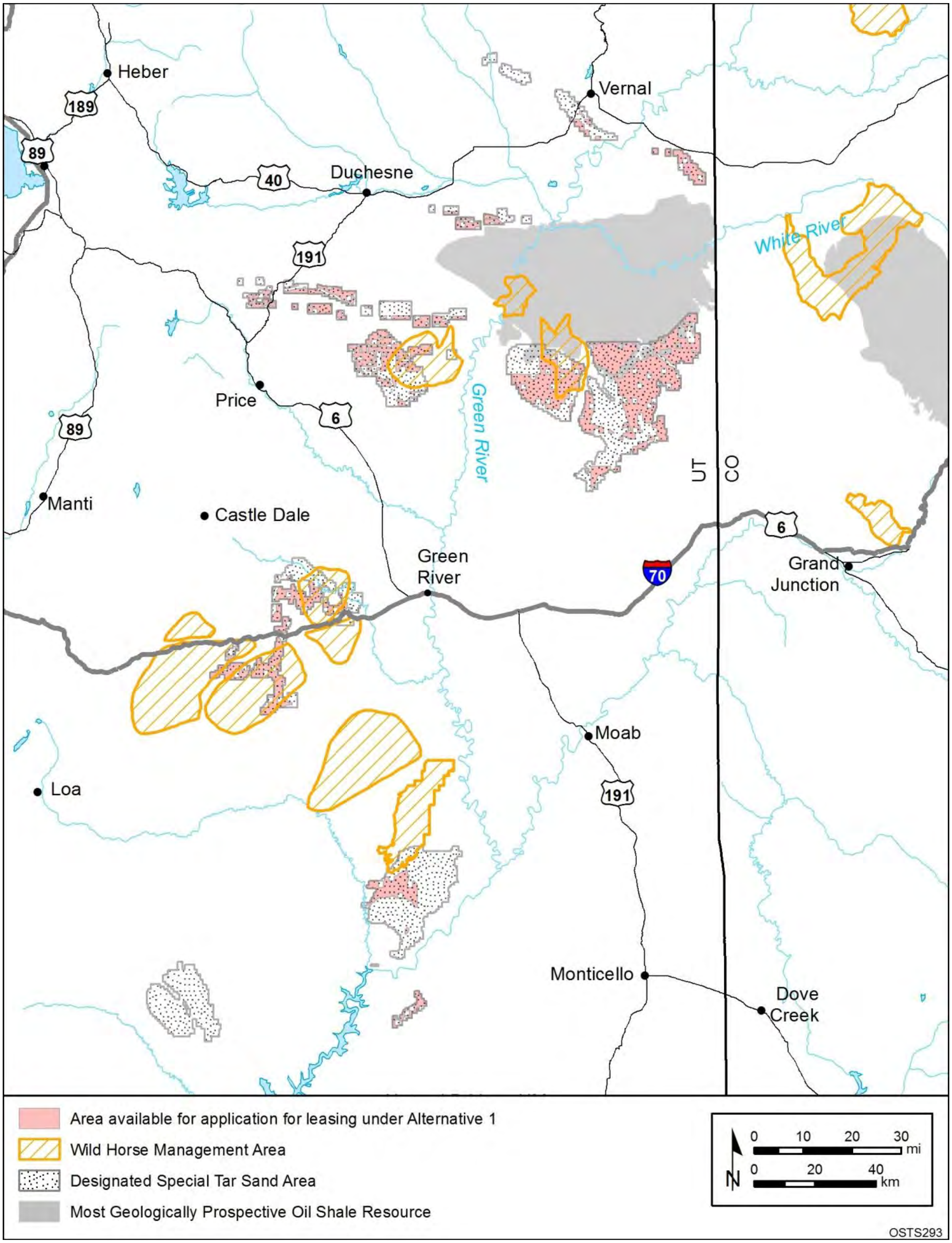


**FIGURE 6.2.1-3 Lands Available for Application for Tar Sands Leasing under Alternative 1 in Relation to Wild Horse and Burro Herd Management Areas**

last longer than 2 years]), (2) CSU, and (3) lands designated as TL. Table 6.2.1-8 identifies the amount of habitats protected by these stipulations in areas available for application for oil shale leasing in Alternative 1. In most instances, the stipulations for these species are TLs. In the White Canyon STSA, there are stipulations listed as closed to leasing, CSU/TL, NSO, and TLs that total 7,000 acres (28.3 km$^2$); however, no information was available as to whether these stipulations applied to threatened, endangered, and sensitive species.

Under Alternative 1, 71 of the 76 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.2.1-9, and 22 of the 23 federally listed threatened or endangered species listed in Table 6.2.1-10 could occur in areas that are available for application for commercial leasing of tar sands. This determination is based on records of occurrence in project counties, species occurrences from state natural heritage programs,[15] and the presence of potentially suitable habitat.[16] Potential lease areas include about 2,200 acres of critical habitat for the Mexican spotted owl (*Strix occidentalis lucida*); designated critical habitat for Colorado

**TABLE 6.2.1-8 Habitat for Threatened, Endangered, and Sensitive Species Protected by Stipulations in BLM RMPs within the Alternative 1 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres)[a] |
|---|---|
| ***Plants*** | |
| Graham's penstemon habitat | 1,625 (1,625)[b] |
| ***Birds*** | |
| Bald eagle habitat | 36 (280) |
| Sage-grouse habitat | 42,017 (53,866) |

[a] Acreage may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the acreages identified for protection within the most geologically prospective lands.

15 Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.2.1-9 and 6.2.1-10.

16 Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the lease areas. This quantification is presented in Tables 6.2.1-9 and 6.2.1-10.

**TABLE 6.2.1-9 Potential Effects of Commercial Tar Sands Development in Utah under Alternative 1 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Amsonia jonesii* | Jones blue star | BLM-S | Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | Emery, Garfield, Grand, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 8 mi (13 km) from the STSAs. |
| *Astragalus piscator* | Fisher Towers milkvetch | BLM-S | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Astragalus rafaelensis* | San Rafael milkvetch | BLM-S | Emery, Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha osterhoutii* | Osterhout cat's eye | BLM-S | Emery, Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S | Duchesne, San Raphael, Uintah, Wayne | **Potential for negative impact.** Quad-level occurrences of this species intersect the STSAs. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gentianella tortuosa* | Utah gentian | BLM-S | Duchesne, Emery, Garfield, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Listera borealis* | Northern twayblade | BLM-S | Duchesne, San Juan | **No impact.** Suitable habitat is not likely to occur in the STSAs. Nearest occurrences are approximately 28 mi (45 km) from the STSAs. |
| *Lygodesmia doloresensis* | Dolores River skeletonplant | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (14 km) from the STSAs. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia goodrichii* | Goodrich's blazingstar | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mimulus eastwoodiae* | Eastwood monkey-flower | BLM-S | Garfield, Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | Duchesne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Pediomelum aromaticum* | Paradox breadroot | BLM-S | Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C; | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Gila robusta* | Roundtail chub | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Uintah, Wayne | **Potential for negative impact.** Approximately 10,518 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 5 mi (8 km) of the STSAs. |
| *Hyla arenicolor* | Canyon treefrog | BLM-S | Garfield, Grand, Wayne, San Juan | **Potential for negative impact.** Approximately 15,500 acres of potentially suitable habitat for this species occurs in the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Amphibians (Cont.)*** | | | | |
| *Rana luteiventris* | Columbia spotted frog | BLM-S | Wasatch | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs. |
| *Rana pipiens* | Northern leopard frog | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 797 acres of potentially suitable habitat for this species occurs in the STSAs. This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| *Spea intermontana* | Great basin spadefoot | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 359,205 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Reptiles*** | | | | |
| *Elaphe guttata* | Corn snake | BLM-S; UT-SC | Grand, San Juan | **Potential for negative impact.** Approximately 8,625 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 4,056 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xantusia vigilis* | Desert night lizard | BLM-S; UT-SC | Garfield, San Juan | **Potential for negative impact.** Approximately 3,359 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 104,173 acres of potentially suitable habitat for this species occurs in the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | Duchesne, Uintah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Athene cunicularia* | Burrowing owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 154,858 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Buteo regalis* | Ferruginous hawk | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 135,430 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Centrocercus minimus* | Gunnison sage-grouse | ESA-C; UT-SC | Grand, San Juan | **Potential for negative impact.** Approximately 455 acres of potentially suitable habitat for this species occurs in the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs. |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C; BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 106,835 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Charadrius montanus* | Mountain plover | BLM-S; UT-SC | Duchesne, Uintah | **Potential for negative impact.** Approximately 9,152 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in riparian habitats near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cypseloides niger* | Black swift | BLM-S; UT-SC | Duchesne, Uintah | **Potential for negative impact.** Approximately 14 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 12 mi (19 km) of the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 253,181 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 12,710 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Numenius americanus* | Long-billed curlew | BLM-S; UT-SC; | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,590 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 3,629 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,847 acres of potentially suitable habitat for this species occurs in the STSAs. |
| ***Mammals*** | | | | |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC | Garfield, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 386,746 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.1-9 (Cont.)**

| Scientific Name | Common Name | Status | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Cynomys gunnisoni* | Gunnison's prairie dog | ESA-C; BLM-S; UT-SC | Grand, San Juan | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Approximately 128,626 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 301,048 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Idionycteris phyllotis* | Allen's big-eared bat | BLM-S; UT-SC | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) of the STSAs. |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | Carbon, Emery, Grand, Garfield, San Juan, Wayne | **Potential for negative impact.** Approximately 28 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 10 mi (16 km) of the STSAs. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 411,285 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 304,777 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Vulpes macrotis* | Kit fox | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 31,811 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**Footnotes on next page.**

**TABLE 6.2.1-9 (Cont.)**

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[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-C = candidate for listing under the ESA; UT SC = species of special concern in the state of Utah.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the STSAs.

River endangered fishes may also occur downstream within 10 mi (16 km) of potential tar sands lease areas (Figure 6.2.1-4). Greater sage-grouse (*Centrocercus urophasianus*) core habitats and lek sites are shown in Figure 6.2.1-5. Potential tar sands lease areas under Alternative 1 intersect approximately 117,716 acres of core and priority sage-grouse habitat in Utah.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) by commercial tar sands development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions, contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

Potential impacts on threatened and endangered species (see Section 5.8.1.4) under Alternative 1 are fundamentally similar to or the same as impacts on aquatic resources, plant communities and habitats, and wildlife described in Sections 5.8.1.1, 5.8.1.2, and 5.8.1.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

#### 6.2.1.8 Visual Resources

Under Alternative 1, 430,686 acres of public land in Utah is available for application for commercial tar sands development. While these lands support a wide variety of visual resources (Section 3.8), these resources would not be affected by the amendment of land use plans to identify these potential lease areas. However, visual resources in and around areas available for application for leasing could be affected by future commercial development of tar sands.

**TABLE 6.2.1-10 Potential Effects of Commercial Tar Sands Development in Utah under Alternative 1 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Cycladenia humilis* var. *jonesii* | Jones cycladenia | ESA-T | Emery, Garfield, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Erigeron maguirei* | Maguire daisy | ESA-T | Emery, Garfield, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Pediocactus despainii* | San Rafael cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pediocactus winkleri* | Winkler cactus | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 11 mi (18 km) from the STSAs. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Phacelia argillacea* | Clay phacelia | ESA-E | Wasatch | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) of the STSAs. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Schoenocrambe barnebyi* | Barneby reed-mustard | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 9 mi (14 km) of the STSAs. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.1-10 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) of the STSAs. |
| *Sclerocactus wrightiae* | Wright fishhook cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Townsendia aprica* | Last chance townsendia | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Designated critical habitat occurs downstream within 10 mi (16 km) of the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Gila elegans* | Bonytail | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Designated critical habitat occurs downstream within 10 mi (16 km) of the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Designated critical habitat occurs downstream within 10 mi (16 km) of the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E | Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in or near the STSAs. Designated critical habitat occurs downstream within 10 mi (16 km) of the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.1-10 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 21,193 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Gymnogyps californianus* | California condor | ESA-E | Grand | **Potential for negative impact.** Approximately 30,730 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 109,098 acres of potentially suitable habitat for this species occurs in the STSAs. About 2,200 acres of critical habitat intersects the proposed tar sands lease area. Quad-level occurrences of this species intersect the STSAs. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T | Emery, Uintah | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN | Carbon, Duchesne, Emery, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 10,234 acres of potentially suitable habitat for this species occurs in the STSAs. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from the UDWR (2011). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the STSAs. Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

Several scenic resource areas are located within areas identified as available for application for leasing under Alternative 1 (Figures 6.2.1-6 through 6.2.1-9). These scenic resource areas include:

- The Lucky Strike, Nine Mile Canyon, Temple Mountain, and Wild Horse Canyon ACECs;
- The White Canyon SRMA;

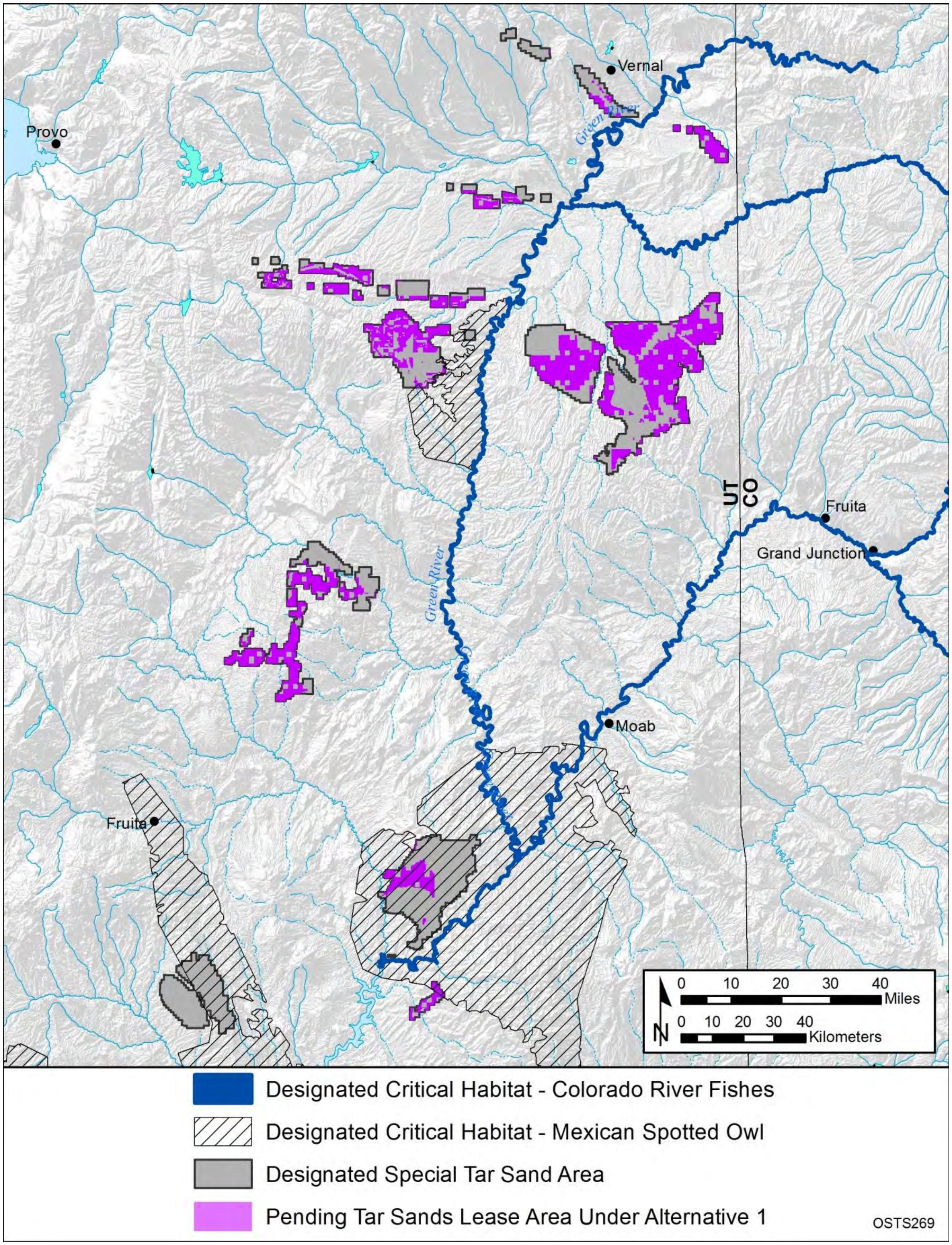


**FIGURE 6.2.1-4 Designated Critical Habitats of Threatened and Endangered Species That Are in or near Pending Tar Sands Lease Areas under Alternative 1**

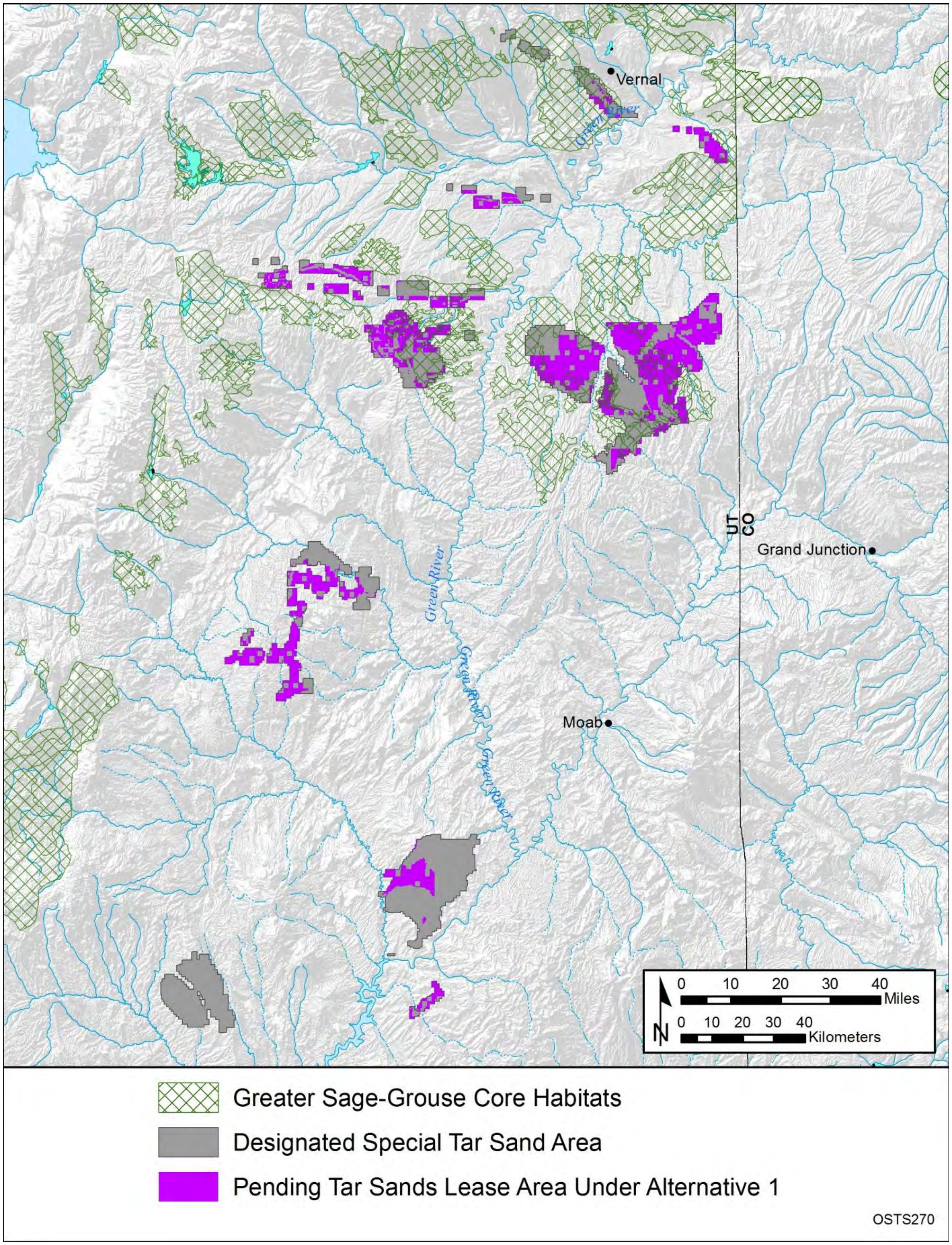


**FIGURE 6.2.1-5 Distribution of Core and Priority Habitat Areas for Greater Sage-Grouse That Are near Pending Tar Sands Lease Areas under Alternative 1**

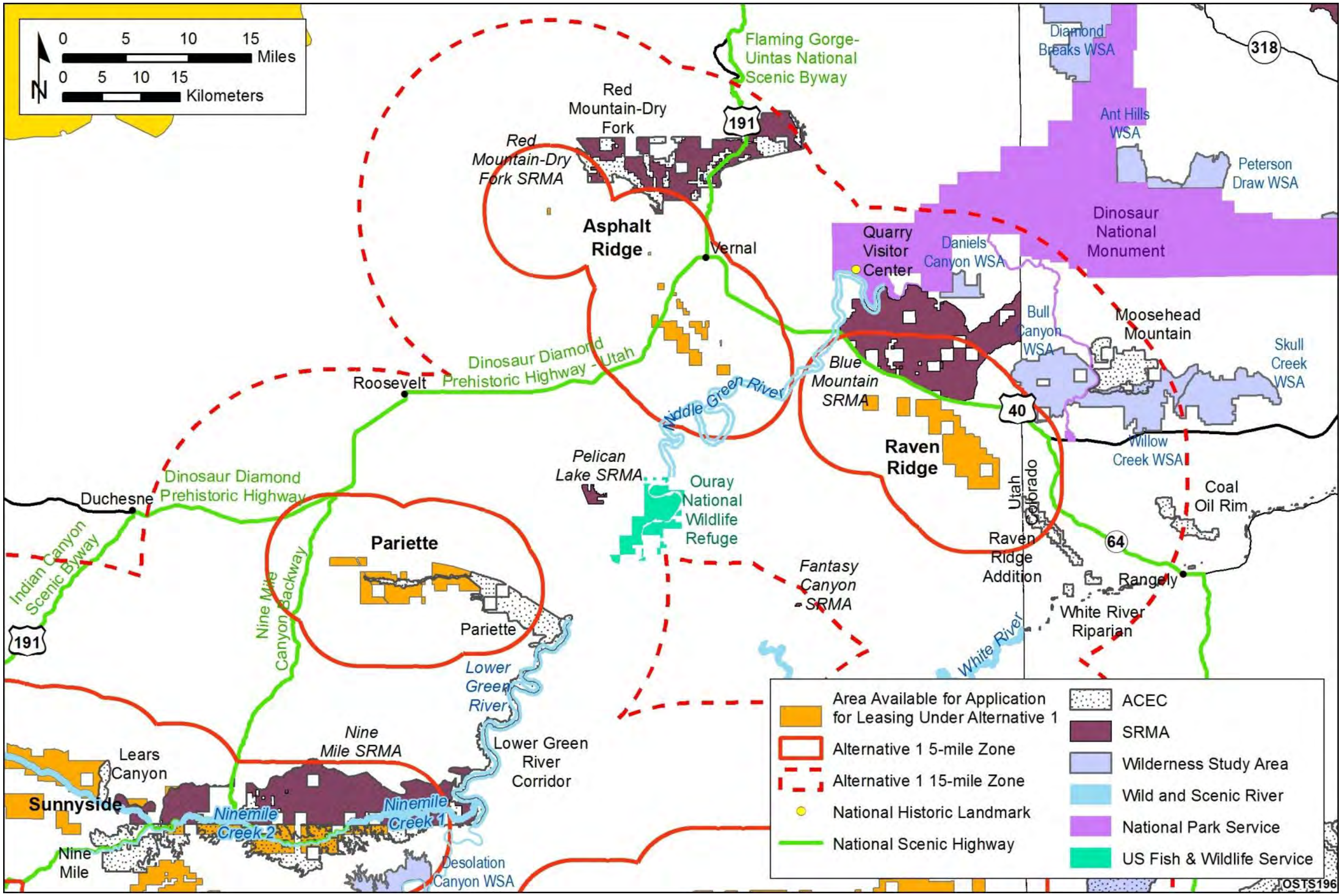


**FIGURE 6.2.1-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 for the Asphalt Ridge, Pariette, and Raven Ridge STSAs**

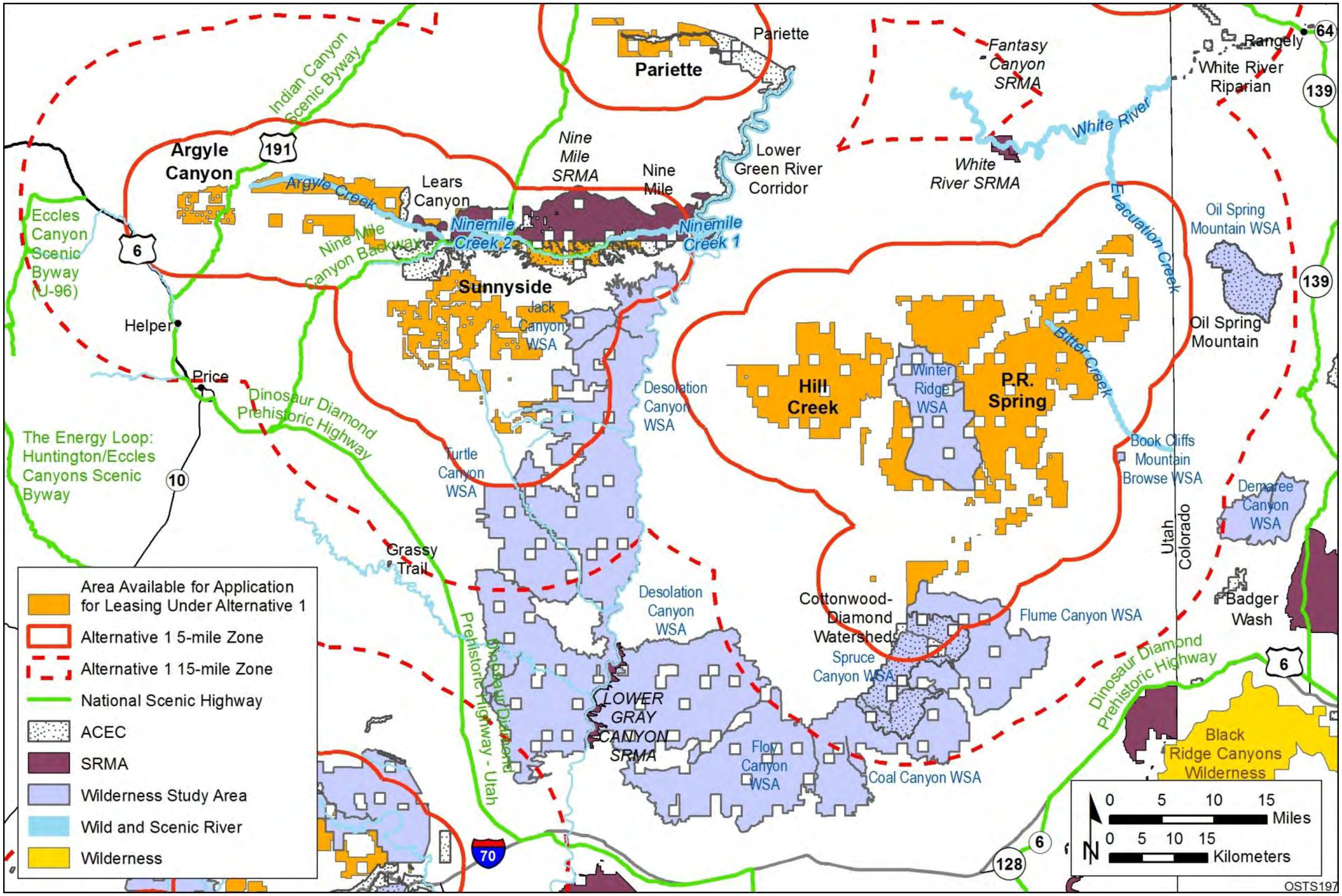


**FIGURE 6.2.1-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 for the Argyle Canyon, Hill Creek, P.R. Spring, and Sunnyside STSAs**

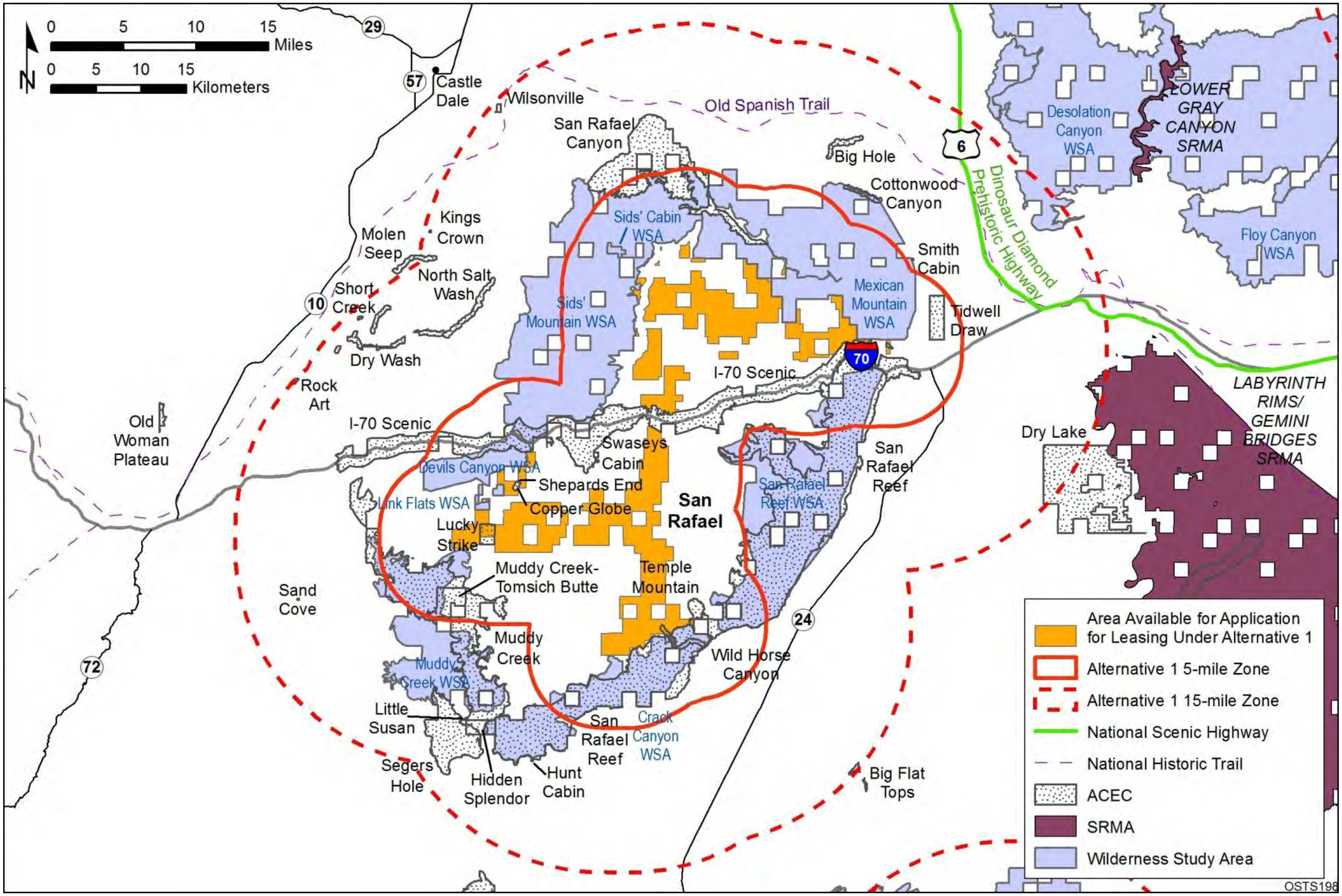


**FIGURE 6.2.1-8 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 for the San Rafael STSA**

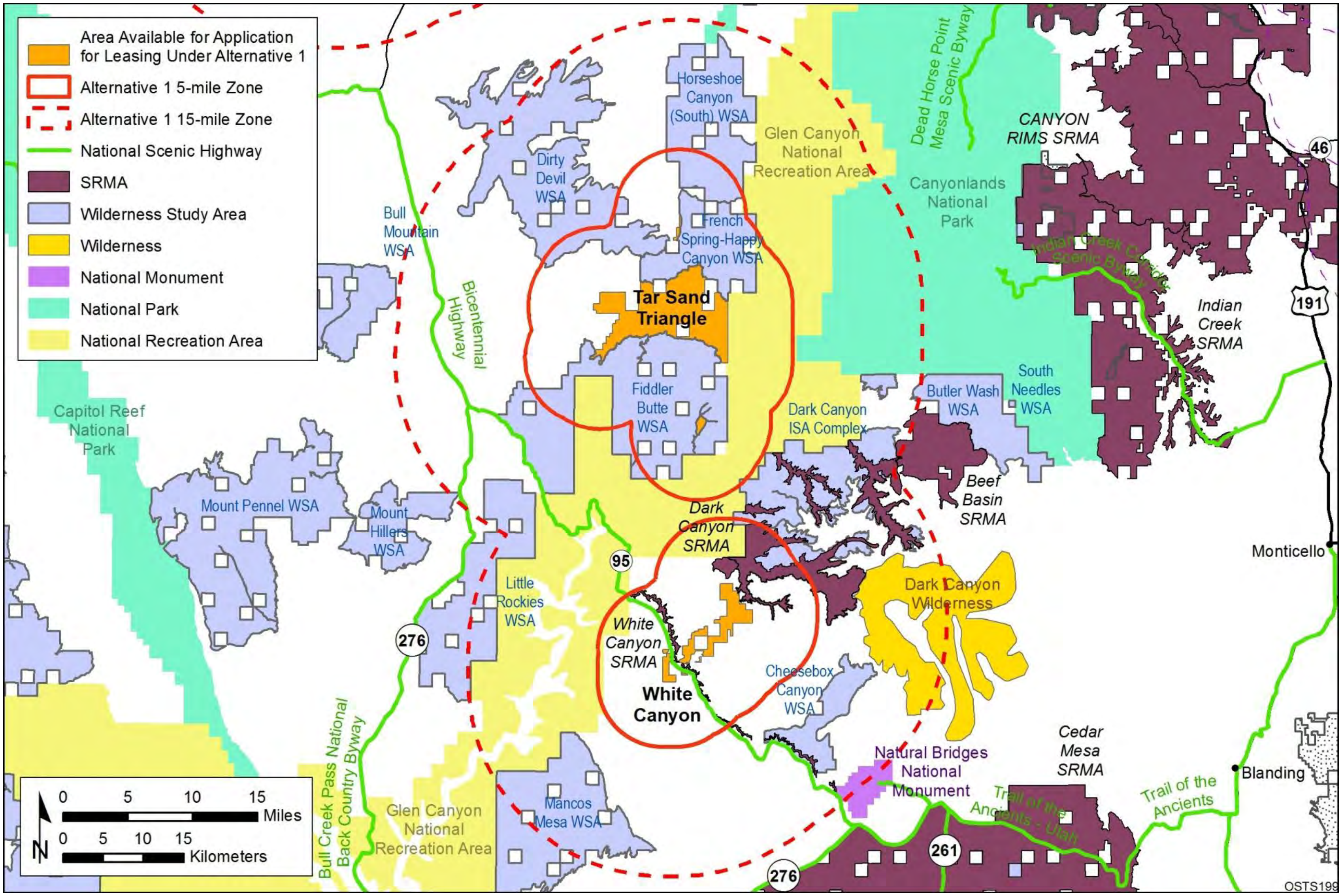


**FIGURE 6.2.1-9 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 1 for the Tar Sand Triangle and White Canyon STSAs**

- The Dinosaur Diamond Prehistoric National Scenic Highway;

- The Indian Canyon State Scenic Byway; and

- The Nine Mile Canyon Backcountry Byway.

Additional scenic resource areas are located within 5 or 15 mi of the Alternative 1 proposed lease areas (Figures 6.2.1-6 through 6.2.1-9). The 5-mi zone corresponds to the BLM's VRM foreground-middleground distance limit, and the 15-mi zone corresponds to the BLM's background distance limit. Based on the assumption of an unobstructed view of a commercial tar sands project, viewers in these areas would be likely to perceive some level of visual impact from the project; impacts would be expected to be greater for resources within the foreground-middleground distance, and lesser for resources within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.2.1-11 presents the scenic resource areas that fall within these zones.

Visual resources could be affected at and near the lease areas where commercial tar sands projects would be developed and operated, and at areas where supporting infrastructure (such as utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 5.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components, such as tar sands processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

### 6.2.1.9 Cultural Resources

Under Alternative 1, a total of 430,686 acres of public land are available for commercial tar sands leasing. The lands available contain cultural resources (O'Rourke et al. 2007). More than 8% of public lands available for application for leasing in the STSAs under Alternative 1 have been surveyed for cultural resources (more than 35,749 acres in addition to 604 linear mi). [17] In those areas that have been surveyed, 577 sites have been identified. Additional cultural resources are likely in unsurveyed portions of the study area. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), nearly 242,200 acres within areas available for application for leasing in Alternative 1 have been identified as having a medium or high sensitivity for containing cultural resources.[18] However, tar sands development could also result in scientifically beneficial discoveries that may not have otherwise been made.

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[17] This percentage was calculated by using block acre surveys only and does not include approximately 602 linear mi of survey.

[18] The Argyle Canyon, Asphalt Ridge, Circle Cliffs, Raven Ridge, and White Canyon STSAs and portions of the San Rafael, Sunnyside and Tar Sand Triangle STSAs had not been surveyed sufficiently to derive sensitivity information; therefore, these acreages have not been included in this percentage calculation. Out of 430,686 acres available under Alternative 1, sensitivity information is available for 280,569 acres (65%).

**TABLE 6.2.1-11 Visually Sensitive Areas That Could Be Affected by Commercial Tar Sands Projects Developed in Potential Lease Areas under Alternative 1**

| Scenic Resources within 5 mi of Alternative 1 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 1 Lease Areas |
|---|---|
| Bull Canyon, Crack Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, Flume Canyon, French Spring-Happy Canyon, Horseshoe Canyon (South), Jack Canyon, Link Flats ISA, Mexican Mountain, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain, Spruce Canyon, and Winter Ridge WSAs. | Book Cliffs Mountain Browse ISA, Bull Canyon, Butler Wash, Cheese Box Canyon, Coal Canyon, Crack Canyon, Daniels Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, Floy Canyon, Flume Canyon, French Spring-Happy Canyon, Horseshoe Canyon (South), Jack Canyon, Link Flats ISA, Little Rockies, Mancos Mesa, Mexican Mountain, Mt. Hillers, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain, Spruce Canyon, Turtle Canyon, and Winter Ridge WSAs. |
| Copper Globe, Cottonwood-Diamond Watershed, I-70 Scenic, Lears Canyon, Lucky Strike, Muddy Creek, Muddy Creek-Tomsich Butte, Nine Mile, Pariette, Raven Ridge Addition, Red Mountain-Dry Fork, Rock Art, San Rafael Canyon, San Rafael Reef, Shepards End, Swaseys Cabin, Temple Mountain, Tidwell Draw, and Wild Horse Canyon ACECs. | Big Flat Tops, Big Hole, Copper Globe, Cottonwood Canyon, Cottonwood-Diamond Watershed, Dry Lake, Dry Wash, Hidden Splendor, Hunt Cabin, I-70 Scenic, Kings Crown, Lears Canyon, Little Susan, Lower Green River Corridor, Lucky Strike, Molen Seep, Muddy Creek, Muddy Creek-Tomsich Butte, Nine Mile, North Salt Wash, Pariette, Raven Ridge Addition, Red Mountain-Dry Fork, Rock Art, San Rafael Canyon, San Rafael Reef, Sand Cove, Segers Hole, Shepards End, Short Creek, Smith Cabin, Swaseys Cabin, Temple Mountain, Tidwell Draw, White River Riparian, Wild Horse Canyon, and Wilsonville ACECs. |
| Blue Mountain, Dark Canyon, Nine Mile, Red Mountain-Dry Fork, and White Canyon SRMAs. | Beef Basin, Blue Mountain, Dark Canyon, Labyrinth Rims/Gemini Bridges, Nine Mile, Pelican Lake, Red Mountain-Dry Fork, White Canyon, and White River SRMAs. |
| Dinosaur Diamond Prehistoric and Flaming Gorge Uintas National Scenic Highways. | Dinosaur Diamond Prehistoric, Energy Loop, and Flaming Gorge Uintas National Scenic Highways. |
| Indian Canyon Scenic Byway and Bicentennial Highway Utah State Scenic Byways. | Indian Canyon Scenic Byway and Bicentennial Highway Utah State Scenic Byways. |
| Nine Mile Canyon BLM Backcountry Byway. | Bull Creek Pass and Nine Mile Canyon BLM Backcountry Byways. |
| | Eccles Canyon National Forest Scenic Byway. |
| Glen Canyon National Recreation Area. | Canyonlands National Park, Dark Canyon Wilderness, Glen Canyon National Recreation Area, Ouray National Wildlife Refuge, Quarry Visitor Center National Historic Landmark, Dinosaur National Monument, and Natural Bridges National Monument. |
| | Old Spanish Trail National Historic Trail. |

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to impact cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts from future development could include the destruction of individual resources present within development areas, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resources from looting or vandalism of resources as a result of increased human presence and activity in the sensitive areas, and visual degradation of the cultural setting (see Section 6.2.1.8). Any future leasing and development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts, or to denial of the lease or project. The cultural resources in the Circle Cliffs STSA would not be impacted by tar sands leasing and development because no leasing and development would occur in this STSA. The cultural resources in the Argyle Canyon, Hill Creek, Pariette, Raven Ridge, San Rafael, Tar Sand Triangle, and White Canyon STSAs are less likely to be impacted by tar sands leasing and development than those resources present in the Asphalt Ridge, P.R. Spring, and Sunnyside STSAs.

#### 6.2.1.10 Indian Tribal Concerns

Under Alternative 1, no BLM land use plans would be altered. Tribes with traditional ties to the BLM planning areas in which the STSAs lie were contacted and provided the opportunity to consult during the development of these plans. Many Native American concerns have been taken into account in the plans and procedures laid out in these plans. These concerns include ensuring that water sources are protected; ensuring cultural resource surveys are undertaken; ensuring affected tribes are consulted; ensuring access to sacred sites, landscapes, and traditional resource collecting places; ensuring sacred sites are protected; enforcing OHV regulations; and protecting the visual and auditory context of sacred sites such as mountains (e.g., the Henry Mountains and Abajo Mountains sacred to the Navajo), rivers (e.g., the Colorado, Green, and Price Rivers sacred to the Ute and the Navajo), and rock art panels (sacred to many tribes, including the Hopi).

The allotment process is not expected to adversely affect resources. Developing tar sands resources, however, has that potential to the extent that it involves ground-disturbing activities; introduces industrial facilities that may be incompatible with sacred sites; increases human activity in or near sacred spots; and increases access to previously remote areas, thus raising the chances of vandalism. BLM land management plans include provisions for consulting with the tribes and protecting identified resources important to Native Americans. For example, the Ute Indian Tribe filed a protest over provisions for the development of subsurface resources on split estate lands in the Hill Creek Extension of the Uintah and Ouray Reservation. Government-to-government consultation resulted in the identification of stipulations for Hill Creek Extension actions that require coordination with the surface owner (BLM 2008c). Under this alternative, 430,686 acres in the STSAs would be available for application for commercial lease, the most of any tar sands alternative. Both surface mining and in situ technologies will be considered, all of which require extensive surface disturbance, although surface mining would have the greatest potential for adversely affecting resources important to Native Americans. Lands in the STSAs excluded from commercial leasing—Wilderness Areas, WSAs and other areas that are part of the NLC, existing ACECs, historic trails, and segments of rivers eligible for WSR status—afford some protection to traditional and sacred sites important to Native Americans because of their various restrictions on surface use and development. Development of the parcels would require site-specific NEPA reviews that would take into account resources of concern to Native Americans identified through required consultation and surveys.

#### 6.2.1.11 Socioeconomics

Under Alternative 1, 430,686 acres of land in Utah is available for application for commercial tar sands development. With the possible exception of an impact on property values, there is no socioeconomic impact from this land allocation action. The socioeconomic impacts described in Section 5.11 and summarized in this section are for hypothetical individual commercial tar sands projects. These types of impacts represent those that could occur as a result of development on lands identified as available for commercial leasing under Alternative 1. The specific socioeconomic impacts would depend on the technologies employed, the project size or production level, and development time lines and mitigation measures.

- Tar sands development projects and their associated ancillary facilities could affect property values in ROI communities located nearby. Furthermore, it is possible that there will be property value impacts simply from designating land as available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.12.1.6). Property values could decline in some locations as a result of the deterioration in aesthetic quality, increases in noise, real or perceived health effects, congestion, or social disruption. In other locations, property values could increase as a result of access to employment opportunities associated with tar sands development.

- Under Alternative 1, a single tar sands facility would produce 1,831 jobs in the ROI (1,187 direct jobs at tar sands facilities and 644 indirect jobs in the remainder of the local economy) during the peak construction year. During commercial production, 747 employees (482 direct and 265 indirect) would be required in the ROI.

- Construction of housing for tar sands workers and families would create 551 jobs (432 direct and 119 indirect in the remainder of the local economy) in the ROI.

- Population in-migration associated with tar sands construction would represent an increase of 0.7% over the projected ROI population baseline.

- In-migrating population associated with tar sands facilities would absorb 0.7% of the projected vacant housing stock in the ROI.

- Provision of additional local public services for in-migrant workers would require an increase in 1.0% in local expenditures during the peak construction year and 0.7% during operations.

- The number of new residents from outside the producing regions and the pace of population growth associated with the commercial development of tar sands resources, including large-scale production facilities and housing developments, could lead to substantial demographic and social change in small rural communities. These communities could be required to adapt to a different quality of life, with a transition away from a more traditional lifestyle in small, isolated, close-knit, homogenous communities with a strong orientation toward personal and family relationships, toward a more urban lifestyle with increasing cultural and ethnic diversity and increasing dependence on formal social relationships within the community.

- Substantial changes in access to water by agriculture could have large impacts on the economy of each ROI, which would depend on the amount of agricultural production lost, the extent of local employment in agriculture, the reliance of other industries in each ROI on agricultural production, the extent of local procurement of equipment and supplies by agriculture, and the local spending of wage and salaries by farmers, ranchers, and farmworkers. Loss of property tax revenues on agricultural land could also impact local government expenditures and consequently impact the provision of public services in local communities in each ROI. Changes in agricultural activity would likely change the character of community life in each ROI, with a movement away from activities that historically represent small rural communities.

- The impact of tar sands development on recreational visitation, assuming a 10% reduction in recreation employment in the ROI, would be the loss of 388 jobs in the ROI, and assuming a 20% reduction, the loss of 776 jobs.

Under Alternative 1, 430,686 acres of public land would remain available for commercial tar sands leasing. It is not anticipated that this allocation decision would result in impacts on transportation systems and infrastructure. The types of impacts on transportation that may occur as a result of potential tar sands development on lands identified as available for commercial leasing are described in Section 5.12.1.6. Because of the many variables regarding project location, location of employer-provided housing, and the variability of the level of employment depending upon the phase of individual projects, this general assessment of potential transportation impacts utilizes the maximum number of direct employees employed in support of only tar sands projects as the basis for this discussion. Direct and indirect jobs associated with the construction of housing, pipelines, and power lines serving the tar sands facilities are not included in this number because of additional uncertainties over location and timing. The maximum number of direct employees would occur during the construction period for projects and therefore overstates potential traffic volume effects during the operations phase for the projects. In addition, because the potential locations of projects are unknown, identifying specific impacts is not possible at this time. Specific transportation impacts would be assessed once site-specific proposals are evaluated.

The maximum number of direct employees for a commercial tar sands facility is estimated to be 1,187 during the construction phase and 482 during the operations phase. Assuming a range of 2 to10 average passengers per vehicle, the estimated number of employees could add 119 to 593 daily vehicle trips during construction and 48 to 241 additional daily vehicle trips during operations. Depending on the distribution of this traffic volume, impacts on traffic flow may occur. Structural changes to road systems may be required to provide additional capacity for traffic and to deal with heavier loads of associated construction equipment.

The above maximum vehicle numbers do not include traffic generated by indirect jobs associated with tar sands development. Uncertainties about where indirect jobs may be located further complicate making assumptions about their specific impact; however; these employees will also have an impact on traffic loads throughout the immediate region.

#### 6.2.1.12 Environmental Justice

The environmental justice impacts described in Section 5.13 and summarized in this section for individual commercial tar sands projects represent the types of impacts that could occur as a result of development on lands identified as available for commercial leasing under Alternative 1.

Since tar sands development projects and associated facilities would lead to rapid population growth in many of the communities in each ROI, it is possible that social disruption would occur, leading to the undermining of local community social structures with contrasting beliefs and value systems among the local population and in-migrants and, consequently, to a range of changes in social and community life, including increases in crime, alcoholism, drug use, and so forth. Impacts on property values of property owned by minority and low-income individuals would depend on the range of alternate uses of specific land parcels, current property values, and the perceived value of costs (traffic congestion, noise and dust pollution, and visual, air quality, and EMF effects) and benefits (infrastructure upgrades, employment opportunities, and local tax revenues) associated with proximity to tar sands-related facilities.

Tar sands development would produce surface disturbance, fugitive dust, vehicle emissions, and activity that could generate visual impacts. Emissions associated with construction activities would consist primarily of particulate matter ($PM_{2.5}$ and $PM_{10}$), criteria pollutants, VOCs, $CO_2$, and certain HAPs released from heavy construction equipment and vehicle exhaust. Because of the limited surface water and groundwater, the amount of water needed in Utah for commercial tar sands projects and associated population growth would mean that additional water resources would be needed. Tar sands facilities might impact certain animals or vegetation types that may be of cultural or religious significance to certain population groups or that form the basis for subsistence agriculture. Similarly, land used for these facilities that has additional economic uses might affect access to resources by low-income and minority population groups.

Given the location of environmental justice populations in Utah, construction and operation of tar sands facilities and employer-provided housing required for the operation of tar sands development projects could produce impacts that would be experienced disproportionately by minority and low-income populations. Of particular importance would be social disruption impacts of large increases in population in small rural communities, the undermining of local community social structures, and the resulting deterioration in quality of life. The impacts of facility operations on air and water quality and on the demand for water in the region could also be important. Land use and visual impacts could be significant depending on the locations of land parcels for tar sands projects and the associated housing facilities, their importance for subsistence, their cultural and religious significance, and alternate economic uses. Depending on the locations of low-income and minority populations, impacts could also occur with the development of transmission lines associated with power development and the supply of power to tar sands facilities in each state.

#### 6.2.1.13 Hazardous Materials and Waste Management

Under Alternative 1, 430,686 acres of land would remain available for application for leasing for commercial tar sands development. It is not anticipated that this allocation decision would result in any hazardous material or waste management concerns. Impacts related to hazardous materials and wastes could occur during the construction and operation of commercial tar sands projects within areas identified in Alternative 1 as available for application for commercial leasing. Such impacts would generally be independent of location and would be unique to the technology combinations used for tar sands development. Hazardous materials and wastes would also be associated with ancillary support activities that would be required for development of any tar sands facility regardless of the technology used. These include the impacts from development of energy transmission or pipeline ROWs and employer-provided housing.

Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, glycol-based coolants, and solvents, adhesives, and corrosion-control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites, and other wastes typically associated with construction, none of which is expected to be hazardous (Section 5.13.1).

During project operations, hazardous materials could be utilized and a variety of wastes (some hazardous) would be generated. Hazardous materials used include fuels, solvents, corrosion-control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations would depend on the specific design of the commercial tar sands project (surface mining, various surface retorting technologies, and in situ processes). Waste materials produced during operations could include waste engine fuels and lubricants, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 5.13.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial tar sands project, it is not possible to quantify project-related impacts of these materials. Under Alternative 1, individual facilities could be located anywhere within the areas identified as available for leasing, pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Sections 5.14 and 6.2.1.14) at locations where the individual projects are sited within the Alternative 1 potential lease areas.

#### 6.2.1.14 Health and Safety

Under Alternative 1, 430,686 acres of land would remain available for application for leasing for commercial tar sands development. It is not anticipated that this land allocation decision would result in any direct health and safety concerns. However, a number of health and safety concerns would be associated with the commercial development of tar sands projects within the areas available for application for commercial leasing in Alternative 1. The level of health and safety impacts would be mainly dependent on the extent of tar sands development, the extent of health and safety precautions imposed by the operators, and the design of each project (as related to the level of air and water emissions associated with a facility).

Potential health and safety impacts from the construction and operation of commercial tar sands projects would be associated with the following activities: (1) constructing project facilities and associated infrastructure; (2) surface mining (if processing is not in situ) the tar sands; (3) obtaining and upgrading the syncrude, either through surface retorting or in situ processing; (4) transporting construction and raw materials to the upgrading facility and transporting product from the facility; and (5) exposing the general public to water and air contamination associated with tar sands development. Hazards from tar sands development (summarized in Table 5.14-1) could include physical injury from construction, tar sands processing, and vehicle transportation accidents, and exposure to fugitive dust and hazardous materials such as retort emissions and industrial chemicals (Section 5.14). Health and safety impacts would be largely restricted to the immediate workforce of each facility. Accidents may also affect members of the general public who could be present in the immediate vicinity of an accident (e.g., project-related truck accident on a public road or recreational users in areas adjacent to the project lease area).

Workers would be exposed to different hazards depending on the type of jobs they perform. Workers at all types of tar sands development facilities could be exposed to high noise levels, which could result in hearing loss. The health and safety of miners could be impacted by injuries or deaths due to accidents (e.g., highwall bank failures or cave-ins, uncontrolled explosions, and accidents involving heavy machinery) or heat exposures. Workers operating surface retorts also could be injured or die due to accidental explosions, heat stress, or accidents involving heavy machinery. Physical hazards from well drilling, use of explosives, and operation of heavy equipment would be present for in situ workers.

Serious and often fatal lung disease in miners has been associated with inhalation of particulates and volatile compounds containing carcinogenic PAHs; such exposures could be limited by adherence to applicable occupational health and safety standards. Lung disease caused by inhalation of emissions from the retorting process is also of concern for retort operators, although these exposures are generally lower than those associated with mining. For workers at facilities using in situ recovery techniques, hazards associated with inhalation of emissions would also be expected to be lower than those associated with mining.

Estimates of expected injuries and fatalities can be made on the basis of the number of employees and the type of work. On the basis of the numbers of employees projected to be needed for construction and operation of tar sands facilities, there statistically would be less than 1 death and about 100 injuries per year expected per facility during construction activities, and less than 1 death and about 30 injuries per year expected per facility during operations (NSC 2006). A comprehensive facility health and safety plan and worker safety training could be required as part of the plan of development for every proposed commercial tar sands project.

Health and safety concerns are largely independent of the locations of tar sands development facilities. However, the health and safety impacts on the general public from emissions from these facilities would depend both on the specific characteristics and level of emissions and on the distance of the emissions source from population centers. The level of air and water emissions would be regulated under required permits. Potential impacts on the general public from emissions would be assessed in future site-specific NEPA and permitting documentation.

### 6.2.2 Impacts of Alternative 2, Conservation Focus

Under Alternative 2, the BLM would amend the following four BLM Utah land use plans: Monticello RMP, Price RMP, Richfield RMP, and Vernal RMP. The BLM would make 91,045 acres (approximately 14% of the public lands in the STSAs) available for application for leasing for commercial development of tar sands within eight designated STSAs: Hill Creek, Pariette, P.R. Spring, Raven Ridge, San Rafael, Sunnyside, Tar Sand Triangle, and White Canyon STSAs (see Figure 2.4.3-2 and Table 2.4.3-1). As with Alternative 1, leasing would not be allowed in the Circle Cliffs STSA, but in addition, the Argyle Canyon and Asphalt Ridge STSAs would be totally unavailable under Alternative 2 and the acreage available in the Pariette, Tar Sand Triangle, and White Canyon STSAs could be so small as to make them practically unavailable for development. The public lands that would be available under Alternative 2 comprise approximately 81,417 acres of BLM-administered lands and 9,627 acres of split estate lands. (See Sections 2.4.3 and 2.4.3.1 for a complete description of Alternative 2.) Public lands within the study area not identified as available for application for leasing under Alternative 2 are thereby excluded from application for leasing.

Lands other than those 91,045 acres to be designated as available for application for leasing for commercial development of tar sands under Alternative 2 that are currently open would be closed to such leasing and development; that is, the difference between the 430,686 acres currently open and 91,045 acres. As described below, the potential impacts on lands currently available for application for leasing for commercial development but considered in Alternative 2 for closure to such leasing and development would not be adverse, as no leasing or development would take place, and that unless otherwise discussed, any benefit would accrue in proportion to the number of acres closed

In addition to public lands excluded under Alternative 1, under Alternative 2 the BLM would exclude additional lands containing sensitive resources. By making these additional exclusions, the BLM is placing a priority on protecting known sensitive resources within each field office in this alternative. By excluding these lands from future commercial leasing and development, direct impacts on resources on these lands would be avoided. The resources present in these excluded areas still could incur indirect impacts as a result of commercial tar sands development on adjacent lands or within the region. Under Alternative 2, approximately 339,640 acres of land now available for tar sands commercial leasing and development would be made unavailable.

On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with amending land use plans to make lands available or not available for application for commercial leasing in the three-state study area, but there may be impacts on land values. The development of commercial tar sands projects that could occur on lands made available for application for commercial leasing by these land use plan amendments, however, would have impacts on these resources. The following sections describe the impacts of Alternative 2 on the environment and the socioeconomic setting. The sections also describe the potential impact of subsequent commercial development that might occur on the lands identified as available for leasing.

#### 6.2.2.1 Land Use

Alternative 2 would amend the four land use plans listed above (Monticello, Price, Richfield, and Vernal) and would identify only 91,045 acres of public land in Utah as available for application for leasing for commercial development of tar sands. The remaining lands currently open to such application would be identified as not available for this use. The public lands that would be available under Alternative 2 are composed of 81,417 acres of BLM-administered lands and 9,727 acres of split estate lands. Table 6.2.1-1 lists the acreages per STSA.

Under Alternative 2, some of the potential impacts on land use could be the same as those under Alternative 1 (e.g., impacts on mineral development, grazing, and recreational use), although Alternative 2 does not make available nearly as many acres as Alternative 1 and removes many lands with known sensitive resources from consideration for commercial leasing.

The nature of the impacts of Alternative 2 on land uses would be essentially the same as those listed for Alternative 1 in Section 6.2.1.1, with the following exceptions:

- The 144,998 acres of LWC are excluded from application for leasing and would not be directly affected by tar sands development.

- Core or priority sage-grouse habitat, current and recommended ACECs, and about 86,000 acres of land identified as potential ACECs under Alternative C of the 2008 OSTS PEIS would be removed from application for commercial tar sands leasing.

- This alternative specifically removes the Adobe Town "Very Rare and Uncommon Area" from consideration for leasing of tar sands resources, but since there are no tar sands resources present within this area (tar sands are located in Utah, not in Wyoming, where Adobe Town is located), this does not represent a difference between Alternative 2 and Alternative 1 and is not considered further.

#### 6.2.2.2 Soil and Geologic Resources

Under Alternative 2, land use plans in Utah would be amended to designate 91,043 acres of public land as available for commercial tar sands leasing. The amendment of land use plans to identify these areas would not have any direct impacts on soil and geologic resources in these lands. Development of commercial tar sands projects could, however, affect soils and geologic resources in these lands.

Construction-related activities could directly disturb surface and subsurface soils during clearing and grading activities and construction of project facilities and infrastructure. This disturbance could include soil disturbance, removal, and compaction, and disturbed areas would be more susceptible to the effects of precipitation and wind-driven erosion (see Section 5.3.1). Surface and subsurface mining activities during project operations would directly disturb geologic resources. Erosion of exposed soils could lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust. Soils in project areas would remain susceptible to erosion until completion of construction, mining, and tar sands processing activities, and site stabilization and reclamation (e.g., revegetation of pipeline ROWs and surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as to areas where associated off-lease infrastructure (e.g., access roads and utility ROWs) would be located.

Under Alternative 3, project-related impacts could occur wherever individual projects are located within the 91,045 acres identified for application for leasing under this alternative. For any project, the erosion potential of the soils would be a direct function of the lease and project location and of the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

#### 6.2.2.3 Paleontological Resources

Under Alternative 2, land use plans in Utah would be amended to designate 91,045 acres for commercial tar sands leasing, excluding special areas such as all ACECs (Section 2.4.3.1).

The designation of leasing areas, as well as the amendment of land use plans to incorporate these areas, would not affect paleontological resources because these actions do not authorize or approve any ground-disturbing activities. However, paleontological resources within these areas could be adversely affected if leasing and subsequent commercial development occur. Of the acreage identified as available for application for leasing under Alternative 2, a total of 80,429 acres (approximately 88% of the 91,045 acres that would be available under Alternative 2) has been identified as overlying geologic formations having the potential to contain important paleontological resources (Murphey and Daitch 2007).

Impacts from tar sands development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development areas, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 5.4.

#### 6.2.2.4 Water Resources

The acreage available for application for leasing under Alternative 2 specifically excludes lands identified in BLM land use plans as sensitive for numerous resources (see Table 2.2.3-1). Excluding these lands from application for leasing would provide complete protection from direct impacts on water resources found on these lands. To the extent that development could occur adjacent to these excluded lands, there is the potential for indirect adverse impacts on water resources on the excluded lands, as described in Section 5.5. In those areas that are available for application for leasing under Alternative 2, the potential impacts would be the same as those described for Alternative 1 in Section 6.2.1.4, with the exception that under Alternative 2, approximately 125 mi (46%) of perennial streams in the STSAs could be impacted by future commercial development (in comparison with 185 mi under Alternative 1).

The assessment of impacts on water resources under Alternative 2 has the same limitations identified under Alternative 1. Without site-specific information on the location and type of technology to be employed, it is not possible to assess the overall impacts of this alternative.

#### 6.2.2.5 Air Quality

Under Alternative 2, four land use plans would be amended to designate 91,045 acres of public land available for application for leasing for commercial development of tar sands (Section 2.4.3.1) and to exclude other acres, as described above. Air resources would not be affected by this action. Air resources in and around these areas could, however, be affected by future commercial tar sands development. Under Alternative 2, local, short-term, air quality impacts may be incurred as a result of (1) PM releases (fugitive dust and diesel exhaust) during construction activities such as site clearing and grading in preparation for facility construction and (2) exhaust emissions ($NO_x$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 5.6). These types of impacts would be of short duration and largely limited to specific project locations and immediately adjacent areas, as well as to other areas where project-related electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the tar sands. Processing activities could also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, which could extend beyond the lease areas identified under Alternative 2. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during tar sands processing (Section 5.6). In addition, ozone precursors of $NO_x$ and VOC from tar sands development could exacerbate wintertime high-ozone occurrences already prevalent in the study area, especially in Uintah County. Operational releases of HAPs (such as benzene, toluene, and formaldehyde) as well as diesel PM could also affect workers and nearby residences; these impacts, however, would be localized to the immediate project location.

During all phases of tar sands development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustions sources could contribute to climate change to some extent.

#### 6.2.2.6 Noise

Under Alternative 2, four land use plans would be amended to designate 91,045 acres of public land available for application for leasing for commercial development of tar sands (Section 2.4.3.1) and to exclude other acres, as described above. Ambient noise levels in potential lease areas would not be affected by this action. Ambient noise levels, however, could be affected by subsequent commercial development of tar sands. Under Alternative 2, local, short-term changes in ambient noise levels could occur during the construction, operation, and reclamation of tar sands projects (see Section 5.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Impacts on wildlife and recreational users are discussed in Sections 5.8.1.3 and 5.2.1.4, respectively.

Increased noise levels could result from the operation of construction equipment (graders, excavators, and haul trucks) and from blasting activities. Increases in noise levels during operations would be associated with mining and tar sands processing activities and would be more long-term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short-term and long-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could also be increased in the immediate vicinity of any pipeline pump station and could also be affected by project-related vehicular traffic at the project site and related locations such as access roads to the site.

Construction-related noise levels could exceed EPA guidelines. Similarly, in the absence of mitigation, operational noise associated with mining and retort activities could exceed EPA guidelines at some project locations at nearby sensitive receptors. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline levels except for short durations and very close to road or high traffic areas.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes to ambient noise levels from project development could occur wherever a project is located within the 91,045 acres identified for application for leasing under Alternative 2.

#### 6.2.2.7 Ecological Resources

Under Alternative 2, a total of 91,045 acres of public land would be made available within Utah for application for commercial tar sands leasing. The ecological resources in these areas (Section 3.7) would not be affected by the amendment of land use plans to identify these areas. Ecological resources in and around these areas, however, could be affected by future commercial development of tar sands in these areas. The following sections describe the potential impacts on ecological resources that may result from commercial tar sands development within the Alternative 2 lease areas.

**6.2.2.7.1 Aquatic Resources.** Under Alternative 2, a total of 91,045 acres of land in Utah would be made available for application for leasing for commercial tar sands development. There are no impacts on aquatic habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Potential impacts on aquatic resources from tar sands development could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), the release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 5.8.1.1. As described in Section 5.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals occur. Consequently, the analysis here considers the potential for impacts in waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities occur farther from waterways, the potential for negative effects on aquatic resources is reduced. For the analysis of potential impacts under each of the alternatives considered in this PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increases.

Under Alternative 2, there are 7 perennial streams, and about 7 mi of perennial stream habitat within the STSAs of Utah that are directly overlain by areas that would be potentially available for tar sands development (Table 6.2.2-1). When an additional 2-mi zone surrounding these areas is considered, there are 12 perennial streams and about 125 mi of perennial stream habitat that could be affected by future development activities (Table 6.2.1-5). The development of commercial tar sands projects in the areas identified under Alternative 2 could impact aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 5.1.1.1, impacts from water quality degradation and water depletions could affect resources in areas not only within or immediately adjacent to leased areas but also farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

**TABLE 6.2.2-1 Perennial Streams in Utah within the Lease Areas Identified under Alternative 2**

| Stream | Length of Stream (mi) |
|---|---|
| Bitter Creek | 0.6 |
| Center Fork | 1.4 |
| Cottonwood Canyon | 0.1 |
| Dry Creek | 3.7 |
| Nine-Mile Draw | <0.1 |
| Sweetwater Canyon | 0.7 |
| Wells Draw | 0.4 |
| Total | 7.0 |

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the STSAs are described in Section 3.7.1.2, and some of these aquatic habitats are known to, or are likely to, contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. Specific impacts would depend greatly upon the locations and methods of extraction used by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing decisions to evaluate potential impacts in greater detail.

**6.2.2.7.2 Plant Communities and Habitats.** Under Alternative 2, 91,045 acres of land in Utah would be made available for application for commercial leasing of tar sands resources. There would be no impacts on plant communities and habitats associated with identifying lands as available for application for leasing. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Areas available for application for commercial leasing under Alternative 2 support a wide variety of plant communities and habitats (see Section 3.7.2). None of these potential lease areas contain land designated in BLM land use plans for the protection of riparian habitats, floodplains, or special status plant species. Direct and indirect impacts could be incurred during project construction and operation and extend over a period of several decades (especially within facility and infrastructure footprints) (see Section 5.8.1.2). Some impacts (e.g., habitat loss) could continue beyond the termination of tar sands production.

Direct impacts on plant communities and habitat from future construction and operation activities would include the destruction of vegetation and habitat during land clearing on the lease site and also where ancillary facilities such as access roads, pipelines, transmission lines, and employer-provided housing would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be local, occurring within construction and operation footprints and in the immediate surrounding area, the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the locations of the areas where project construction and facilities would occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The area available for application for leasing under Alternative 2 includes locations that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of tar sands development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

No ACECs are included in the lands available under this alternative. Therefore direct impacts on sensitive plant species and plant communities within ACECs would not occur. However, one ACEC is located adjacent to the Alternative 2 footprint, the Nine Mile Canyon ACEC. This ACEC includes sensitive plant species. Indirect impacts on these species could occur.

Four ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) the Alternative 2 footprint: Raven Ridge (2.3 mi), Pariette Wetlands (0.9 mi), San Rafael Reef (0.3 mi), and Leers Canyon (2.9 mi). Indirect impacts on the sensitive species or communities within these ACECs could occur.

**6.2.2.7.3 Wildlife.** Under Alternative 2, 91,045 acres of land in Utah would remain available for application for commercial leasing for tar sands development. While no impacts on wildlife species associated with lands identified as available for application for leasing are expected, impacts could result from post-lease construction and operation as described in

Section 5.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. These areas available for application for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for different wildlife species. These stipulations include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) TL (where the BLM may allow specified activities but not during certain sensitive seasons, such as when raptors are nesting or when big game are on their winter ranges). No additional acreage of protected habitat has resulted from updates to tar sands stipulations since the preparation of the 2008 OSTS PEIS in areas available for application for leasing tar sands in Alternative 2.

Areas in Alternative 2 available for application for leasing overlap areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.2.2-1 and 6.2.2-2, respectively). Table 6.2.2-2 presents the amount of these habitats (as identified by state resource agencies) that would occur in the areas available for application and that could be affected by future commercial tar sands development in these areas.

Several wild horse and burro HMAs overlap lands that would be available for application for tar sands leasing, including the Hill Creek HMA, which overlaps with the Hill Creek STSA (9,739 acres); the Muddy Creek and Sinbad HMAs, which overlap with the San Rafael STSA (128 and 7,368 acres, respectively); and the Range Creek HMA, which overlaps with the Sunnyside STSA (337 acres) (Figure 6.2.2-3). Any tar sands development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Potential impacts on wildlife (including wild horses and burros) from the construction and operation of future commercial tar sands projects could occur in a number of ways and could be related to (1) habitat loss, alteration, or fragmentation (as a result of construction); (2) disturbance and displacement of biota (by construction and operation activities and the presence of project infrastructure); (3) mortality (from construction activities and collisions with project infrastructure and vehicles); (4) exposure to hazardous materials; and (5) increase in human access. These can result in changes in habitat use; changes in behavior; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities that would not be directly associated with commercial tar sands projects or workforces but that instead would be associated with the potentially increased access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads could lead to increased human access into the area. Potential impacts associated with increased access include the disturbance of wildlife from human activities, such as an increase in legal and illegal harvest, an increase of invasive vegetation, and an increase in the incidence of fires.

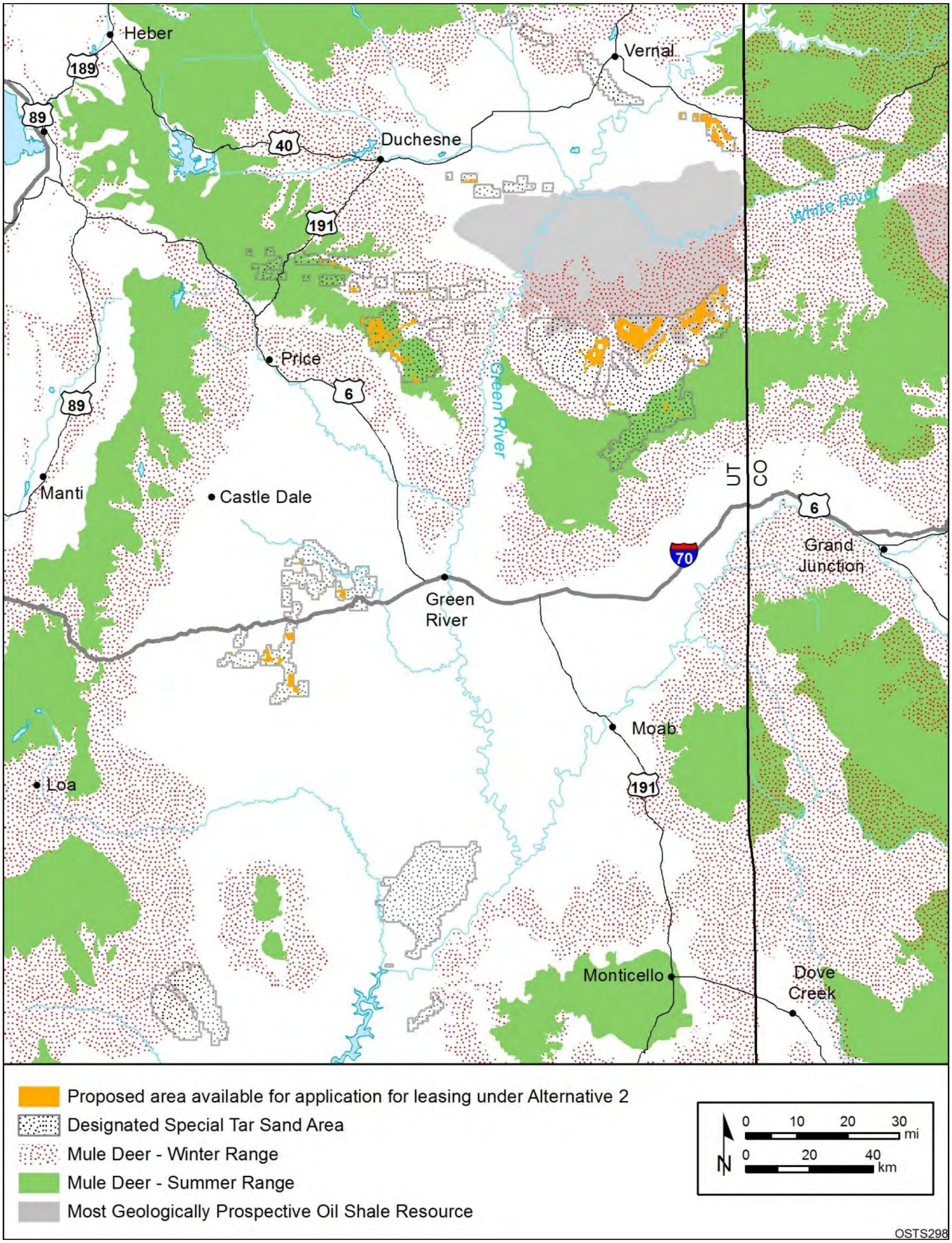


**FIGURE 6.2.2-1 Lands Available for Application for Tar Sands Leasing under Alternative 2 in Relation to the Summer and Winter Ranges of the Mule Deer**

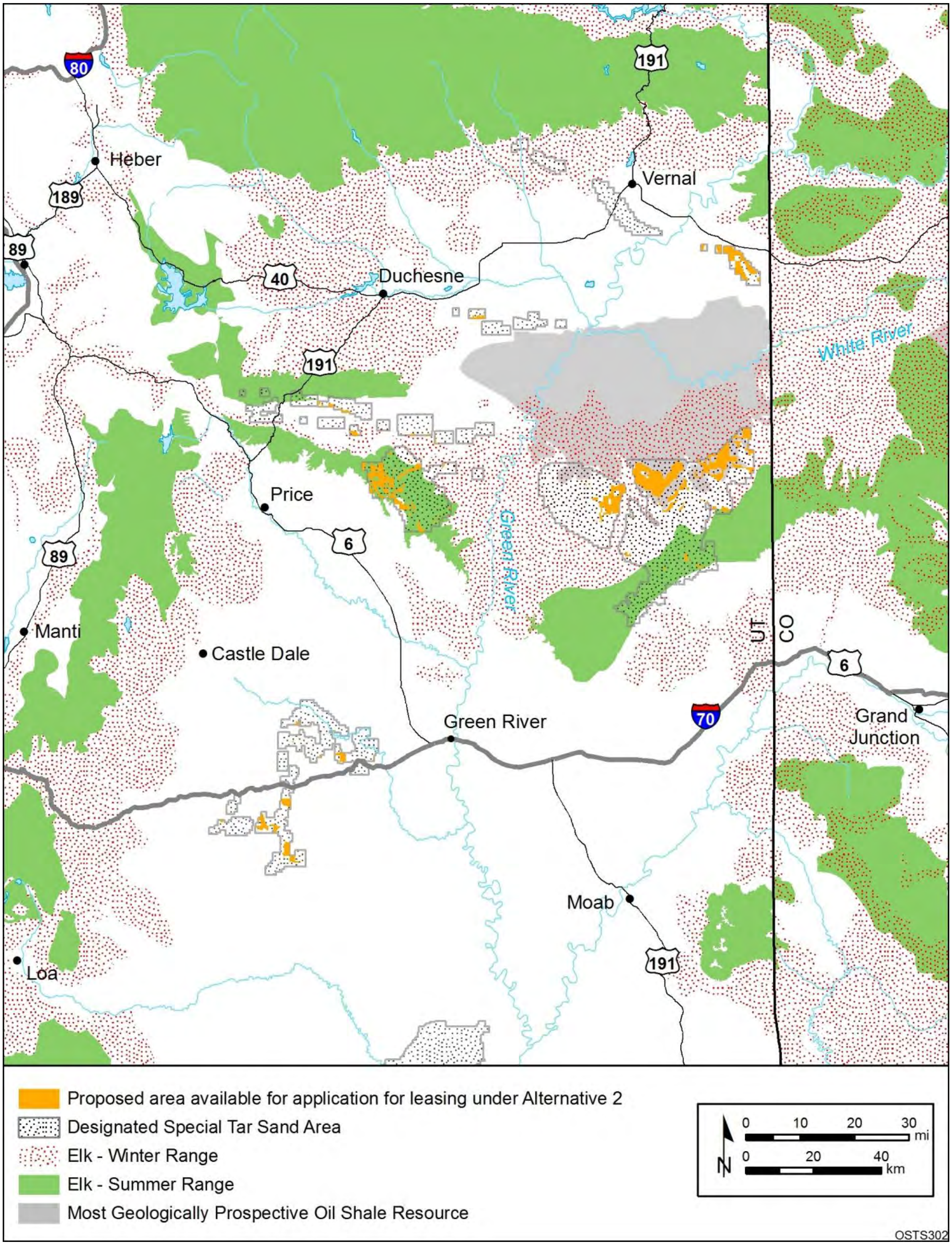


**FIGURE 6.2.2-2 Lands Available for Application for Tar Sands Leasing under Alternative 2 in Relation to the Summer and Winter Ranges of the Elk**

The potential for impacts on wildlife and their habitats by commercial tar sands development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. Their magnitude is also considered to be proportional to the amount of land disturbance.

**TABLE 6.2.2-2 State-Identified Elk and Mule Deer Habitat Present in the Alternative 2 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres) |
|---|---|
| ***Mule Deer*** | |
| Winter habitat | 57,708 |
| Summer habitat | 17,110 |
| ***Elk*** | |
| Winter habitat | 52,361 |
| Summer habitat | 17,170 |

**6.2.2.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 2, four land use plans would be amended to identify 91,045 acres of land in Utah as available for application for leasing for commercial development of tar sands. See Section 2.4.3 (and Table 2.4.2-2) for a full description of Alternative 2 for commercial tar sands development. Under this alternative, tar sands development would be excluded from core or priority habitats for the greater sage-grouse (*Centrocercus urophasianus*), as defined by the guidance set forth in the BLM's sage-grouse interim policy (BLM 2005i). There would be no impacts on threatened and endangered species associated with this land use plan amendment action. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.4. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. In addition, the BLM's approval of any projects would be subject to appropriate compliance with the ESA, and those policies provided under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Under Alternative 2, 63 of the 72 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.2.2-3, and 20 of the 22 federally listed threatened or endangered species listed in Table 6.2.2-4 could occur in areas that are available for application for commercial leasing of tar sands. This determination is based on records of occurrence in project counties, species occurrences from state natural heritage programs,[19] and the presence of potentially suitable habitat.[20] Potential lease areas include about 471 acres of critical habitat for

[19] Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.2.2-3 and 6.2.2-4.

[20] Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the lease areas. This quantification is presented in Tables 6.2.2-3 and 6.2.2-4.

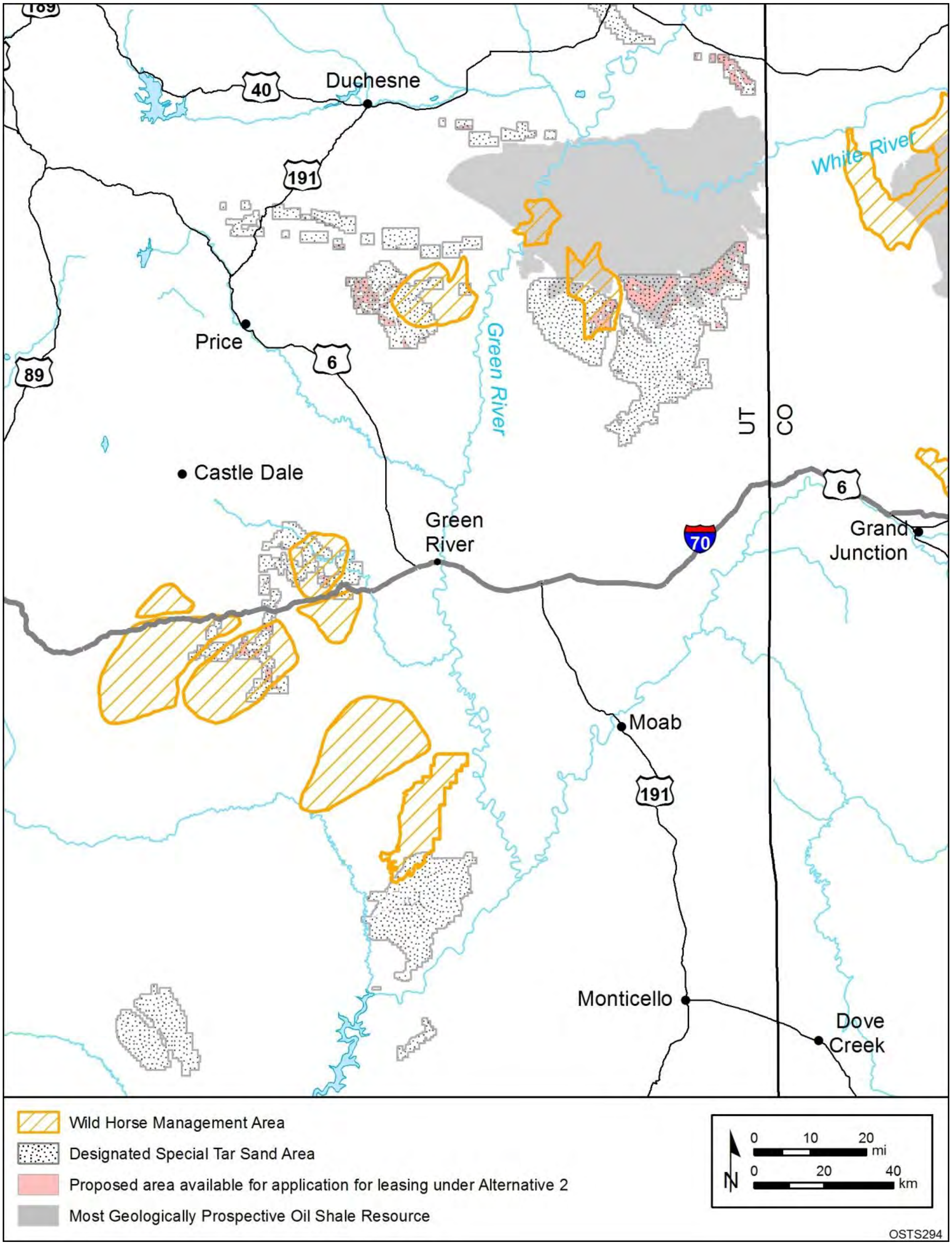


**FIGURE 6.2.2-3 Lands Available for Application for Oil Shale Leasing under Alternative 2 in Relation to Wild Horse and Burro Herd Management Areas**

**TABLE 6.2.2-3 Potential Effects of Commercial Tar Sands Development under Alternative 2 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Amsonia jonesii* | Jones blue star | BLM-S | Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | Emery, Garfield, Grand, Wayne | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | San Juan | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Astragalus piscator* | Fisher Towers milkvetch | BLM-S | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Astragalus rafaelensis* | San Rafael milkvetch | BLM-S | Emery, Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S | Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any project areas. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | Carbon, Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the project area. Quad-level occurrences are within 9 mi (14 km) from the STSAs. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha osterhoutii* | Osterhout cat's eye | BLM-S | Emery, Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S; WY-SC | Duchesne, San Raphael, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Listera borealis* | Northern twayblade | BLM-S | Duchesne, San Juan | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any of the STSAs. Nearest occurrences are approximately 90 mi (145 km) from the STSAs. |
| *Lygodesmia doloresensis* | Dolores River skeletonplant | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Mentzelia goodrichii* | Goodrich's blazingstar | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mimulus eastwoodiae* | Eastwood monkey-flower | BLM-S | Garfield, Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | Duchesne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pediomelum aromaticum* | Paradox breadroot | BLM-S | Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Penstemon scariosus var. albifluvis* | White River beardtongue | ESA-C; | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Gila robusta* | Roundtail chub | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Amphibians*** | | | | |
| *Hyla arenicolor* | Canyon treefrog | BLM-S | Garfield, Grand, Wayne, San Juan | **Potential for negative impact.** Approximately 3,743 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Rana pipiens* | Northern leopard frog | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 14 acres of potentially suitable habitat for this species occurs in the STSAs. Nearest occurrences are approximately 80 mi (129 km) from the STSAs. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians (Cont.)*** | | | | |
| *Spea intermontana* | Great basin spadefoot | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 73,173 acres of potentially suitable habitat for this species occurs in the STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| ***Snakes*** | | | | |
| *Elaphe guttata* | Corn snake | BLM-S; UT-SC | Grand, San Juan | **Potential for negative impact.** Approximately 1,736 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 4 mi (6 km) from the STSAs. |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xantusia vigilis* | Desert night lizard | BLM-S; UT-SC | Garfield, San Juan | **Potential for negative impact.** Approximately 28 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 24,054 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | Duchesne, Uintah, Utah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Athene cunicularia* | Burrowing owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 41,134 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Buteo regalis* | Ferruginous hawk | BLM-S; UT-SC; | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 29,904 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Centrocercus minimus* | Gunnison sage-grouse | ESA-C; UT-SC | Grand, San Juan | **No impact.** Suitable habitat for the species does not occur in the project area, and the species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs. |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C; BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact**. Approximately 26,630 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Species may occur in riparian habitats near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cypseloides niger* | Black swift | BLM-S; UT-SC | Duchesne, Uintah | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for this species may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S; | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 48,037 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 6,021 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Numenius americanus* | Long-billed curlew | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 498 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 626 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,295 acres of potentially suitable habitat for this species occurs in the STSAs. |
| ***Mammals*** | | | | |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC | Garfield, Wayne | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 76,547 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cynomys gunnisoni* | Gunnison's prairie dog | ESA-C; BLM-S; UT-SC | Grand, San Juan | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |

**TABLE 6.2.2-3 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Approximately 29,890 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 63,552 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Idionycteris phyllotis* | Allen's big-eared bat | BLM-S; UT-SC | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | Carbon, Emery, Grand, Garfield, San Juan, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 10 mi (16 km) from the STSAs. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 82,539 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 61,189 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Vulpes macrotis* | Kit fox | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,779 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**Footnotes are on next page.**

**TABLE 6.2.2-3 (Cont.)**

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[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the STSAs.

the Mexican spotted owl (*Strix occidentalis lucida*). There are no designated critical habitats for Colorado River endangered fishes within potential lease areas; however, critical habitat for Colorado River endangered fishes may occur downstream within 10 mi (16 km) of potential tar sands lease areas (Figure 6.2.2-4). Areas including greater sage-grouse habitat are shown in Figure 6.2.2-5. Although greater sage-grouse core and priority habitats are excluded from tar sands development under this alternative, core and priority habitats may occur in close proximity (<1 mi [1.6 km]) to proposed lease areas.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) by commercial tar sands development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions, contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

Potential impacts on threatened, endangered, and sensitive species under Alternative 2 are similar to or the same as impacts on aquatic resources, plant communities and habitats, and wildlife described in Sections 6.2.2.7.1, 6.2.2.7.2, and 6.2.2.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

#### 6.2.2.8 Visual Resources

The lands made available for application for leasing for commercial development of tar sands under Alternative 2 support a wide variety of visual resources (Section 3.9). These resources would not be affected by the amendment of land use plans to identify these lease areas.

**TABLE 6.2.2-4 Potential Effects of Commercial Tar Sands Development under Alternative 2 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Cycladenia humilis* var. *jonesii* | Jones cycladenia | ESA-T | Emery, Garfield, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Erigeron maguirei* | Maguire daisy | ESA-T | Emery, Garfield, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Pediocactus despainii* | San Rafael cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pediocactus winkleri* | Winkler cactus | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 11 mi (18 km) from the STSAs. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSA project areas. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 6 mi (10 km) from the STSAs. |
| *Schoenocrambe barnebyi* | Barneby reed-mustard | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 9 mi (14 km) from the STSAs. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.2-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | Carbon, Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Sclerocactus wrightiae* | Wright fishhook cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Townsendia aprica* | Last chance townsendia | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Designated critical habitat occurs within 10 mi (16 km) from STSA areas. Quad-level occurrences are within 4 mi (6 km) from the STSAs. |
| *Gila elegans* | Bonytail | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Designated critical habitat occurs within 10 mi (16 km) from STSA areas. Quad-level occurrences of this species intersect the STSAs. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Designated critical habitat occurs within 6 mi (10 km) from the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E | Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Designated critical habitat occurs within 6 mi (10 km) from the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.2-4 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 8,782 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Gymnogyps californianus* | California condor | ESA-E | Grand | **Potential for negative impact.** Approximately 171 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 19,514 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T | Emery, Uintah | **No impact.** Suitable habitat for the species does not occur in the STSAs. Designated critical habitat does not occur in the vicinity of the project areas. Nearest quad-level occurrences are approximately 13 mi (21 km) from the STSAs. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN | Carbon, Duchesne, Emery, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 5,978 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from the UDWR (2011). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the STSAs. Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

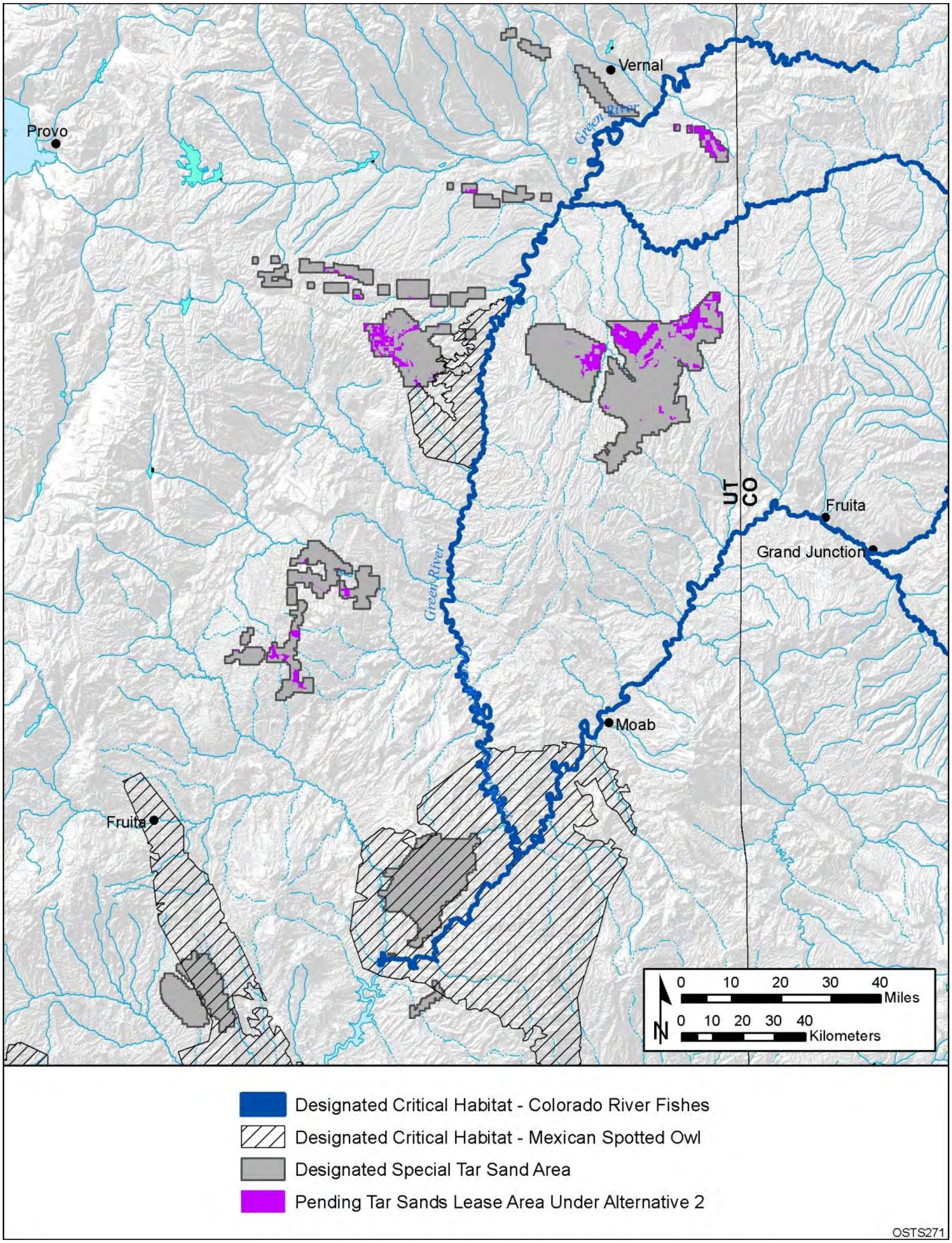


**FIGURE 6.2.2-4 Designated Critical Habitats of Threatened and Endangered Species That Are near Tar Sands Lease Areas under Alternative 2**

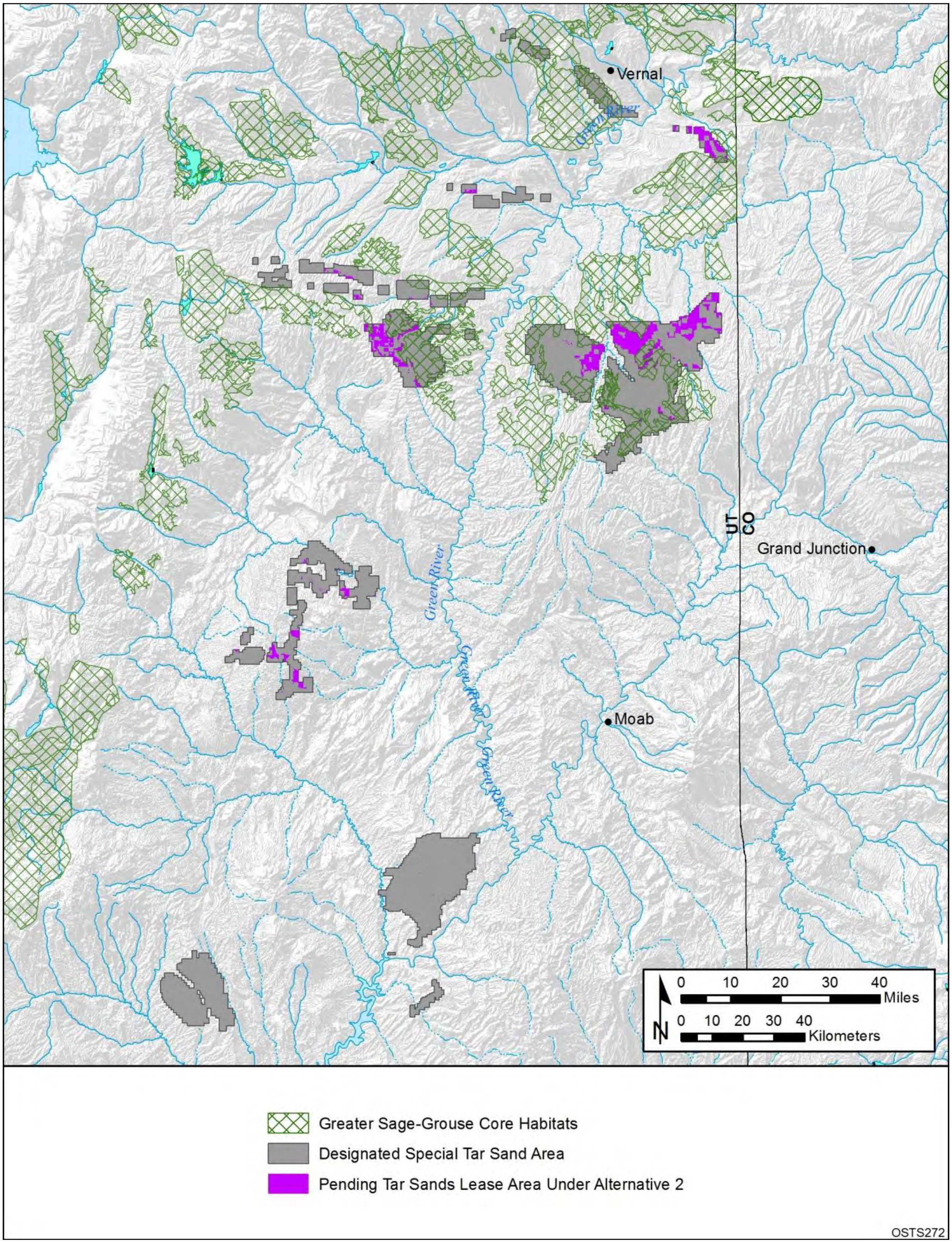


**FIGURE 6.2.2-5 Distribution of Core and Priority Habitat Areas for Greater Sage-Grouse That Are near Pending Tar Sands Lease Areas under Alternative 2**

Visual resources in and around the identified areas, however, could be affected by subsequent commercial development of tar sands.

Scenic resource areas are located within 5 or 15 mi of the areas in Alternative 2 identified as available for commercial leasing (Figures 6.2.2-6 through 6.2.2-9). The 5-mi zone corresponds to the BLM's VRM foreground-middleground distance limit, and the 15-mi zone corresponds to the BLM's background distance limit. Based on the assumption of an unobstructed view of a commercial tar sands project, viewers in these areas would be likely to perceive some level of visual impact from the project; more impacts would be expected for resources within the foreground-middleground distance, and fewer for resources within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be minor to negligible. Table 6.2.2-5 presents the scenic resource areas that fall within these zones.

Visual resources at these areas, as well as elsewhere within the areas available for application for leasing, could be affected at and near where commercial tar sands projects are developed and operated, and at areas where supporting infrastructure (such as utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 5.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components such as tar sands processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

#### 6.2.2.9 Cultural Resources

Alternative 2 includes 91,045 acres of public land available for application for commercial tar sands leasing. The lands available for application for leasing overlap with some lands identified as having cultural resources present (O'Rourke et al. 2007). Approximately 6% of public lands that would remain available for application for leasing in the STSAs under Alternative 2 have been surveyed for cultural resources (more than 5,640 acres in addition to 81 linear mi).[21] In these areas that have been surveyed, 154 sites have been identified. Additional resources are likely to be found in unsurveyed portions of the study area. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), nearly 59,568 acres of the STSA Alternative 2 area have been identified as having a medium or high sensitivity for containing cultural resources.[22]

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[21] This percentage was calculated by using block acre surveys only and does not include approximately 125 linear miles of survey.

[22] The Argyle Canyon, Asphalt Ridge, Circle Cliffs, Raven Ridge and White Canyon STSAs and portions of the San Rafael, Sunnyside, and Tar Sand Triangle STSAs had not been surveyed sufficiently to derive sensitivity information; therefore, these acreages have not been included in this percentage calculation. Out of 91,045 acres available under Alternative 2, sensitivity information is available for 78,721 acres (86%).

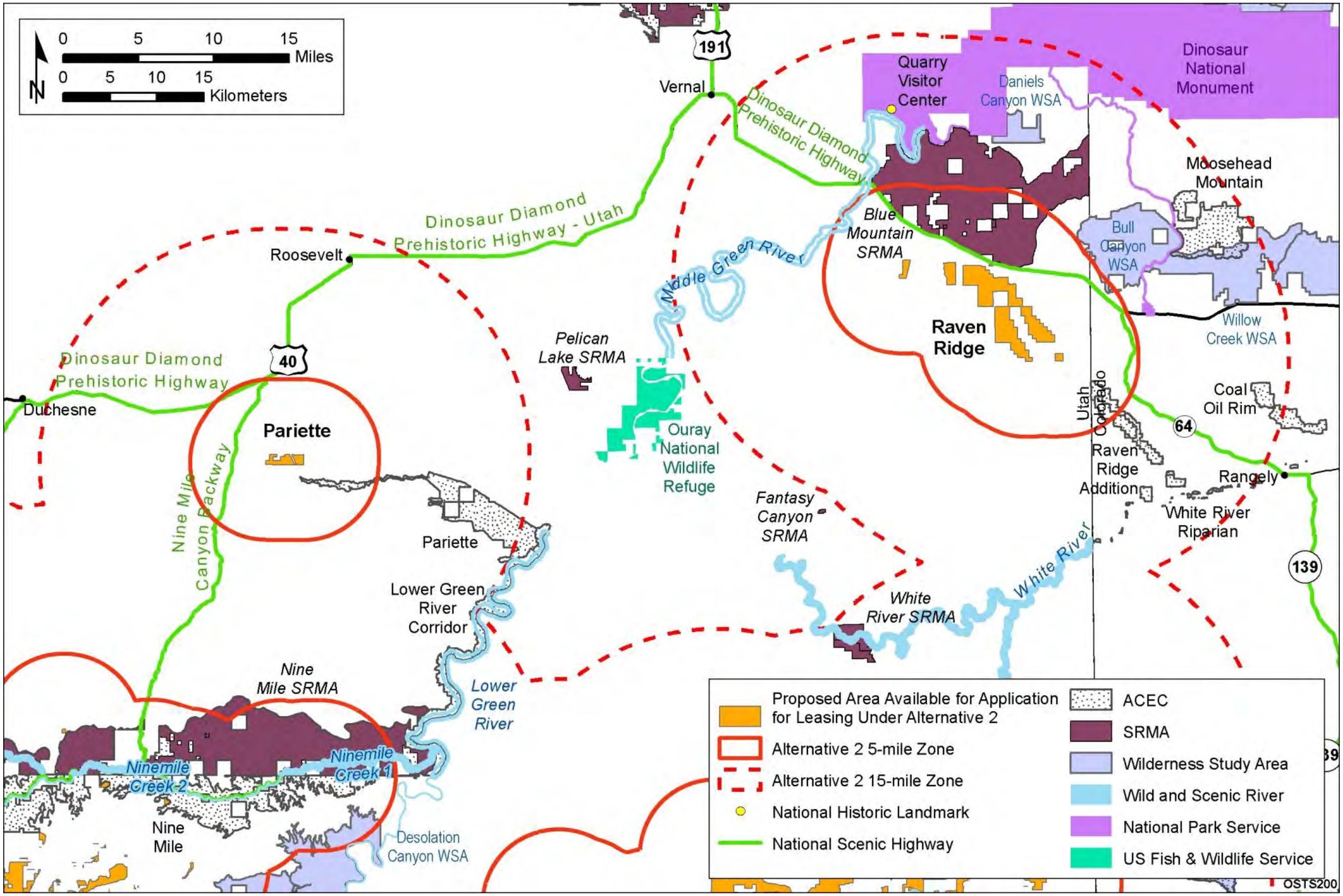


**FIGURE 6.2.2-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 for the Asphalt Ridge, Pariette, and Raven Ridge STSAs**

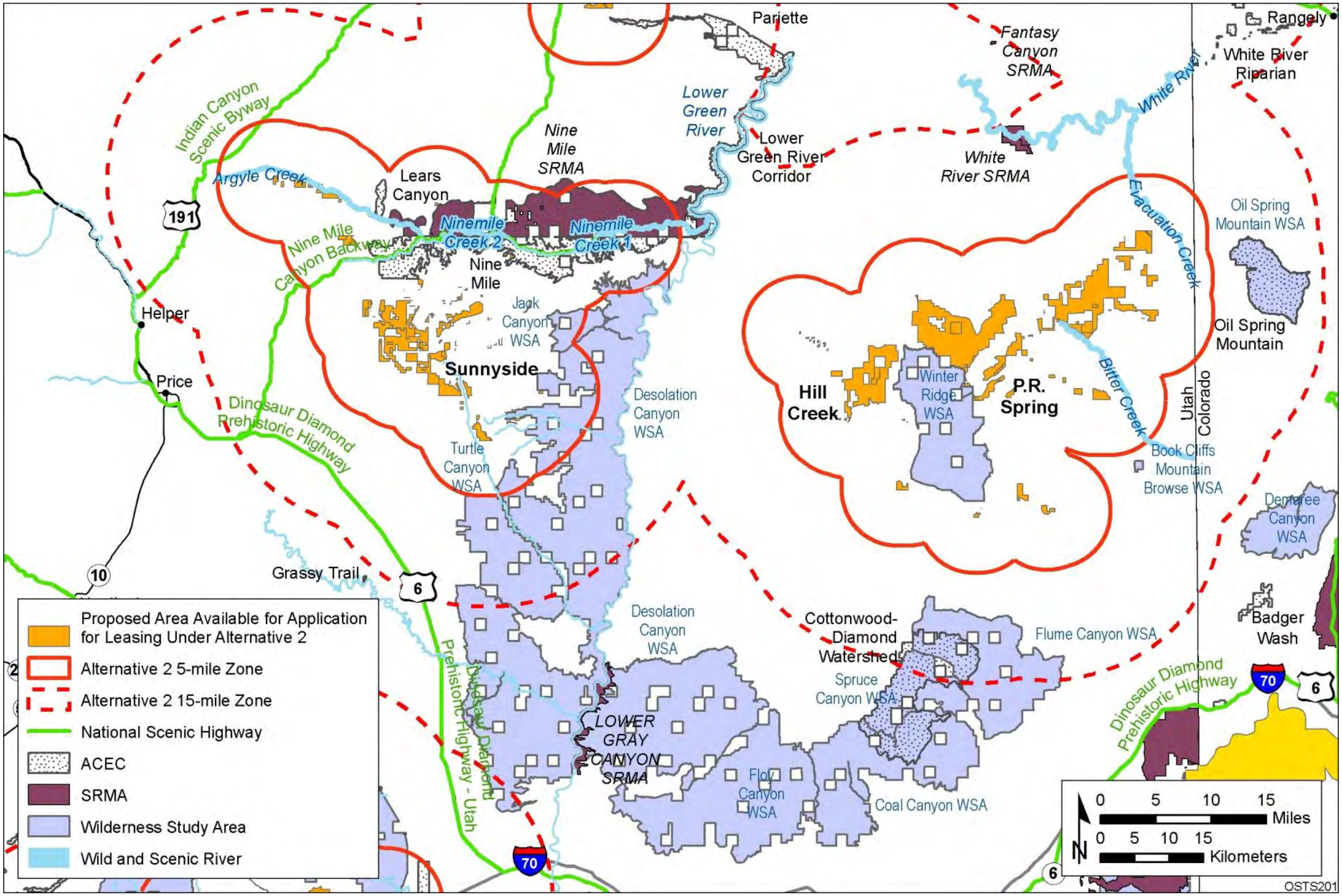


**FIGURE 6.2.2-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 for the Hill Creek, P.R. Spring, and Sunnyside STSAs**

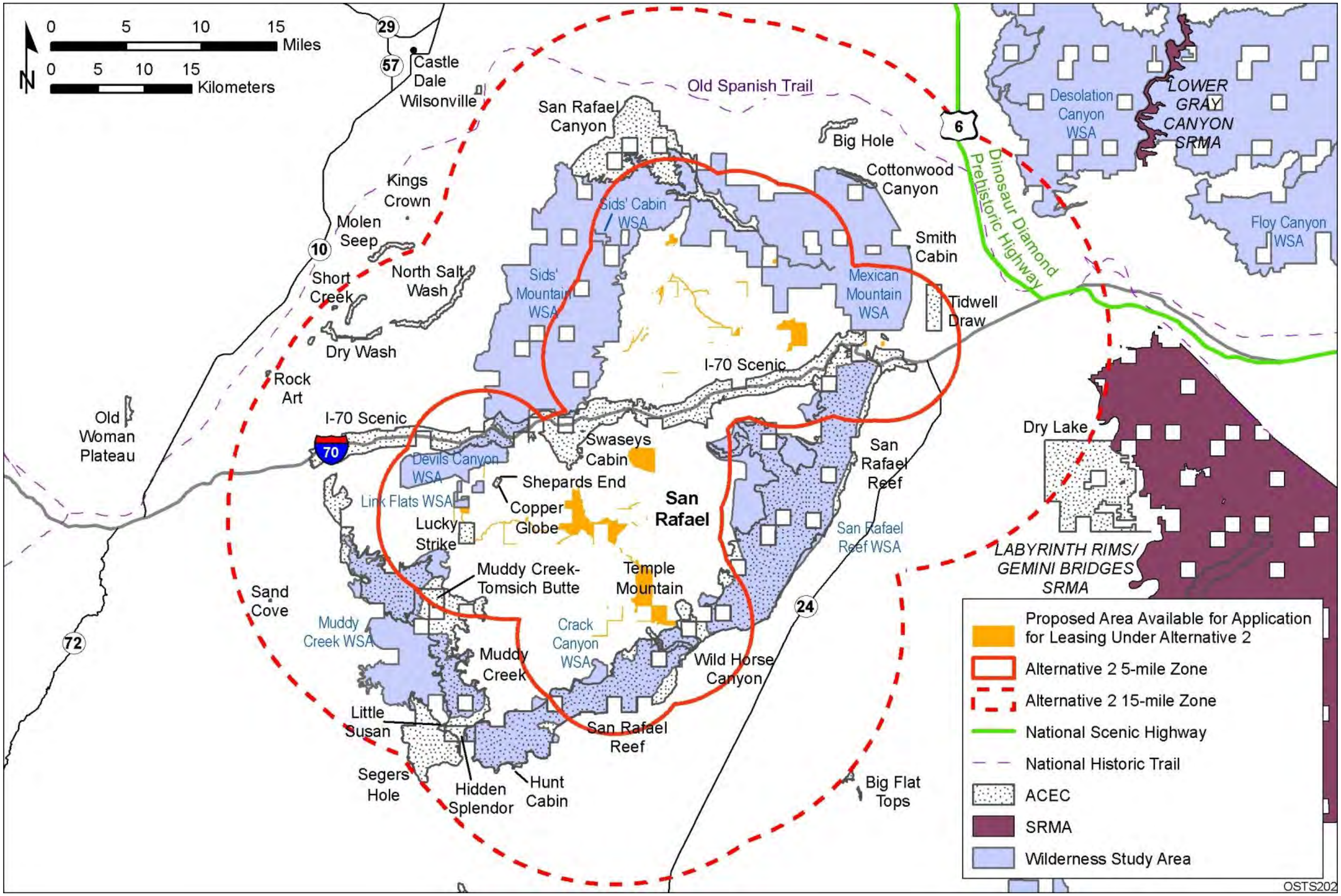


**FIGURE 6.2.2-8 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 for the San Rafael STSA**

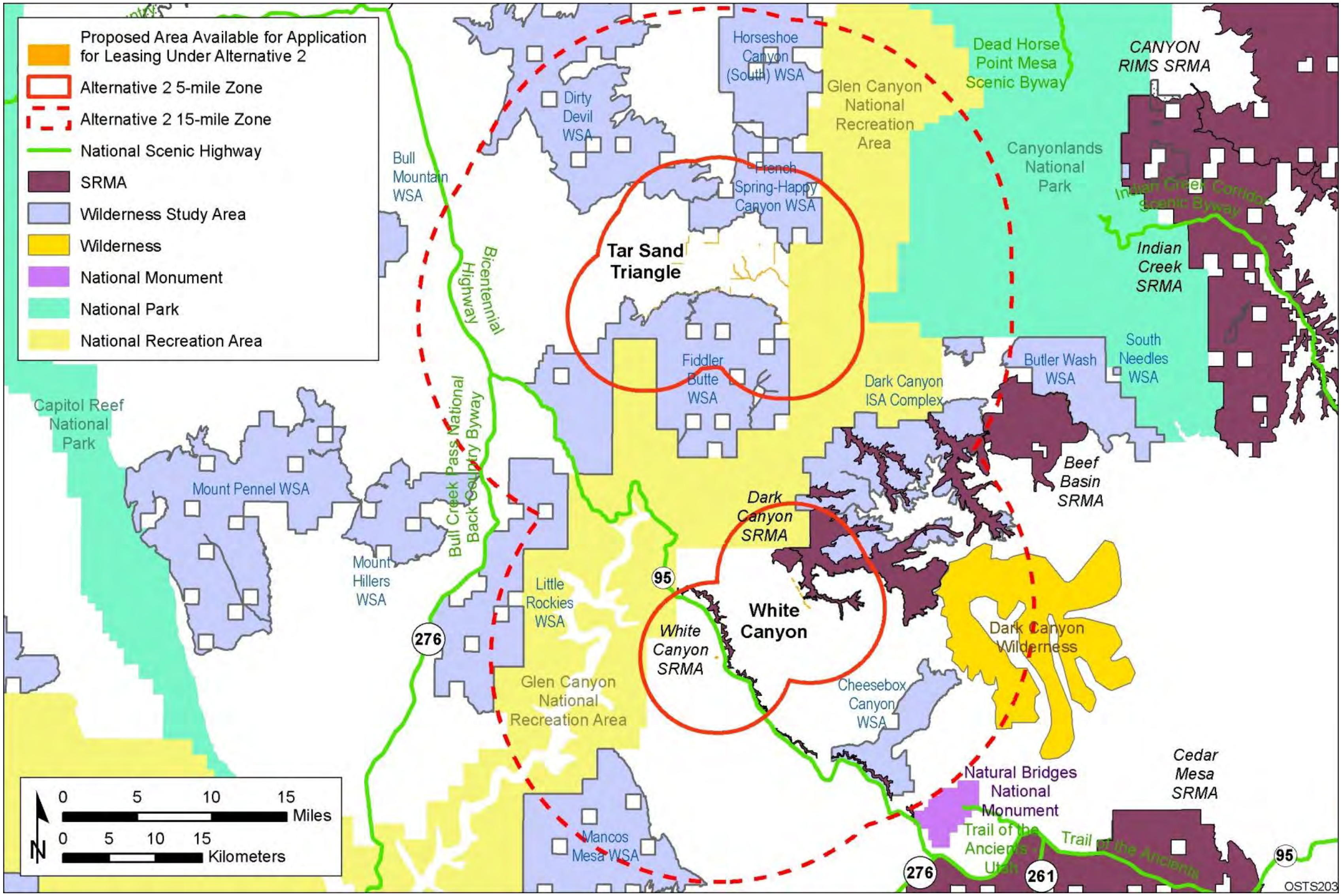


**FIGURE 6.2.2-9 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 2 for the Tar Sand Triangle and White Canyon STSAs**

**TABLE 6.2.2-5 Visually Sensitive Areas That Could Be Affected by Commercial Tar Sands Projects Developed in Potential Lease Areas under Alternative 2**

| Scenic Resources within 5 mi of Alternative 2 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 2 Lease Areas |
|---|---|
| Bull Canyon, Crack Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, French Spring-Happy Canyon, Jack Canyon, Link Flats ISA, Mexican Mountain, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain and Winter Ridge WSAs. | Book Cliffs Mountain Browse ISA, Bull Canyon, Butler Wash, Cheese Box Canyon, Crack Canyon, Daniels Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, Flume Canyon, French Spring-Happy Canyon, Horseshoe Canyon (South), Jack Canyon, Link Flats ISA, Little Rockies, Mancos Mesa, Mexican Mountain, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain, Spruce Canyon, Turtle Canyon, and Winter Ridge WSAs. |
| Copper Globe, I-70 Scenic, Lucky Strike, Muddy Creek, Muddy Creek-Tomsich Butte, Raven Ridge Addition, Rock Art, San Rafael Canyon, San Rafael Reef, Shepards End, Swaseys Cabin, Temple Mountain, Tidwell Draw, and Wild Horse Canyon ACECs. | Copper Globe, Cottonwood Canyon, Cottonwood-Diamond Watershed, Dry Lake, Dry Wash, Hidden Splendor, Hunt Cabin, I-70 Scenic, Lears Canyon, Little Susan, Lower Green River Corridor, Lucky Strike, Muddy Creek, Muddy Creek-Tomsich Butte, Nine Mile, North Salt Wash, Pariette, Raven Ridge Addition, Rock Art, San Rafael Canyon, San Rafael Reef, Sand Cove, Segers Hole, Shepards End, Short Creek, Smith Cabin, Swaseys Cabin, Temple Mountain, Tidwell Draw, White River Riparian, and Wild Horse Canyon ACECs. |
| Blue Mountain, Nine Mile, Dark Canyon, and White Canyon SRMAs. | Beef Basin, Labyrinth Rims/Gemini Bridges, White River, Blue Mountain, Nine Mile, Dark Canyon, and White Canyon SRMAs. |
| Dinosaur Diamond Prehistoric National Scenic Highway, Bicentennial and Indian Canyon State Scenic Byways. | Dinosaur Diamond Prehistoric National Scenic Highway, Bicentennial and Indian Canyon State Scenic Byways, and Bull Creek Pass BLM Backcountry Byway. |
| Canyonlands National Park and Glen Canyon National Recreation Area. | Canyonlands National Park, Dark Canyon Wilderness, Glen Canyon National Recreation Area, Dinosaur and Natural Bridges National Monuments. |
| | Quarry Visitor Center National Historic Landmark and Old Spanish Trail National Historic Trail. |

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to impact cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts from future development could include the destruction of individual resources present within development areas, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resource from looting or vandalism as a result of increased human presence and activity in the sensitive areas, and visual degradation of the cultural setting (see Section 6.2.2.8). Any future leasing and development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts, or to denial of the lease or project. The cultural resources in the Circle Cliffs STSA would not be impacted by tar sands leasing and development because no leasing and development would occur in this STSA. The cultural resources in the Argyle Canyon, Hill Creek, Pariette, Raven Ridge, San Rafael, Tar Sand Triangle, and White Canyon STSAs are less likely to be impacted by tar sands leasing and development than those resources present in the Asphalt Ridge, P.R. Spring, and Sunnyside STSAs.

#### 6.2.2.10 Indian Tribal Concerns

Four land use plans would be amended under Alternative 2. Under Alternative 2 (Conservation Focus), 91,045 acres of public land, less than a quarter of that available under Alternative 1, is identified as available for application for commercial tar sands leasing. The amendment of land use plans would not directly impact resources important to Native Americans. However, resources of concern to Native Americans in these areas could be adversely impacted if leasing and future development occur. Potential impacts would be similar to those discussed for Alternative 1, but over a smaller area. Additional lands excluded from application for leasing include all the Argyle Canyon and Asphalt Ridge STSAs and portions of the remaining STSAs. (The Circle Cliffs STSA is excluded from all alternatives because it lies within lands administered by the National Park Service not by the BLM.) Adverse effects on resources important to Native Americans would be reduced by implementation of legally required procedures in the amended management plans for cultural resources survey and by government-to-government consultations with the affected tribes. Project-specific NEPA analyses would be required that could result in lease stipulations specific to the parcels considered for lease resulting in avoidance and protection of the resources through changes in project design and development plans.

#### 6.2.2.11 Socioeconomics

Under Alternative 2, land use plans would be amended to identify 91,045 acres of land in Utah as available for application for commercial tar sands development. With the possible exception of an impact on property values, there is no socioeconomic impact of this action. Although the socioeconomic and transportation impacts of Alternative 2 would be dependent on the exact locations of future development, the types of impacts that could occur would be the same as those described in Section 5.12 and summarized in Section 6.2.1.11 for Alternative 1. The specific impacts would be dependent upon the technologies employed, the project size or production level, development time lines, mitigation measures, and the location of employee housing.

Under Alternative 2, it is possible that there would be property value impacts simply from designating land as available or not available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.11.1.6).

#### 6.2.2.12 Environmental Justice

Although the environmental justice impacts of Alternative 2 would be dependent on the exact locations of specific developments, the types of impacts that would occur on lands identified as remaining available for application for commercial leasing by the proposed land use plan amendments under Alternative 2 would be the same as those described in Section 5.13 and summarized in Section 6.2.1.12.

#### 6.2.2.13 Hazardous Materials and Waste Management

The amendment of land use plans under Alternative 2 to identify 91,045 acres of land as available for application for leasing for commercial tar sands development would not result in any hazardous material or waste management effects. Impacts related to hazardous materials and wastes, however, could occur during the future development of commercial tar sands projects within the areas identified in Alternative 2 as available for commercial leasing. Such impacts are generally independent of location and would be unique to the technology combinations used for tar sands development. Impacts from hazardous materials and wastes would also be associated with ancillary support activities that would be required for development of any tar sands facility regardless of the technology used. These include the impacts from development of energy transmission or pipeline ROWs and employer-provided housing.

Hazardous materials impacts associated with project construction would be minimal and limited to the hazardous materials typically utilized in construction, such as fuels, lubricating oils, hydraulic fluids, and glycol-based coolants, solvents, adhesives, and corrosion control coatings. Construction-related wastes could include landscape wastes from clearing and grading of the construction sites, and other wastes typically associated with construction, none of which is expected to be hazardous (Section 5.13.1).

During project operations, hazardous materials would be utilized and a variety of wastes (some hazardous) would be generated. Hazardous materials used include fuels, solvents, corrosion control coatings, flammable fuel gases, and herbicides (for vegetation clearing and management at facilities or along ROWs). The types and amounts of hazardous waste generated during operations would depend on the specific design of the commercial tar sands project (surface or subsurface mining, surface retorting, or in situ processes). Waste materials produced during operations could include waste engine fuels and lubricants, flammable gases, volatile and flammable organic liquids, and heavier-molecular-weight organic compounds (Section 5.13.1).

Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial tar sands project, it is not possible to quantify project-related impacts of these materials. Under Alternative 2, individual facilities could be located anywhere within the area identified as being available for leasing pending project review and authorization. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Sections 5.14 and 6.2.2.14) at locations where the individual projects are sited within the Alternative 2 lease areas.

#### 6.2.2.14 Health and Safety

The amendment of land use plans to identify 91,045 acres of land as available for application for leasing for commercial tar sands development would not result in any direct health and safety effects. A number of health and safety concerns, however, would be associated with the commercial development of tar sands projects within the areas identified in Alternative 2 as available for application for commercial leasing. For commercial tar sands development in Alternative 2 proposed lease areas, potential health and safety impacts from the construction and operation of commercial tar sands projects would be associated with the following activities: (1) constructing project facilities and associated infrastructure; (2) mining (if processing is not in situ) the tar sands; (3) obtaining and upgrading the crude oil, either through surface retorting or in situ processing; (4) transporting construction and raw materials to the upgrading facility and transporting product from the facility; and (5) exposing the public to water and air contamination associated with tar sands development. Hazards from tar sands development (summarized in Table 5.14-1) could include physical injury from construction, tar sands processing, and vehicle transportation accidents, and exposure to fugitive dust and hazardous materials such as retort emissions and industrial chemicals (Section 5.14). Health and safety impacts would be largely restricted to the immediate workforce of each facility. Accidents could also affect members of the general public who could be present in the immediate vicinity of an accident (e.g., project-related truck accident on a public road, recreational users in areas adjacent to the project lease area).

Hazards for workers at tar sands development facilities include risks of accidental injuries or fatalities, lung disease caused by inhalation of particulates and other hazardous substances, and hearing loss. Estimates of expected injuries and fatalities can be made on the basis of numbers of employees and the type of work. On the basis of the number of employees projected to be needed for construction and operation of tar sands facilities, statistically there would be less than 1 death and about 100 injuries per year expected per facility during construction activities, and less than 1 death and about 30 injuries per year expected per facility during operations (NSC 2006). A comprehensive facility health and safety plan and worker safety training would be required as part of the plan of development for every proposed commercial tar sands project.

Health and safety concerns are largely independent of the location of tar sands development facilities. However, the health and safety impacts on the general public from emissions from these facilities would depend both on the specific characteristics and level of emissions and on the distance of the emissions source from population centers. The level of air and water emissions would be regulated under required permits. Potential impacts on the general public from emissions would be assessed in future site-specific NEPA and permitting documentation.

### 6.2.3 Impacts of Alternative 3, Consideration only of a Pending Commercial Lease; Classification of the Public Lands for No Application for Tar Sands Leasing

Under Alternative 3, the BLM would amend the same four BLM Utah land use plans as in Alternative 2, but these amendments would be to close the public lands within the STSAs to application for tar sands leasing with the exception of the lands encompassed by a proposed 2,100-acre lease in the Asphalt Ridge STSA near Vernal, Utah. See Sections 2.4.3 and 2.4.3.2 for a complete description of Alternative 3. This alternative analyzes foregoing the leasing of tar sands entirely except for the lands encompassed by this proposed lease.

On the basis of the analysis in this PEIS, the BLM has determined that there is no environmental impact associated with making lands available for application for commercial leasing, but there may be impacts on land values. However, the development of a commercial tar sands project on the lands associated with the proposed lease located in the Asphalt Ridge STSA could have impacts on some resources on public, state, and private lands. The following sections describe the impacts of Alternative 3 on the environment and the socioeconomic setting. The sections also describe the potential impact of the proposed commercial development within the Asphalt Ridge STSA. This analysis does not constitute complete NEPA compliance for approval of the proposed 2,100-acre lease; NEPA compliance supporting that decisionmaking is being prepared separately from this PEIS. Rather, this analysis is provided both for itself, as well as primarily illustrative of the kinds of impacts that might be expected from this type of development, in order to inform the land use allocation decision. If the NEPA analysis of this proposed project is completed prior to preparation of the Final PEIS, salient points from that analysis will be included in the Final PEIS.

#### 6.2.3.1 Land Use

The amendment of four land use plans to close all public lands to future application for tar sands would not adversely affect existing land uses on these lands; in fact, current uses would not be subjected to potential impacts associated with tar sands development, apart from that which might occur on the basis of valid existing rights. Combined hydrocarbon leases (CHLs) issued in the mid-1980s on tar sands deposits have not been developed, and in the 2008 OSTS PEIS, it was anticipated that no development under the CHL program was likely to occur in the near future. Therefore, the classification of public lands to not allow future commercial application for the development of tar sands resources, subject to valid existing rights, will not have a significant impact on the human environment. Under this alternative, there is the possibility of limited development, in the event the pending commercial lease is issued, or a future lease is issued on these 2,100 acres; therefore, the opportunity remains for future decisions regarding availability of public lands for this resource to be made on the basis of demonstrable economic viability and in light of specific environmental information. Should tar sands development technologies be demonstrated to be feasible, the opportunity will still exist whether to consider making public lands available for future development.

This alternative does include the consideration of the development of 2,100 acre of public lands within a larger development proposal within the Asphalt Ridge STSA. Although the acreage under consideration is much smaller than that in any of the other alternatives, some of the potential impacts on land use could be the same as those identified for Alternative 1, although at a much smaller scale and with the following exceptions. No areas have been identified as possessing one or more characteristics of wilderness, nor are there any areas identified as potential ACECs within the area under application that could be affected.

#### 6.2.3.2 Soil and Geologic Resources

Under Alternative 3, land use plans would be amended to designate about 2,100 acres in the Asphalt Ridge STSA in Utah as available for commercial tar sands leasing (Section 2.4.3.2). The amendment of land use plans to identify this area would not have any direct impacts on soil and geologic resources in these lands. Development of commercial tar sands projects could, however, affect soils and geologic resources in these lands.

Construction-related activities could directly disturb surface and subsurface soils during clearing and grading activities and construction of project facilities and infrastructure. This disturbance could include soil disturbance, removal, and compaction, and disturbed areas would be more susceptible to the effects of precipitation and wind-driven erosion (see Section 5.3.1). Surface and subsurface mining activities during project operations would directly disturb geologic resources. Erosion of exposed soils could lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust. Soils in project areas would remain susceptible to erosion until completion of construction, mining, and tar sands processing activities, and site stabilization and reclamation (e.g., revegetation of pipeline ROWs and surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as to areas where associated off-lease infrastructure (e.g., access roads and utility ROWs) would be located.

Under Alternative 3, project-related impacts could occur wherever individual projects are located within the 2,100 acres identified for application for leasing under this alternative. For any project, the erosion potential of the soils would be a direct function of the lease and project location and of the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

#### 6.2.3.3 Paleontological Resources

Under Alternative 3, land use plans would be amended to designate about 2,100 acres in the Asphalt Ridge STSA in Utah for commercial tar sands leasing (Section 2.4.3.2). The designation of leasing areas, as well as the amendment of land use plans to incorporate this area, would not affect paleontological resources because these actions do not authorize or approve any ground-disturbing activities. Paleontological resources within these areas, however, could be adversely affected if leasing and subsequent commercial development occur. Of the acreage identified as available for application for leasing under Alternative 3, a total of 1,458 acres (approximately 69% of the 2,100 acres that would be available under Alternative 3) has been identified as overlying geologic formations having the potential to contain important paleontological resources (Murphey and Daitch 2007).

Impacts from tar sands development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development areas, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 5.4.

#### 6.2.3.4 Water Resources

The acreage available for application for leasing under Alternative 3 is limited to about 2,100 acres at the Asphalt Ridge STSA. Nevertheless, there is a potential for indirect adverse impacts on water resources, as described in Section 5.5. In those areas available for application for leasing under Alternative 3, the nature of potential impacts would be the same as those described for Alternative 1 in Section 6.2.1.4; however, under Alternative 3, no perennial stream miles are present that could be impacted by future commercial development.

Although the regional impacts on water resources under Alternative 3 would be much smaller than those of the other alternatives, the assessment of impacts on water resources under Alternative 3 has the same limitations identified under Alternative 1. Without site-specific information on the location and type of technology to be employed, it is not possible to assess the overall impacts of this alternative.

#### 6.2.3.5 Air Quality

Under Alternative 3, land use plans would be amended to designate about 2,100 acres in the Asphalt Ridge STSA in Utah as available for commercial tar sands leasing (Section 2.4.3.2). Air resources would not be affected by this action. Under Alternative 3, local, short-term, air quality impacts may be incurred as a result of (1) PM releases (fugitive dust and diesel exhaust) during construction activities such as site clearing and grading in preparation of facility construction and (2) exhaust emissions ($NO_x$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 5.6). These types of impacts would be of short duration and largely limited to specific project locations and immediately adjacent areas, as well as to other areas where project-related electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the tar sands. Processing activities could also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, that could extend beyond the lease areas identified under Alternative 2. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during tar sands processing (Section 5.6). In addition, ozone precursors of $NO_x$ and VOC from tar sands development could exacerbate wintertime high-ozone occurrences already prevalent in the study area, especially in Uintah County. Operational releases of HAPs (such as benzene, toluene, and formaldehyde) as well as diesel PM could also affect workers and nearby residences; these impacts, however, would be localized to the immediate project location.

During all phases of tar sands development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustions sources could contribute to climate change to some extent.

### 6.2.3.6 Noise

Under Alternative 3, land use plans would be amended to designate about 2,100 acres of public land as available for commercial tar sands leasing (Section 2.4.3.2); all other areas identified as available in the 2008 OSTS ROD would be excluded. Ambient noise levels in potential lease areas would not be affected by this action. Ambient noise levels could be affected, however, by subsequent commercial development of tar sands. Under Alternative 3, local, short-term changes in ambient noise levels could occur during the construction, operation, and reclamation of tar sands projects (see Section 5.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Impacts on wildlife and recreational users are discussed in Sections 5.8.1.3 and 5.2.1.4, respectively.

Increased noise levels could result from the operation of construction equipment (graders, excavators, and haul trucks) and from blasting activities. Increases in noise levels during operations would be associated with mining and tar sands processing activities and would be more long-term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short- and long-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could also be increased in the immediate vicinity of any pipeline pump station and could also be affected by project-related vehicular traffic at the project site and related locations such as access roads to the site.

Construction-related noise levels could exceed EPA guidelines. Similarly, operational noise associated with mining and retort activities could, in the absence of mitigation, exceed EPA guidelines at some project locations or at nearby sensitive receptors. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline levels except for short durations and very close to road or high traffic areas.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes to ambient noise levels from project development could occur wherever a project is located within the 2,100 acres identified for application for leasing under Alternative 3.

#### 6.2.3.7 Ecological Resources

Under Alternative 3, only 2,100 acres of public land would be made available within the pending Asphalt Ridge lease application area for application for commercial development of tar sands. This area supports a variety of biota and their habitats (Section 3.7). Ecological resources in this area would not be affected by the identification of future lands available for application for leasing or by amendment of land use plans to incorporate these lease areas. Ecological resources in and around the area, however, could be affected by future commercial development of tar sands in the area. The following sections describe the potential impacts on ecological resources that may result from commercial tar sands development within the area identified as available for application for commercial leasing under Alternative 3.

The magnitude of the impact on specific ecological resources that could be affected by commercial tar sands development in areas identified as available for application for commercial leasing in Alternative 3 would depend on the specific location of commercial tar sands projects as well as on specific project design.

**6.2.3.7.1 Aquatic Resources.** Under Alternative 3, approximately 2,100 acres of land within the Asphalt Ridge STSA would be made available for application for leasing for commercial tar sands development. Within the area available for leasing, or within the additional 2-mi zone surrounding these areas, there are no perennial streams that are directly overlain by areas that would be potentially available for tar sands development. Therefore, there are no direct impacts on aquatic habitats associated with this land use designation. As described in Section 5.1.1.1, impacts from water quality degradation and water depletions could affect resources in areas not only within or immediately adjacent to leased areas but also farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the STSAs are described in Section 3.7.1.2, and some of these aquatic habitats are known to, or are likely to, contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. Specific impacts would depend greatly upon the locations and methods of extraction used by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing decisions to evaluate potential impacts in greater detail.

**6.2.3.7.2 Plant Communities and Habitats.** Under Alternative 3, approximately 2,100 acres of land are included in a pending tar sands lease application in Utah and would be identified as available for tar sands leasing and development. There are no impacts on plant communities and habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

The project is located in the Asphalt Ridge STSA, which supports a variety of plant communities and habitats (see Section 3.7.2.4). The potential lease area does not contain any land designated in BLM land use plans for the protection of riparian habitats, floodplains, or special status plant species. Pinyon-juniper shrubland covers approximately half of the pending lease area (USGS 2004d). Big sagebrush shrubland and mixed low sagebrush shrubland also cover large areas of the site. Direct and indirect impacts could be incurred during project construction and operation, extending over several decades (especially within facility and infrastructure footprints) (see Section 5.8.1.2). Some impacts, such as habitat loss, could continue beyond the termination of tar sands production.

Direct impacts could include the destruction of vegetation and habitat during land clearing on the lease site and where ancillary facilities such as access roads, pipelines, transmission lines, employer-provided housing, and new power plants would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well as the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be local, (occurring within the construction and operation footprints and in the immediate surrounding area), the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the location of the areas where project construction occurs and where facilities are located, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

No ACECs are included within the Alternative 3 footprint. The nearest ACEC, the Red Mountain–Dry Fork Complex, which supports relict vegetation communities, is located more than 5 mi from the pending lease boundary. No direct or indirect impacts would be expected to occur to habitats within the ACEC.

**6.2.3.7.3 Wildlife.** Under Alternative 3, only 2,100 acres of land in the Asphalt Ridge STSA would be available for application for leasing. Impacts on wildlife could occur from post-lease construction and operations as described in Section 5.8.1.3. The areas identified for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for various wildlife species. These stipulations include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) TL (where the BLM may allow specified activities but not during certain sensitive seasons, such as when raptors are nesting or when big game are on their winter ranges). The only wildlife-related stipulation in areas available for application for tar sands leasing in Alternative 3 that are not associated with special status species is the TL for 41 acres (0.2 $km^2$) of mule deer fawning habitat in Asphalt Ridge.

The Alternative 3 area identified as available for tar sands leasing overlaps or occurs close to areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.2.3-1 and 6.2.3-2, respectively). The Alternative 3 tar sands lease area overlaps with 1,729 acres of mule deer winter habitat. No wild horse and burro HMAs in Utah overlap the lands that would be available for application for tar sands leasing under Alternative 3 (Figure 6.2.3-3).

Impacts on wildlife from commercial tar sands projects (see Section 5.8.1.3) could occur in a number of ways and would be related to (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of biota; (3) mortality; (4) exposure to hazardous materials; and (5) increase in human access. These impacts can result in changes in species distribution and abundance; habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

Wildlife could also be affected by human activities not directly associated with a tar sands project or its workforce, but instead associated with the potentially increased human access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads may lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, (2) an increase in the incidence of fires, and (3) increased runoff that could adversely affect riparian or other wetland areas that are important to wildlife.

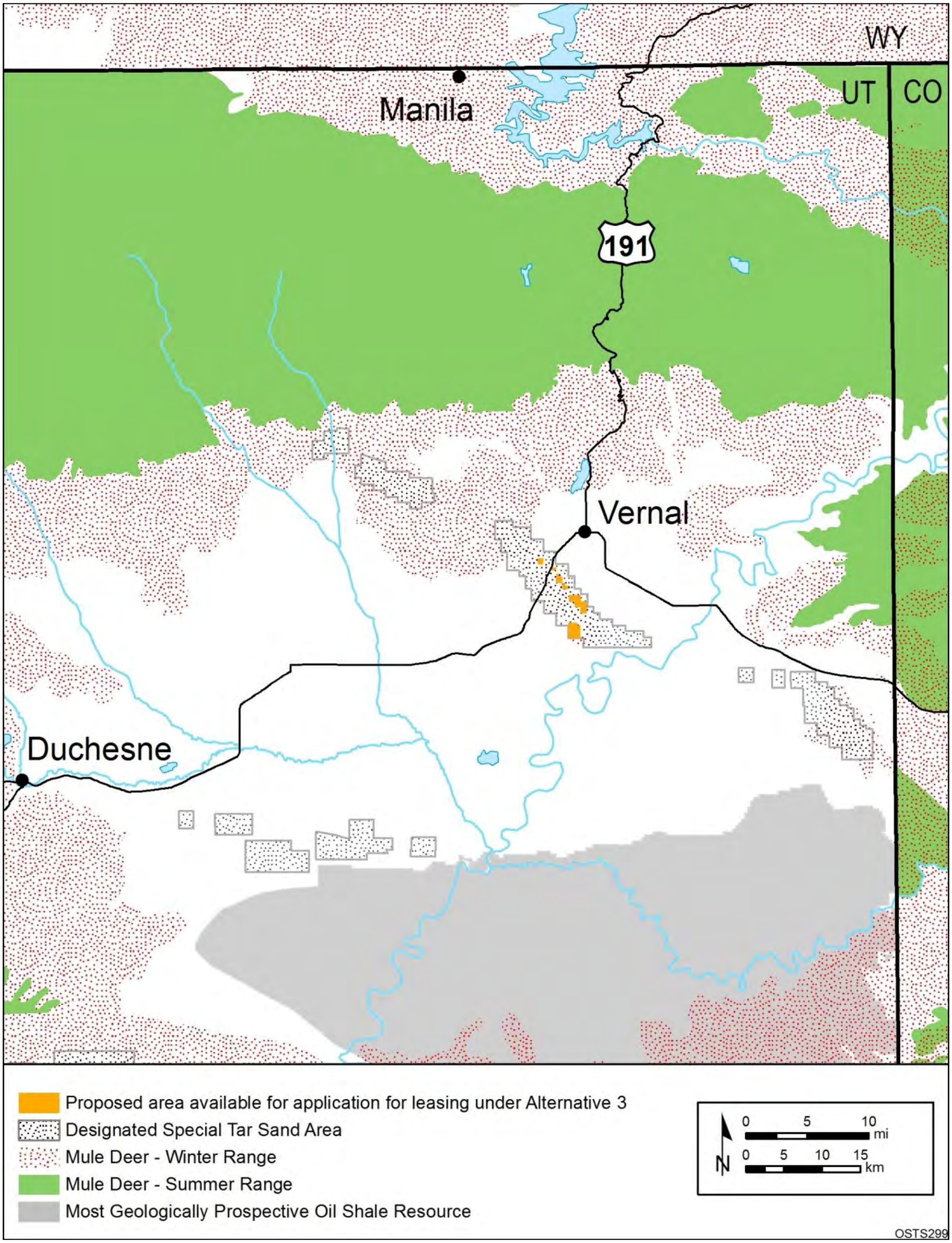


**FIGURE 6.2.3-1 Locations of Lands Available for Tar Sands Leasing under Alternative 3 in Relation to the Summer and Winter Ranges of the Mule Deer**

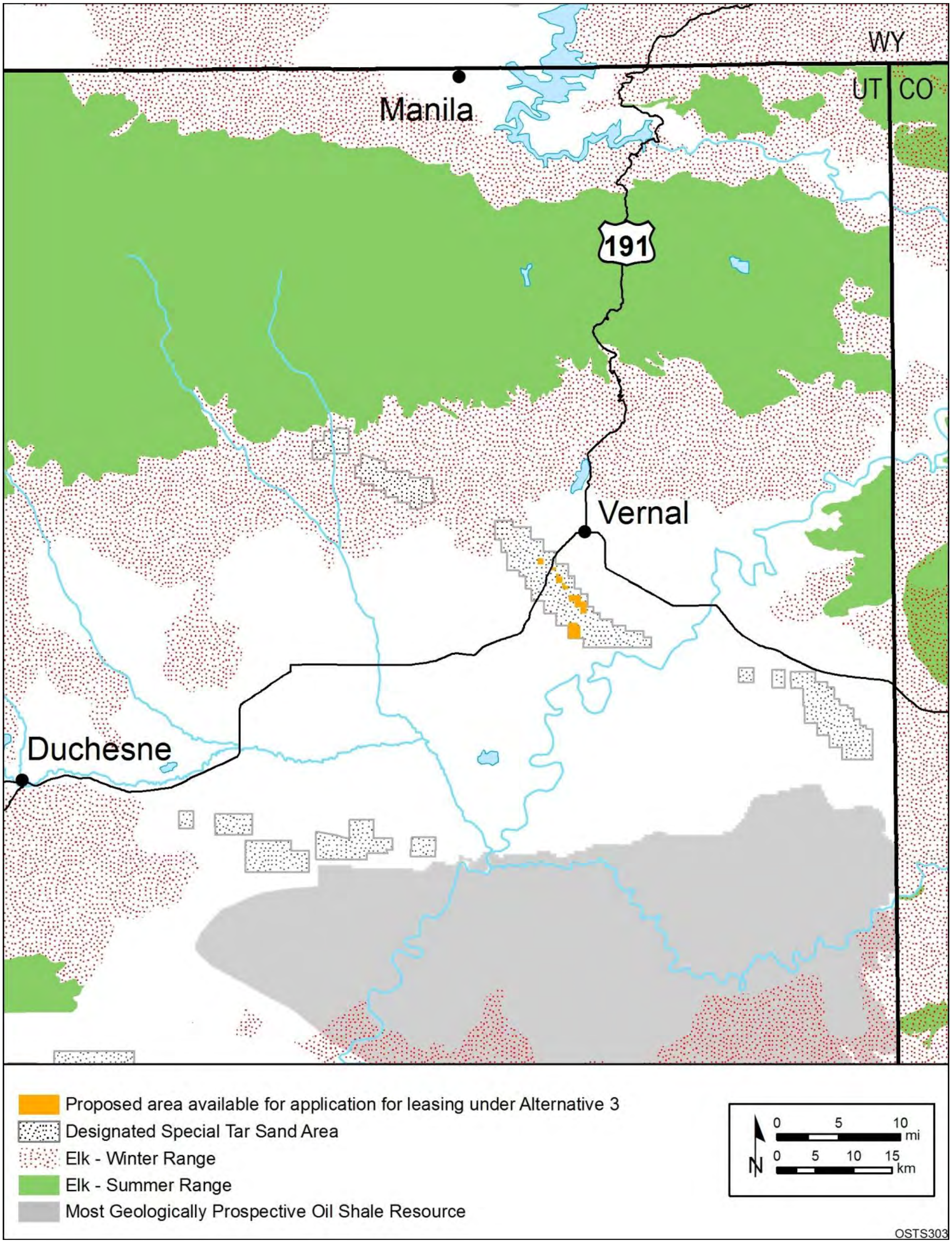


**FIGURE 6.2.3-2 Locations of Lands Available for Tar Sands Leasing under Alternative 3 in Relation to Summer and Winter Ranges of the Elk**

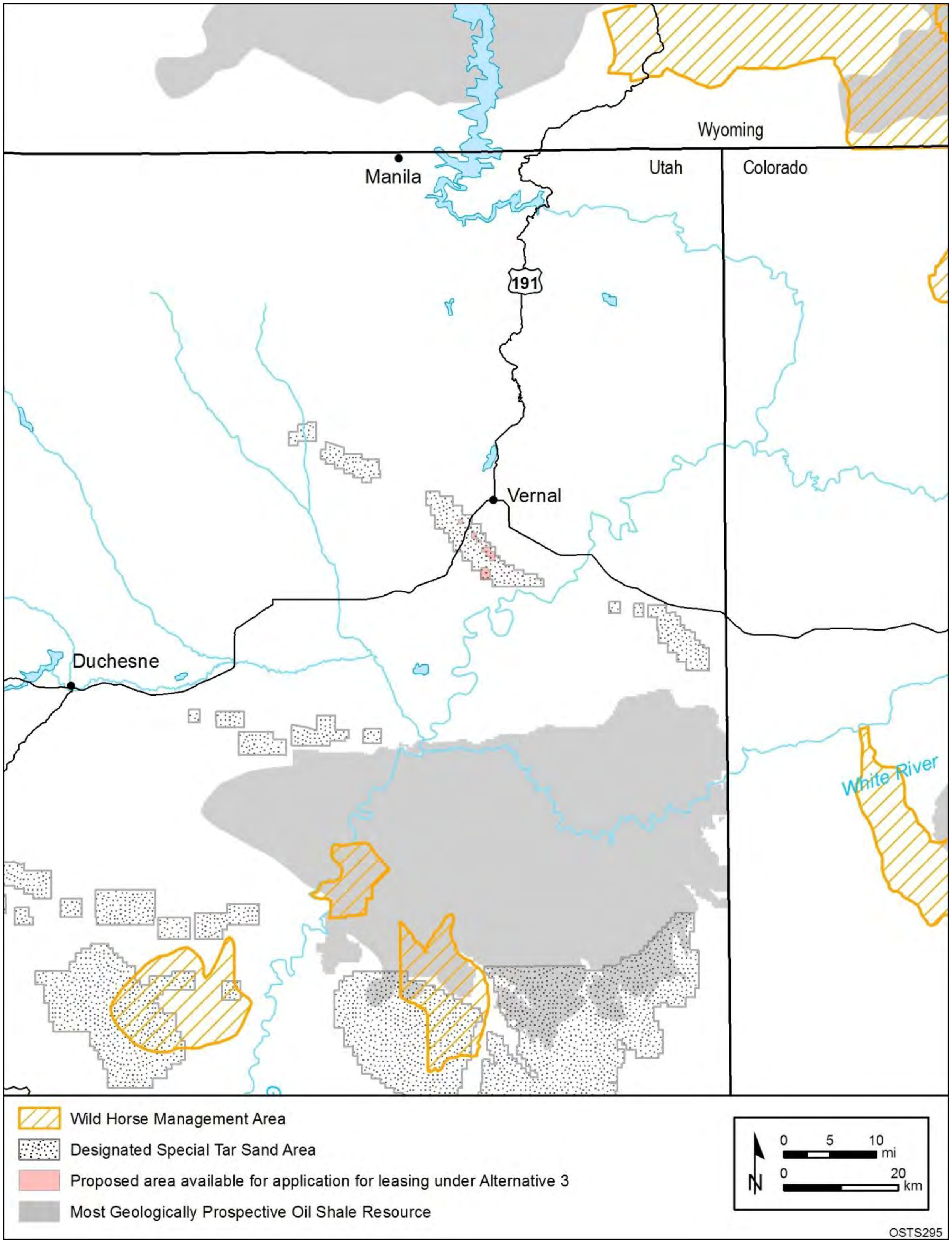


**FIGURE 6.2.3-3 Locations of Lands Available for Tar Sands Leasing under Alternative 3 in Relation to Wild Horse and Burro Herd Management Areas**

**6.2.3.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 3, the lands encompassed by the pending Asphalt Ridge STSA lease application (south of Vernal, Utah) would be identified as available for application for commercial leasing for tar sands. A summary of this alternative is provided in Table 2.4.2-2. There would be no impacts on threatened and endangered species associated with identifying lands as available for application for commercial leasing. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.4. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. In addition, the BLM's approval of any projects would be subject to compliance with the ESA, and those policies provided under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Various stipulations are included in the BLM RMPs that provide protection for different threatened, endangered, and sensitive species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU, and (3) TL. According to these RMPs, stipulations are provided for the protection of approximately 1,638 acres of habitat for the sage-grouse under Alternative 3.

Under Alternative 3, 36 of the 55 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.2.3-1 and 7 of the 15 federally listed threatened or endangered species listed in Table 6.2.3-2 could occur in or near the lands encompassed by the pending tar sands lease. This determination is based on records of occurrence in project counties in Utah, species occurrences from state natural heritage programs,[23] and the presence of potentially suitable habitat.[24] Under this alternative, there are no critical habitats for species listed under the ESA in the pending tar sands lease areas. However, critical habitat for Colorado River endangered fishes occurs within 5 mi (8 km) from the pending tar sands lease areas (Figure 6.2.3-4). Areas including greater sage-grouse habitat are shown in Figure 6.2.3-5. The entire pending Asphalt Ridge STSA lease area (approximately 2,100 acres) is located in core habitat for the greater sage-grouse.

The potential impacts on threatened, endangered, and sensitive species (and their habitats) by commercial tar sands development are directly related to the amount of land disturbance that could occur with a commercial project (including ancillary facilities such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface

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[23] Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the pending lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.2.3-1 and 6.2.3-2.

[24] Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the pending lease areas. This quantification is presented in Tables 6.2.3-1 and 6.2.3-2.

**TABLE 6.2.3-1 Potential Effects of Commercial Tar Sands Development under Alternative 3 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Amsonia jonesii* | Jones blue star | BLM-S | Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 75 mi (120 km) from the pending tar sands lease area. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | Emery, Garfield, Grand, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 70 mi (113 km) from the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S | Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 50 mi (80 km) from the pending tar sands lease area. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | Carbon, Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S | Duchesne, San Raphael, Uintah, Wayne | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | Grand | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 70 mi (113 km) from the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | Carbon, Duchesne, Emery, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the pending tar sands lease area. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mentzelia goodrichii* | Goodrich's blazingstar | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C | Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Gila robusta* | Roundtail chub | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S | Duchesne, Garfield, Uintah, Wayne | **No impact.** This species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 60 mi (97 km) from the pending tar sands lease area. |
| ***Amphibians*** | | | | |
| *Rana pipiens* | Northern leopard frog | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. |
| *Spea intermontana* | Great basin spadefoot | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,149 acres of potentially suitable habitat for this species occurs in the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Reptiles*** | | | | |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 726 acres of potentially suitable habitat for this species occurs in the pending tar sands lease areas. Quad-level occurrences of this species intersect the pending tar sands lease areas. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 313 acres of potentially suitable habitat for this species occurs in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | Duchesne, Uintah, Utah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the pending tar sands lease area. |
| *Asio flammeus* | Short-eared owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Garfield, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Athene cunicularia* | Burrowing owl | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,064 acres of potentially suitable habitat for this species occurs in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Buteo regalis* | Ferruginous hawk | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,110 acres of potentially suitable habitat for this species occurs in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C; BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 925 acres of potentially suitable habitat for this species occurs in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the pending tar sands lease area. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Cypseloides niger* | Black swift | BLM-S; UT-SC | Duchesne, Uintah | **No impact.** Suitable habitat for the species does not occur in the project area and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 100 mi (161 km) from the pending tar sands lease area. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the pending tar sands lease area. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,295 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 14 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the pending tar sands lease area. |
| *Numenius americanus* | Long-billed curlew | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 7 mi (11 km) from the pending tar sands lease area. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the pending tar sands lease area. |
| ***Mammals*** | | | | |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,907 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 10 mi (16 km) from the pending tar sands lease area. |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-SC | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Approximately 954 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,893 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 10 mi (16 km) from the pending tar sands lease area. |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | Carbon, Emery, Grand, Garfield, San Juan, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 1,993 acres of potentially suitable habitat for this species occurs in the STSAs. Nearest occurrences are approximately 20 mi (32 km) from the pending tar sands lease area. |

**TABLE 6.2.3-1 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 50 mi (80 km) from the pending tar sands lease area. |
| *Vulpes macrotis* | Kit fox | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the pending tar sands lease area. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the STSAs.

water or groundwater depletions, contamination, and disturbance and harassment of animal species, would be proportional to the amount of land disturbance.

Potential impacts on threatened, endangered, and sensitive species under Alternative 3 are similar to or the same as impacts on aquatic resources, plant communities and habitats, and wildlife described in Sections 6.2.3.7.1, 6.2.3.7.2, and 6.2.3.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

### 6.2.3.8 Visual Resources

Alternative 3 would identify only a single area for potential tar sands development. This area is defined by a lease application for a tar sands development covering about 2,100 acres in

**TABLE 6.2.3-2 Potential Effects of Commercial Tar Sands Development under Alternative 3 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | Utah Counties in the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Cycladenia humilis* var. *jonesii* | Jones cycladenia | ESA-T | Emery, Garfield, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the pending tar sands lease area. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM-S | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 20 mi (32 km) from the pending tar sands lease area. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | Carbon, Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 90 mi (145 km) from the pending tar sands lease area. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |

**TABLE 6.2.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties in the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the pending tar sands lease area. Designated critical habitat occurs in the Green River within 5 mi (8 km) from the project area. Nearest occurrences are approximately 30 mi (48 km) from the pending tar sands lease area. |
| *Gila elegans* | Bonytail | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the pending tar sands lease area. Designated critical habitat occurs in the Green River within 5 mi (8 km) from the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the pending tar sands lease area. Designated critical habitat occurs in the Green River within 5 mi (8 km) from the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E | Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur near the pending tar sands lease area. Designated critical habitat occurs in the Green River within 5 mi (8 km) from the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | Emery, Garfield, Grand, San Juan, Uintah, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs. Designated critical habitat does not occur in the vicinity of the STSAs. |

**TABLE 6.2.3-2 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties in the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T | Emery, Uintah | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN | Carbon, Duchesne, Emery, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 270 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the pending tar sands lease area. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the STSAs. Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

the Asphalt Ridge STSA in Utah. Scenic resources within this potential tar sands development area would not be affected by the amendment of land use plans to identify the lease area. Visual resources in and around this area, however, could be affected by subsequent commercial development of tar sands.

The Dinosaur Diamond Prehistoric National Scenic Highway is located within the area identified as available for application for leasing under Alternative 3 (Figure 6.2.3-6).

Scenic resource areas are located within 5 or 15 mi of the area in Alternative 3 identified as available for commercial leasing (Figure 6.2.3-6). The 5-mi zone corresponds to the BLM's VRM foreground-middleground distance limit, and the 15-mi zone corresponds to the BLM's background distance limit. Based on the assumption of an unobstructed view of a commercial tar sands project, viewers in these areas would be likely to perceive some level of visual impact from the project; more impacts would be expected for resources within the foreground-middleground distance, and fewer for resources within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be expected to be minor to negligible. Table 6.2.3-3 presents the scenic resource areas within these zones.

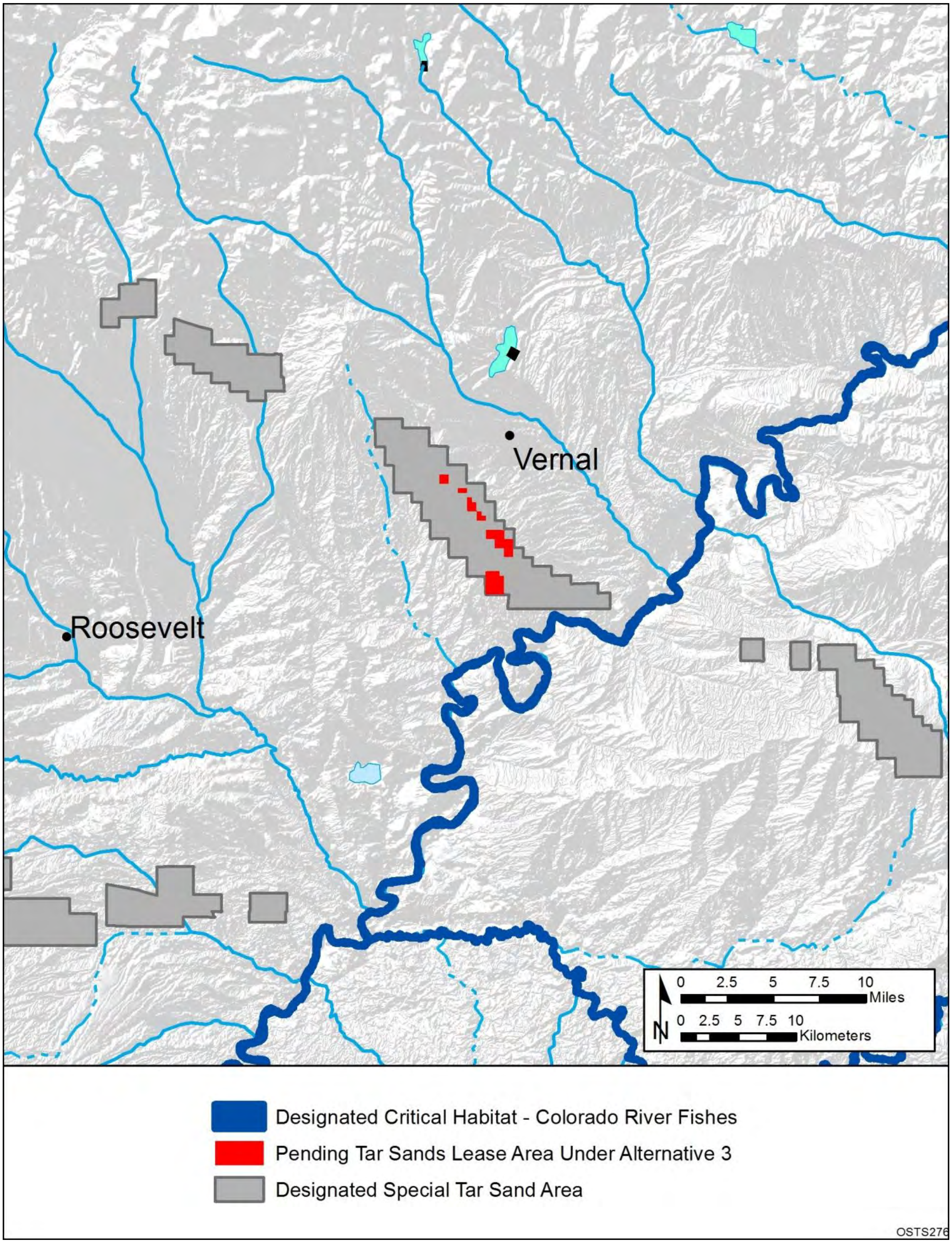


**FIGURE 6.2.3-4 Designated Critical Habitats of Threatened and Endangered Species That Are near Pending Tar Sands Lease Areas under Alternative 3**

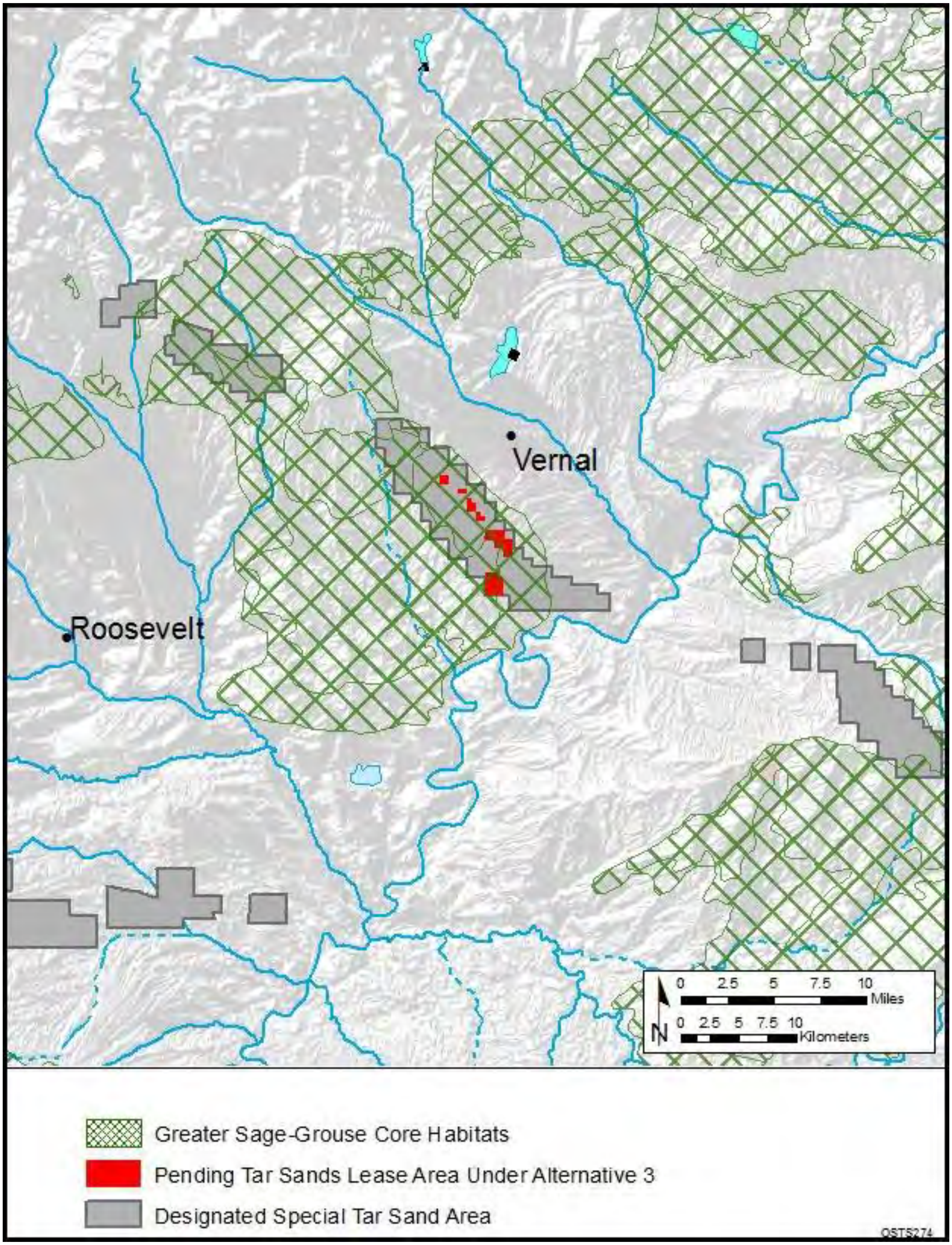


**FIGURE 6.2.3-5 Distribution of Core and Priority Habitat Areas for Greater Sage-Grouse That Are near Pending Tar Sands Lease Areas under Alternative 3**

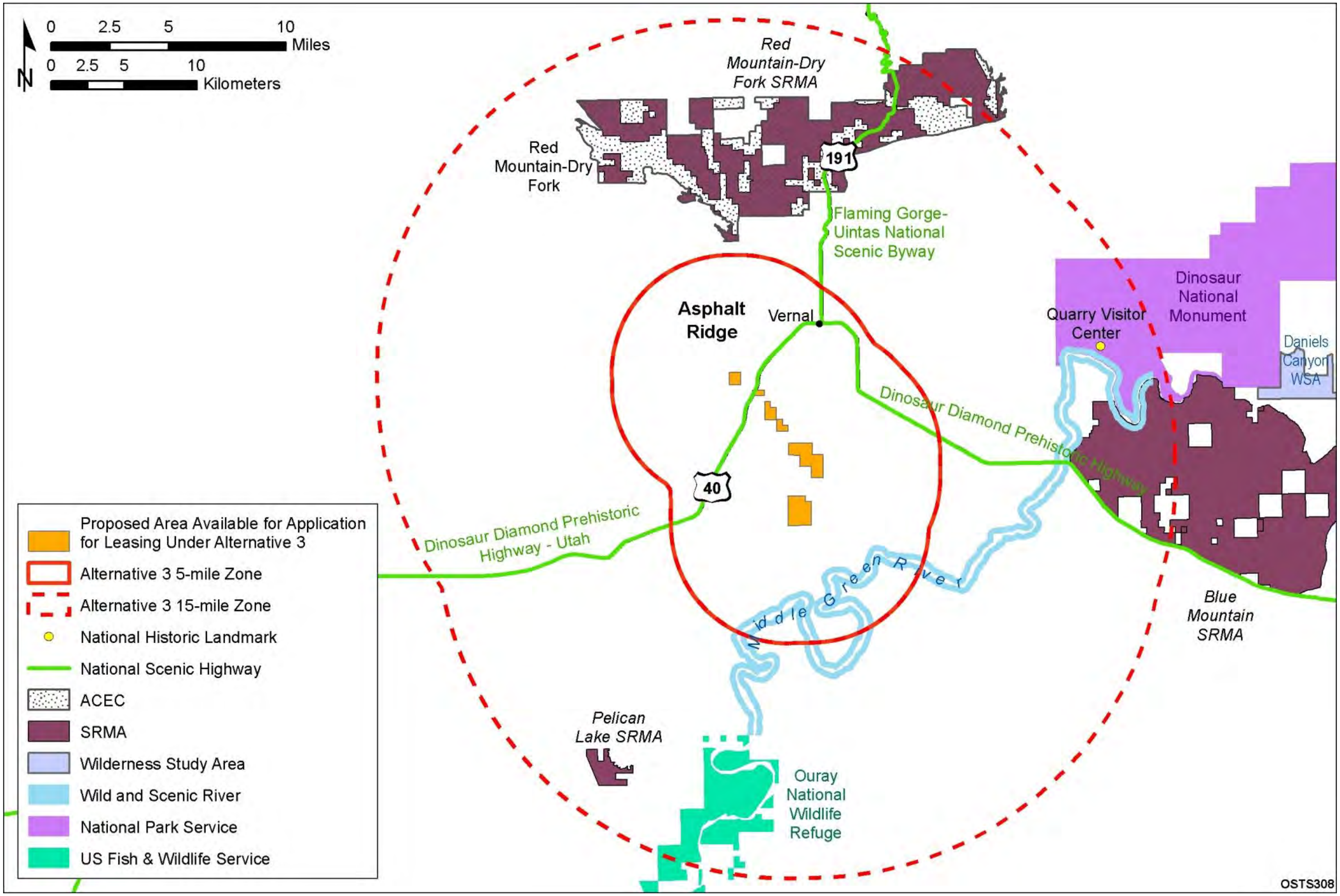


**FIGURE 6.2.3-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 3 for the Asphalt Ridge STSA**

**TABLE 6.2.3-3 Visually Sensitive Areas That Could Be Affected by Commercial Tar Sands Projects Developed in Lease Areas under Alternative 3**

| Scenic Resources within 5 mi of Alternative 2 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 2 Lease Areas |
|---|---|
| Dinosaur Diamond Prehistoric and Flaming Gorge Uintas National Scenic Highways. | Red Mountain-Dry Fork ACEC.<br><br>Dinosaur Diamond Prehistoric and Flaming Gorge Uintas National Scenic Highways.<br><br>Dinosaur National Monument.<br><br>Quarry Visitor Center National Historic Landmark.<br><br>Ouray National Wildlife Refuge.<br><br>Blue Mountain, Pelican Lake, Red Mountain-Dry Fork SRMAs. |

Visual resources at these areas, as well as elsewhere within the area available for application for leasing, could be affected at and near where commercial tar sands projects are developed and operated, and at areas where supporting infrastructure (such as and utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 5.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components, such as tar sands processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

### 6.2.3.9 Cultural Resources

Under Alternative 3, 2,100 acres of public land are available for commercial tar sands leasing. No archaeological sites have been identified in that area (O'Rourke et al. 2007). The 2,100 acres have yet to be surveyed for the presence of cultural resources. Additional cultural resources are likely in unsurveyed portions of the study area. Because of the lack of survey information, no sensitivity analysis was possible for Alternative 3.

Impacts on cultural resources within the Asphalt Ridge STSA would be considered if leasing and future commercial development occur. Leasing itself has the potential to impact cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts from future development could include the destruction of individual resources present within development areas, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resources from looting or vandalism of resources as a result of increased human presence and activity in the sensitive areas, and visual degradation of the cultural setting (see Section 6.2.3.8). Any future leasing and development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts, or to denial of the lease or project.

#### 6.2.3.10 Indian Tribal Concerns

Alternative 3 would amend the same land use plans as Alternative 2 but would identify only a single area of about 2,100 acres for potential tar sands development. The area is defined by a pending lease application for tar sands development in Utah's Asphalt Ridge STSA. The amending of the management plan to include this allotment would not in and of itself impact any resources important to Native Americans located in this parcel. However, the development of this parcel would have the potential for the same kinds of effects discussed for Alternative 1, only on a much reduced scale. The degree of adverse impact resulting from development of this parcel would depend on the location of the development and the technology used. The technologies under consideration for this alternative have yet to be determined, but to the extent that ground surface is disturbed, there is the potential for the loss of archaeological sites, burials, rock art, and other physical features, while increased access and increased human activity could lead to increased vandalism and visual and auditory intrusion on sacred places. Adverse effects on resources important to Native Americans would be reduced by the implementation of legally required procedures in the amended management plans for cultural resources survey and government-to-government consultations with the affected tribes. Project-specific NEPA analyses that would be required could result in lease stipulations specific to the parcels considered for lease, resulting in avoidance and protection of the resources through changes in project design and development plans.

#### 6.2.3.11 Socioeconomics

Under Alternative 3, land use plans would be amended to identify 2,100 acres of land in Utah as available for application for commercial tar sands development. With the possible exception of an impact on property values, there is no socioeconomic impact of this action. Although the socioeconomic and transportation impacts of Alternative 3 would be dependent on the ultimate development of the proposed tar sands lease in the Asphalt Ridge STSA, the types of impacts that could occur would be the same as those for Alternative 1. as described in Section 5.11 and summarized in Section 6.2.1.11. The specific impacts would be dependent upon the technologies employed, the project size or production level, development time lines, mitigation measures, and the location of employee housing.

Under Alternative 3, it is possible that there would be property value impacts simply from designating land as available or not available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.11.1.6).

#### 6.2.3.12 Environmental Justice

Although the environmental justice impacts of Alternative 3 would be dependent on the ultimate development of the proposed tar sands lease in the Asphalt Ridge STSA, the types of impacts that would occur on lands made available for application for commercial leasing by the proposed land use plan amendments under Alternative 3 would be the same as those described in Section 5.13 and summarized in Section 6.2.1.12.

#### 6.2.3.13 Hazardous Materials and Waste Management

Potential impacts from hazardous materials and waste management considerations related to commercial tar sands operations are presented in Section 6.2.1.13 under Alternative 1. Because the use of hazardous materials and the generation of wastes are directly related to the specific design of a commercial tar sands project, it is not possible to quantify project-related impacts of these materials for the 2,100-acre tar sands lease application that composes tar sands Alternative 3. Accidental releases of the hazardous materials or wastes could affect natural resources (such as water quality or wildlife) and human health and safety (see Sections 5.14 and 6.2.1.14) at locations where facilities are sited within the Alternative 3 lease area.

#### 6.2.3.14 Health and Safety

Potential impacts on worker health and safety and on members of the public from operation of a commercial tar sands facility are presented in Section 6.2.1.14 under Alternative 1. The level of health and safety impacts under Alternative 3 would be mainly dependent on the extent of tar sands development, the extent of health and safety precautions imposed by the operator, and the eventual design of any project within the 2,100-acre tar sands lease application that composes tar sands Alternative 3. Important design considerations affecting the surrounding area would be related to the level of air and water emissions associated with the facility.

### 6.2.4 Impacts of Alternative 4, Moderate Development

Under Alternative 4, the same four existing Utah land use plans as included in Alternative 2 would be amended to identify 425,790 acres as available for application for commercial tar sands leasing. These lands are included within 10 designated STSAs: Argyle Canyon, Asphalt Ridge, Hill Creek, Pariette, P.R. Spring, Raven Ridge, San Rafael, Sunnyside, Tar Sand Triangle, and White Canyon (see Figure 2.4.3-4 and Table 2.4.3-3). The public lands that would be available under Alternative 4 consist of 348,652 acres of BLM-administered lands and 70,324 acres of split estate lands. (See Sections 2.4.3 and 2.4.3.3 for a complete description of Alternative 4.) Figure 2.4.3-4 shows the lands available for application for leasing under Alternative 4. In this alternative, any leasing or development of tar sands resources would be managed under the requirements of the four existing land use plans and consistent with the ROD from the 2008 PEIS. Public lands within the study area not identified as available for application for leasing are thereby excluded from application for leasing. Prior to approval of any commercial leasing or development of tar sands resources, additional NEPA analysis would be required.

### 6.2.4.1 Land Use

Alternative 4 would make available 425,790 acres for application for commercial leasing and is structured to remove additional ACECs designated since completion of the 2008 OSTS PEIS and ROD, remove any potential ACECs from ongoing planning efforts, and to recognize that the management of both sage-grouse core habitat and LWC may affect the lands that will be available for leasing. Local field offices will be considering how to manage both core sage-gouse and LWC, and for that reason, a potential range of acreage that may be available for commercial leasing under this alternative has been provided. A complete description of this alternative, including the rationale for including a range of potential development, is found in Section 2.4.3.3. Table 6.2.1-1 lists the acreages per STSA in this alternative.

Alternative 4 makes fewer acres available for application for commercial tar sands leasing than Alternative 1, but the potential development of commercial tar sands in this alternative is the same as in Alternative 1. The nature of the impacts of Alternative 4 on land uses would be essentially the same as that for Alternative 1 in Section 6.2.2.1 with the following exceptions:

- There are an additional 10,459 acres of designated ACECs that are removed from potential leasing.

- No lands that are currently recommended as potential ACECs lie within the Alternative 4 footprint.

- While there are 199,000 acres with tar sands resources that contain either sage-grouse core habitat or LWC that are available for application for leasing in Alternative 4, it is not possible to estimate how much of that land may ultimately be committed to protection of such resources. For that reason, in Tables 2.4.3-4 and 2.4.3-5 a range of potentially available acreages is presented, ranging from 276,708 to 376,096 acres, corresponding to 75% and 25% protection of core sage-grouse habitat and LWC acreage.

### 6.2.4.2 Soil and Geologic Resources

Under Alternative 4, land use plans would be amended to designate 425,790 acres in Utah as available for commercial tar sands leasing. The amendment of land use plans to identify this area would not have any direct impacts on soil and geologic resources in these lands. Development of commercial tar sands projects could, however, affect soils and geologic resources in these lands.

Construction-related activities could directly disturb surface and subsurface soils during clearing and grading activities and construction of project facilities and infrastructure. This disturbance could include soil disturbance, removal, and compaction, and disturbed areas would be more susceptible to the effects of precipitation and wind-driven erosion (see Section 5.3.1). Surface and subsurface mining activities during project operations would directly disturb geologic resources. Erosion of exposed soils could lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust. Soils in project areas would remain susceptible to erosion until completion of construction, mining, and tar sands processing activities, and site stabilization and reclamation (e.g., revegetation of pipeline ROWs and surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as to areas where associated off-lease infrastructure (e.g., access roads and utility ROWs) would be located.

Under Alternative 4, project-related impacts could occur wherever individual projects are located within the 425,790 acres identified for application for leasing under this alternative. For any project, the erosion potential of the soils would be a direct function of the lease and project location and of the soil characteristics, vegetative cover, and topography (i.e., slope) at that location. Development in areas that have erosive soils and steep slopes (e.g., in excess of 25%) could lead to serious erosion problems at those locations.

#### 6.2.4.3 Paleontological Resources

Under Alternative 4, land use plans would be amended to designate 425,790 acres in Utah for commercial tar sands leasing. The designation of leasing areas, as well as the amendment of land use plans to incorporate these areas, would not affect paleontological resources because these actions do not authorize or approve any ground-disturbing activities. Paleontological resources within these areas, however, could be adversely affected if leasing and subsequent commercial development occur. Of the acreage identified as available for application for leasing under Alternative 4, a total of 331,171 acres (approximately 79% of the 425,790 acres that would be available under Alternative 4) has been identified as overlying geologic formations having the potential to contain important paleontological resources (Murphey and Daitch 2007).

Impacts from tar sands development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development areas, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas. These impacts and the application of mitigation measures to reduce or eliminate them are discussed in Section 5.4.

#### 6.2.4.4 Water Resources

The acreage available for application for leasing under Alternative 4 is very similar to the extent available under Alternative 1. There is a potential for indirect adverse impacts on water resources, as described in Section 5.5. In those areas that are available for application for leasing under Alternative 4, the potential impacts would be the same as those described for Alternative 1 in Section 6.2.1.4. Under Alternative 4, approximately 188 mi (69%) of perennial streams was identified in the STSAs that could be impacted by future commercial development, which is not significantly different from the 185 mi identified under Alternative 1.

The assessment of impacts on water resources under Alternative 4 has the same limitations identified under Alternative 1. Without site-specific information on the location and type of technology to be employed, it is not possible to assess the overall impacts of this alternative.

#### 6.2.4.5 Air Quality

Under Alternative 4, 425,790 acres of public land would be made available within Utah for application for leasing for commercial development of tar sands (Section 2.4.3.3). Air resources would not be affected by this action. Air resources in and around these areas, however, could be affected by future commercial development of tar sands. Under Alternative 4, local, short-term air quality impacts could be incurred as a result of (1) PM releases (fugitive dust and diesel exhaust) during construction activities such as site clearing and grading in preparation for facility construction, and (2) exhaust emissions ($NO_x$, CO, PM, VOC, and $SO_2$) from construction equipment and vehicles (see Section 5.6). These types of impacts would be of short duration and largely limited to specific project locations and the immediate surrounding area. Similar short-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located and developed.

Similar but longer term impacts on local air quality could occur during normal project operations such as mining and processing of the tar sands. Processing activities may also result in regional impacts on air quality and AQRVs, such as visibility and acid deposition, that could extend beyond the boundaries of the potential lease areas. These regional impacts would be associated with operational releases of $NO_x$, CO, PM, and other pollutants (VOCs and $SO_2$) during tar sands excavation and processing (see Section 5.6). In addition, ozone precursors of $NO_x$ and VOC from tar sands development could exacerbate wintertime high-ozone occurrences already prevalent in the study area, especially in Uintah County. Operational releases of HAPs (such as benzene, toluene, and formaldehyde) as well as diesel PM could also affect workers and nearby residences (if any are present); these impacts, however, would be localized to the immediate project location and subject to further analyses prior to implementation.

During all phases of tar sands development, GHG emissions of primarily $CO_2$ and lesser amounts of $CH_4$ and $N_2O$ from combustions sources could contribute to climate change to some extent.

#### 6.2.4.6 Noise

Under Alternative 4, a total of 425,790 acres of public land would be made available within Utah for application for leasing for commercial development of tar sands

(Section 2.4.3.3). Ambient noise levels in these areas would not be affected by this action. Ambient noise levels could be affected, however, by future commercial development of tar sands. Under Alternative 4, local, short-term changes in ambient noise levels could occur during the construction, operation, and reclamation of tar sands projects (see Section 5.7.1). Project-related increases in noise levels could disturb or displace wildlife and recreational users in nearby areas. Impacts on wildlife and recreational users are discussed in Sections 5.8.1.3 and 5.2.1.4, respectively.

Noise levels could be affected as a result of the operation of construction equipment (graders, excavators, and haul trucks) and as a result of any blasting activities. Increases in ambient noise levels during operations would be associated with mining and tar sands processing activities and would be more long term than construction-related noise. These types of impacts would be largely limited to specific project locations and the immediate surrounding area. Similar short-term and long-term impacts could also occur in other areas where electric transmission lines, oil pipelines, transportation ROWs, and other infrastructure would be located, developed, and operated. For example, ambient noise levels could also be increased in the immediate vicinity of any pipeline pump stations and could also be affected by project-related vehicular traffic at the project site and related locations such as access roads to the site.

Construction-related noise levels could exceed EPA guidelines. Similarly, operational noise associated with mining and retort activities could, in the absence of mitigation, exceed EPA guidelines at some project locations or at nearby sensitive receptors. Noise generated as a result of project-related vehicular traffic is not expected to exceed EPA guideline levels except for short durations and very close to road or high traffic areas.

In the absence of lease- and project-specific information, it is not possible at the level of this PEIS to identify the duration and magnitude of any project-related changes in noise levels. Changes to ambient noise levels from project development could occur where a project is located within the 425,790 acres identified for application for leasing under Alternative 4.

#### 6.2.4.7 Ecological Resources

Under Alternative 4, a total of 425,790 acres of public land would be made available within Utah for application for leasing for commercial development of tar sands. These lands support a wide variety of biota and their habitats (Section 3.7). Ecological resources in these areas would not be affected by the identification of future lands available or not available for application for leasing or by amendment of land use plans to incorporate these lease areas. Ecological resources in and around these areas, however, could be affected by future commercial development of tar sands in these areas. The following sections describe the potential impacts on ecological resources that may result from commercial tar sands development within the areas identified as available for application for commercial leasing under Alternative 4.

The magnitude of the impact on specific ecological resources that could be affected by commercial tar sands development in areas identified as available for application for commercial leasing in Alternative 4 would depend on the specific location of the commercial tar sands projects as well as on specific project design.

**6.2.4.7.1 Aquatic Resources.** Under Alternative 4, a total of 425,790 acres of land in Utah would be made available for application for leasing for commercial tar sands development. There are no impacts on aquatic habitats associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Potential impacts on aquatic resources from tar sands development could result primarily from increased turbidity and sedimentation, changes to water table levels, degradation of surface water quality (e.g., alteration of water temperature, salinity, and nutrient levels), the release of toxic substances to surface water, and increased public access to aquatic habitats as described in Section 5.8.1.1. As described in Section 5.8.1.1, there is a potential for development and production activities in upland areas to affect surface water and groundwater beyond the area where surface disturbance or water withdrawals occur. Consequently, the analysis here considers the potential for impacts in waterways up to 2 mi beyond the boundary of the lands that would be allocated for potential leasing under this alternative. However, as project development activities occur farther from waterways, the potential for negative effects on aquatic resources is reduced. For the analysis of potential impacts under each of the alternatives considered in this PEIS, it was assumed that the potential for negative impacts on aquatic resources increases as the area potentially affected (i.e., the area that would be considered for leasing) increases and as the number and extent of waterways within a 2-mi zone surrounding those areas increases.

Under Alternative 4, there are 9 perennial streams and about 23 mi of perennial stream habitat within the STSAs of Utah that are directly overlain by areas that would be potentially available for tar sands development (Table 6.2.4-1). When an additional 2-mi zone surrounding these areas is considered, there are 20 perennial streams and about 188 mi of perennial stream habitat that could be affected by future development activities (Table 6.2.1-5). The development of commercial tar sands projects in the areas identified under Alternative 4 could impact aquatic biota and their habitats during project construction and operations, thereby resulting in short- and/or long-term changes (disturbance or loss) in the abundance and distribution of affected biota and their habitats. As described in Section 5.1.1.1, impacts from water quality degradation and water depletions could affect resources in areas not only within or immediately adjacent to leased areas but also farther downstream in affected watersheds. The nature and magnitude of impacts, as well as the specific resources

**TABLE 6.2.4-1 Perennial Streams in Utah within the Lease Areas Identified under Alternative 4**

| Stream | Length of Stream (mi) |
|---|---|
| Bitter Creek | 0.7 |
| Center Fork | 1.9 |
| Cottonwood Canyon | 4.9 |
| Dry Creek | 5.5 |
| Nine-Mile Draw | <0.1 |
| Sand Wash | 0.5 |
| Sweetwater Canyon | 6.0 |
| Tabyago Canyon | 2.1 |
| Wells Draw | 1.1 |
| Total | 22.7 |

affected, would depend on the locations of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

The types of aquatic habitats and organisms that could be impacted by future development in the vicinity of the STSAs are described in Section 3.7.1.2, and some of these aquatic habitats are known to, or are likely to, contain federally listed endangered fish, state-listed or BLM-designated sensitive species (Section 3.7.4), and other native fish and invertebrate species that could be negatively affected by development. Specific impacts would depend greatly upon the locations and methods of extraction used by future projects. Project-specific NEPA analyses would be conducted prior to any future leasing decisions to evaluate potential impacts in greater detail.

**6.2.4.7.2 Plant Communities and Habitats.** Under Alternative 4, a total of 425,790 acres of public land in Utah would be made available for application for commercial leasing of tar sands resources. There would be no impacts on plant communities and habitats associated with identifying lands as available for application for leasing. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

Areas identified as available for application for commercial leasing under Alternative 4 support a wide variety of plant communities and habitats (see Section 3.7.2). These areas include approximately 6,859 acres that are currently identified in BLM land use plans for the protection of riparian habitat, floodplains, and special status plant species. Direct and indirect impacts on plant communities and habitats could be incurred on these areas during project construction and operation and extend over a period of several decades (especially within facility and infrastructure footprints) (see Section 5.8.1.2). Some impacts, such as habitat loss, may continue beyond the termination of tar sands production.

Direct impacts on plant communities and habitat from future construction and operation activities would include the destruction of vegetation and habitat during land clearing on the lease site and also where ancillary facilities, such as access roads, pipelines, transmission lines, and employer-provided housing, would be located. Soils disturbed during construction would be susceptible to the introduction and establishment of non-native invasive species, which in turn could greatly reduce the success of establishment of native plant communities during reclamation of project areas and create a source of future colonization and subsequent degradation of adjacent undisturbed areas. Plant communities and habitats could also be adversely affected by changes in water quality or availability, resulting in plant mortality or reduced growth, with subsequent changes in community composition and structure and declines in habitat quality. Indirect impacts on terrestrial and wetland habitats on or off the project site could result from land clearing and exposed soil; soil compaction; and changes in topography, surface drainage, and infiltration characteristics. These impacts could lead to changes in the abundance and distribution of plant species and changes in community structure, as well as to the introduction or spread of invasive species.

Affected plant communities and habitats could incur short- and/or long-term changes in species composition, abundance, and distribution. While many impacts would be local, occurring within construction and operation footprints and in the immediate surrounding area, the introduction of invasive species could affect much larger areas. The nature and magnitude of these impacts, as well as the communities or habitats affected, would depend on the locations of the areas where project construction and facilities would occur, the plant communities and habitats present in those areas, and the mitigation measures implemented to address impacts.

The area available for application for leasing under Alternative 4 includes locations that support oil shale endemic plant species. Local populations of oil shale endemics, which typically occur as small scattered populations on a limited number of sites, could be reduced or lost as a result of tar sands development activities. Establishment and long-term survival of these species on reclaimed land may be difficult.

No ACECs are included in the lands available under this alternative. Therefore direct impacts on sensitive plant species and plant communities within ACECs would not occur. However, four ACECs are located adjacent to the Alternative 4 footprint: Pariette Wetlands, Nine Mile Canyon, San Rafael Reef, and Leers Canyon. Each of these ACECs includes rare or sensitive plant species and/or rare or important plant communities. Indirect impacts on these species and communities could occur.

Three ACECs with rare plant species and/or rare or important plant communities are located near (within 5 mi) of the Alternative 4 footprint: Red Mountain-Dry Fork (3.1 mi), Raven Ridge (2.0 mi), and Cottonwood-Diamond Watershed (0.6 mi). Indirect impacts on the sensitive species or communities within these ACECs could occur.

**6.2.4.7.3 Wildlife.** Under Alternative 4, 425,790 acres of public land would remain available within Utah for application for leasing for commercial development of tar sands. While no impacts on wildlife species associated with the identification of lands as available or not available for application for commercial leasing are expected, impacts could result from post-lease construction and operation as described in Section 5.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The areas available for application for leasing support a diverse array of wildlife and habitats (see Section 3.7.3). Various stipulations are included in the BLM RMPs that provide protection for various wildlife species. These include lands designated as (1) NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU (where the BLM places special restrictions, including shifting a ground-disturbing activity by more than 200 m from the proposed location to another location to protect a specific resource such as a raptor nest), and (3) TL (where the BLM may allow specified activities but not during certain sensitive seasons, such as when raptors are nesting or when big game are on their winter ranges). Table 6.2.4-2 identifies the amount of habitat protected by these stipulations in areas available for application for tar sands leasing in Alternative 4. In most instances, the stipulations for

**TABLE 6.2.4-2 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 4 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres)[a] |
|---|---|
| ***Birds*** | |
| Raptor nests | 5 (18)[b] |
| ***Mammals*** | |
| Elk crucial winter range | 112,809 (147,676) |
| Elk calving habitat | 26,804 (30,387) |
| Mule deer crucial winter range | 96,564 (104,011) |
| Mule deer fawning habitat | 23,584 (25,574) |
| Mule deer migration corridor | 41,588 (42,322) |

[a] Acreages may be overestimated because of unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the wildlife habitat acreage identified for protection within the most geologically prospective lands.

wildlife are TLs. In the White Canyon STSA, there are stipulations listed as closed to leasing, controlled surface use/TL, NSO, and TLs that total 7,000 acres (28.3 $km^2$); however, no information was available as to whether these stipulations applied to wildlife.

Areas identified in Alternative 4 as available for application for commercial leasing overlap with areas identified by state natural resource agencies as seasonal habitat for big game species. These areas include mule deer and elk winter and summer ranges (Figures 6.2.4-1 and 6.2.4-2). Table 6.2.4-3 presents the amounts of these habitats that occur in the Alternative 4 lease areas and that could be impacted by future commercial tar sands development in these areas.

Several wild horse and burro HMAs overlap lands that would be available for application for tar sands leasing, including the Hill Creek HMA, which overlaps with the Hill Creek STSA (19,820 acres); the Muddy Creek and Sinbad HMAs, which overlap with the San Rafael STSA (3,832 and 39,435 acres, respectively); the Range Creek HMA, which overlaps with the Sunnyside STSA (13,933 acres); and the Canyon Lands HMA, which overlaps with the Tar Sand Triangle STSA (267 acres) (Figure 6.2.4-3). Any tar sands development that occurs in HMAs would need to protect wild horses and burros under the Wild Free-Roaming Horse and Burro Act of 1971.

Impacts on wildlife from commercial tar sands projects (see Section 5.8.1.3) in Alternative 4 lease areas could occur in a number of ways and would be related to (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of biota; (3) mortality;

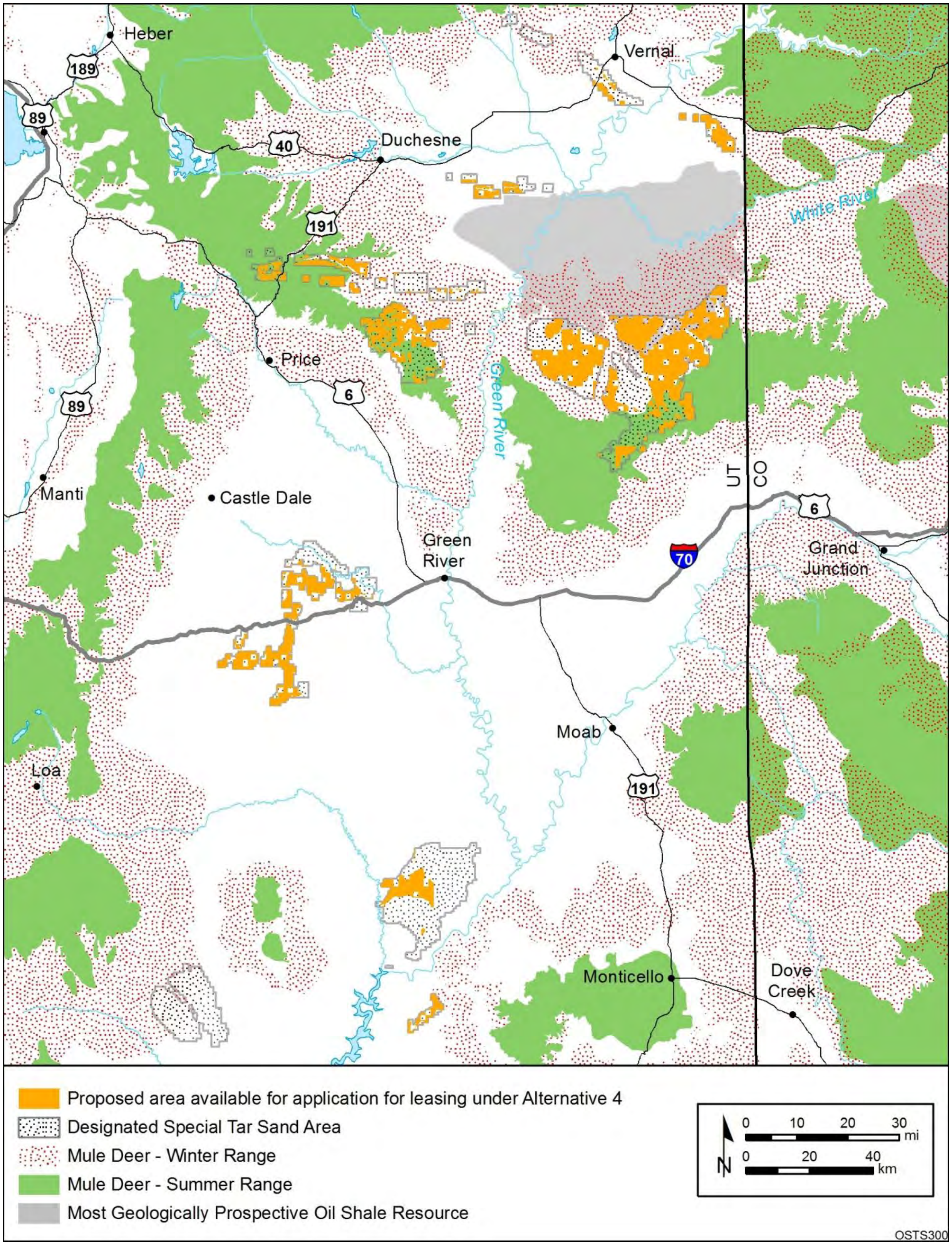


**FIGURE 6.2.4-1 Lands Available for Application for Tar Sands Leasing under Alternative 4 in Relation to the Summer and Winter Ranges of the Mule Deer**

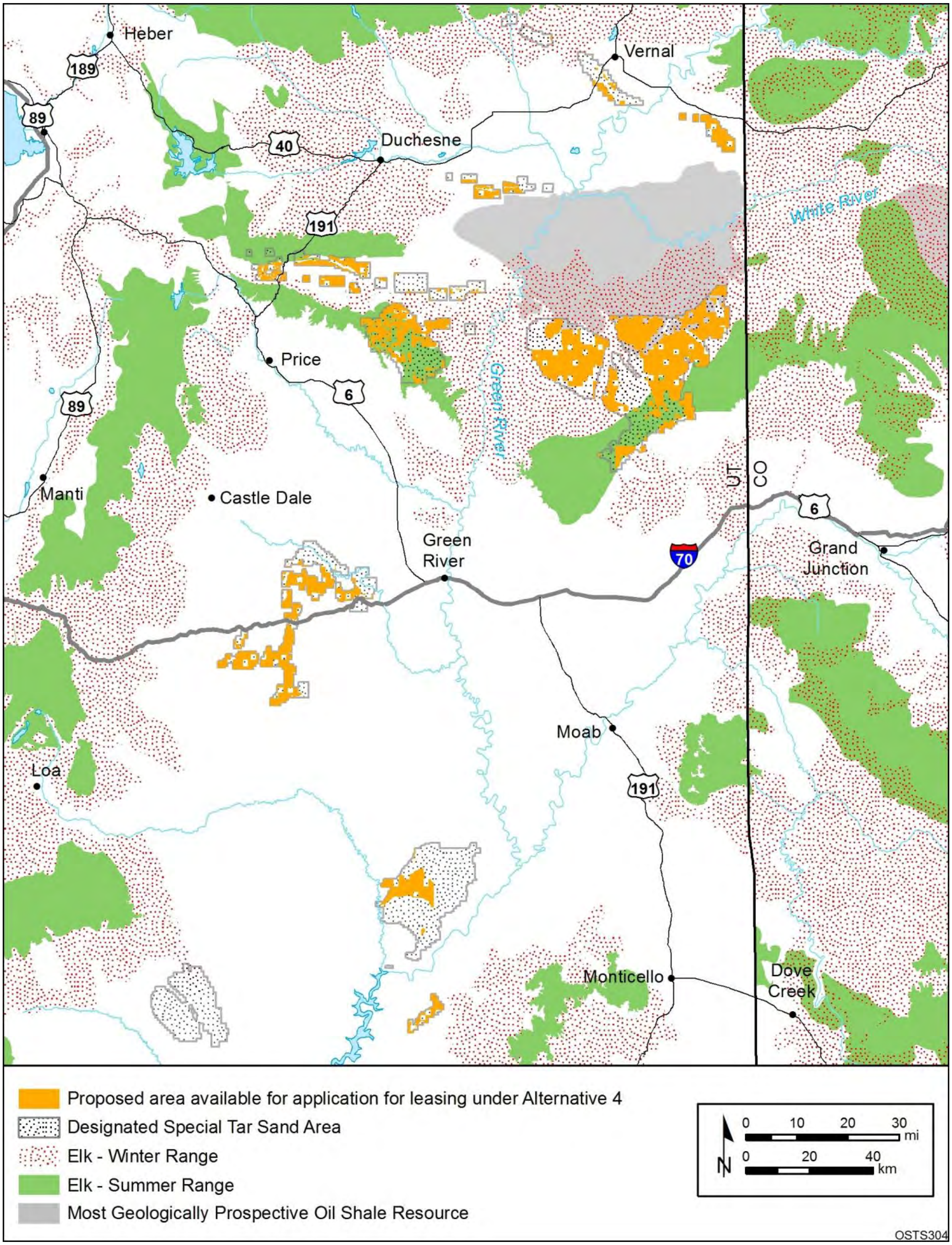


**FIGURE 6.2.4-2 Lands Available for Application for Tar Sands Leasing under Alternative 4 in Relation to the Summer and Winter Ranges of the Elk**

(4) exposure to hazardous materials; and (5) increase in human access. These could result in changes in species distribution and abundance; habitat use; changes in behavior; collisions with structures or vehicles; changes in predator populations; and chronic or acute toxicity from hydrocarbons, herbicides, or other contaminant exposures.

**TABLE 6.2.4-3 State-Identified Elk and Mule Deer Habitat Present in the Alternative 4 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres) |
|---|---|
| ***Mule Deer*** | |
| Winter habitat | 225,508 |
| Summer habitat | 77,172 |
| ***Elk*** | |
| Winter habitat | 198,324 |
| Summer habitat | 65,366 |

Wildlife could also be affected by human activities not directly associated with the tar sands project or its workforce but instead associated with the increased access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads could lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, (2) an increase in the incidence of fires, and (3) increased runoff that could adversely affect riparian or other wetland areas that are important to wildlife.

The potential for impacts on wildlife and their habitats from commercial tar sands development is directly related to the amount of land disturbance that would occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitat affected by development (i.e., the location of the project). Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, water depletions, contamination, and disturbance and harassment, are also considered. Their magnitude is also considered to be proportional to the amount of land disturbance.

**6.2.4.7.4 Threatened, Endangered, and Sensitive Species.** Under Alternative 4, land use plans would be amended to identify 425,790 acres of land in Utah as available for application for leasing for commercial development of tar sands. (See Section 2.3.3.3 for a full description of Alternative 4.) There would be no impacts on threatened and endangered species associated with this land use plan amendment action. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.4. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. In addition, the BLM's approval of any projects would be subject to appropriate compliance with the ESA and those policies provided under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Various stipulations are included in the BLM RMPs that provide protection for different threatened, endangered, and sensitive species. These include (1) lands designated as NSO (where the BLM does not allow long-term ground-disturbing activities [i.e., with an impact that would last longer than 2 years]), (2) CSU, and (3) lands designated as TL. Table 6.2.4-4 identifies the amount of habitats protected by these stipulations in areas available for application for oil shale leasing in Alternative 4. In most instances, the stipulations for these species are TLs. In the White Canyon STSA, there are stipulations listed as closed to leasing, CSU/TL, NSO, and TLs; however, no

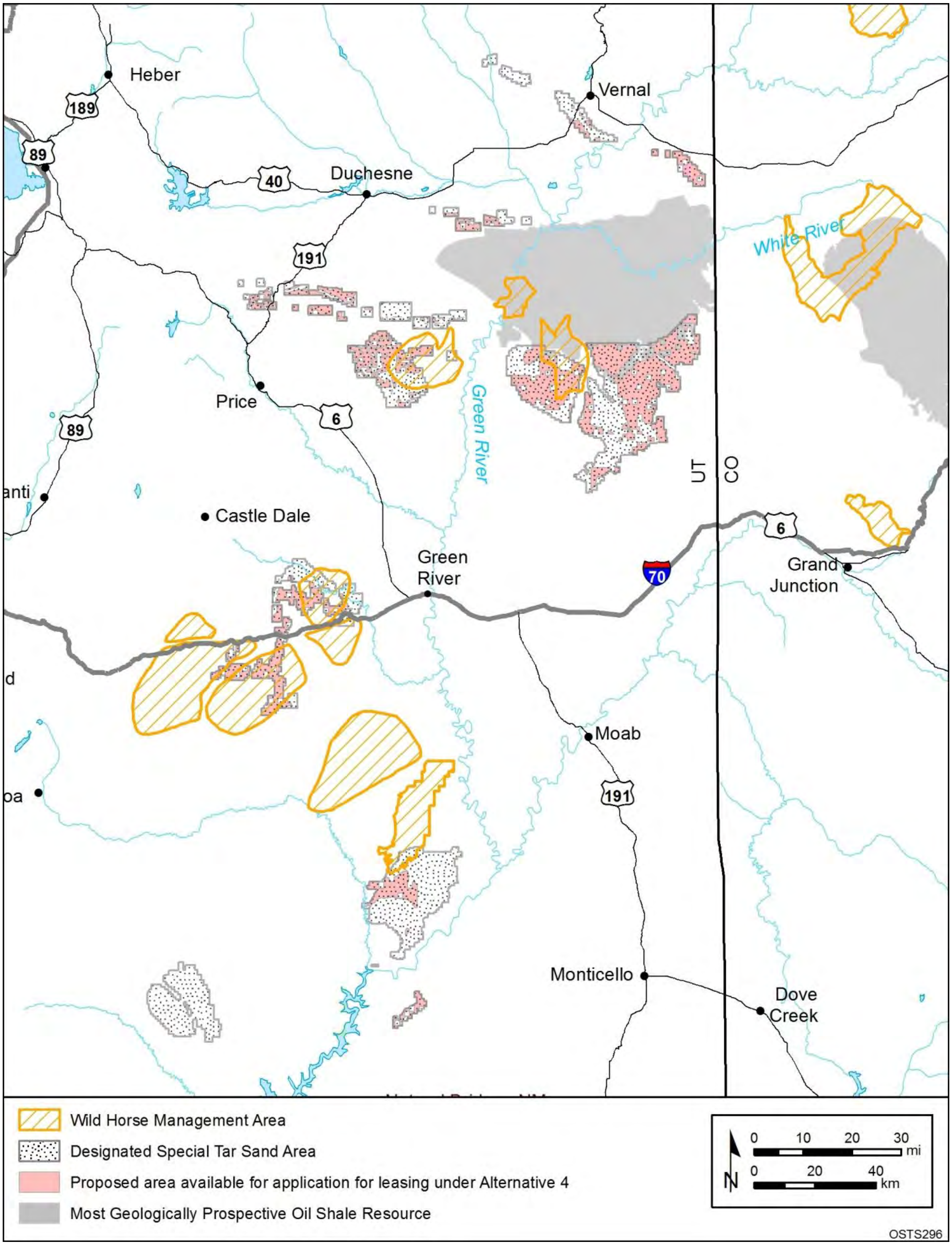


**FIGURE 6.2.4-3 Lands Available for Application for Tar Sands Leasing under Alternative 4 in Relation to Wild Horse and Burro Herd Management Areas**

information was available as to whether these stipulations applied to threatened, endangered, and sensitive species.

Under Alternative 4, 66 of the 56 federal candidate, BLM-designated sensitive, and state-listed species listed in Table 6.2.4-5 and 22 of the 23 federally listed threatened or endangered species listed in Table 6.2.4-6 could occur in areas that are available for application for commercial leasing of tar sands. This determination is based on records of occurrence in project counties, species occurrences from stage natural heritage programs,[25] and the presence of potentially suitable habitat.[26] Potential lease areas include about 27,200 acres of critical habitat for the Mexican spotted owl (*Strix occidentalis lucida*); designated critical habitat for Colorado River endangered fishes may also occur downstream within 10 mi (16 km) of potential tar sands lease areas (Figure 6.2.4-4). Greater sage-grouse (*Centrocercus urophasianus*) core habitats and lek sites are shown in Figure 6.2.4-5. Potential tar sands lease areas under Alternative 4 intersect approximately 87,780 acres of core and priority sage-grouse habitat in Utah.

**TABLE 6.2.4-4 Habitat for Threatened, Endangered, and Sensitive Species Protected by Stipulations in BLM RMPs within the Alternative 4 Tar Sands Lease Areas**

| Habitat Description | Area of Habitat (acres)[a] |
|---|---|
| ***Plants*** | |
| Graham's penstemon habitat | 1,625 (1,625)[b] |
| ***Birds*** | |
| Bald eagle habitat | 36 (280) |
| Sage-grouse habitat | 42,017 (53,866) |

[a] Acreage may be overestimated because of the unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

[b] Numbers in parentheses are the acreages identified for protection within the most geologically prospective lands.

The potential for impacts on threatened, endangered, and sensitive species (and their habitats) by commercial tar sands development is directly related to the amount of land disturbance that could occur with a commercial project (including its ancillary facilities, such as power plants and utility and pipeline ROWs), the duration and timing of construction and operation periods, and the habitats affected by development. Indirect effects, such as impacts resulting from the erosion of disturbed land surfaces, surface or groundwater depletions, contamination, and disturbance and harassment of animal species, are also considered, but their relative magnitude is considered proportional to the amount of land disturbance.

Potential impacts on threatened, endangered, and sensitive species under Alternative 4 are similar to or the same as impacts on aquatic resources; plant communities and habitats; and

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[25] Spatial data were obtained from state natural heritage program or conservation offices that represented USGS quad-level or township range-level occurrences of species (CNHP 2011; UDWR 2011; WYNDDB 2011a). A spatial analysis was performed to determine the distance of recorded occurrences of each species to the potential lease areas. For species tracked in these state databases, these distance measurements are provided in Tables 6.2.4-5 and 6.2.4-6.

[26] Spatial models representing potentially suitable habitat of terrestrial vertebrate wildlife species were obtained from USGS (2007) and WYNDDB (2011b). For species with an available habitat model, a spatial analysis was performed to quantify the amount of potentially suitable habitat within the potential lease areas. This quantification is presented in Tables 6.2.4-5 and 6.2.4-6.

**TABLE 6.2.4-5 Potential Effects of Commercial Tar Sands Development under Alternative 4 on BLM-Designated Sensitive Species, Federal Candidates for Listing, State-Listed Species, and State Species of Special Concern**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Amsonia jonesii* | Jones blue star | BLM-S | Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Aquilegia scopulorum* var. *goodrichii* | Utah columbine | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Arabis vivariensis* | Park rockcress | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus detritalis* | Debris milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus duchesnensis* | Duchesne milkvetch | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Astragalus equisolensis* | Horseshoe milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus hamiltonii* | Hamilton's milkvetch | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Astragalus musiniensis* | Ferron milkvetch | BLM-S | Emery, Garfield, Grand, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Astragalus naturitensis* | Naturita milkvetch | BLM-S | San Juan | **No impact.** This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Astragalus piscator* | Fisher Towers milkvetch | BLM-S | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |

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**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Astragalus rafaelensis* | San Rafael milkvetch | BLM-S | Emery, Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Cirsium ownbeyi* | Ownbey's thistle | BLM-S | Uintah | **No impact.** This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| *Cleomella palmeriana* var. *goodrichii* | Goodrich cleomella | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha barnebyi* | Barneby's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha caespitosa* | Caespitose cat's-eye | BLM-S | Carbon, Duchesne, Uintah | **No impact.** This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 9 mi (14 km) from the STSAs. |
| *Cryptantha grahamii* | Graham's cat's-eye | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Cryptantha osterhoutii* | Osterhout cat's eye | BLM-S | Emery, Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Cryptantha rollinsii* | Rollins' cat's eye | BLM-S | Duchesne, San Raphael, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cymopterus duchesnensis* | Uinta Basin spring-parsley | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Eriogonum contortum* | Grand buckwheat | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Eriogonum ephedroides* | Ephedra buckwheat | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Frasera ackermanae* | Ackerman frasera | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Gentianella tortuosa* | Utah gentian | BLM-S | Duchesne, Emery, Garfield, Uintah | **No impact.** This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs in Utah. |
| *Gilia stenothyrsa* | Narrow-stem gilia | BLM-S | Carbon, Duchesne, Emery, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSA. |
| *Hymenoxys lapidicola* | Rock hymenoxys | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Lepidium huberi* | Huber's pepperplant | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Listera borealis* | Northern twayblade | BLM-S | Duchesne, San Juan | **No impact.** This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 90 mi (145 km) from the STSAs. |
| *Lygodesmia doloresensis* | Dolores River skeletonplant | BLM-S | Grand | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Mentzelia goodrichii* | Goodrich's blazinstar | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Mimulus eastwoodiae* | Eastwood monkey-flower | BLM-S | Garfield, Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Minuartia nuttallii* | Nuttall sandwort | BLM-S | Duchesne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Parthenium ligulatum* | Ligulate feverfew | BLM-S | Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pediomelum aromaticum* | Paradox breadroot | BLM-S | Grand, San Juan | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Penstemon scariosus* var. *albifluvis* | White River beardtongue | ESA-C | Uintah | **Potential for negative impact**. Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Phacelia argylensis* | Argyle Canyon phacelia | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| *Townsendia strigosa* | Strigose Easter-daisy | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Yucca sterilis* | Spanish bayonet | BLM-S | Uintah | **Potential for negative impact.** Suitable habitat may occur in the study area. |
| ***Invertebrates*** | | | | |
| *Speyeria nokomis nokomis* | Great Basin silverspot butterfly | BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| ***Fish*** | | | | |
| *Catostomus discobolus* | Bluehead sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Fish (Cont.)*** | | | | |
| *Catostomus latipinnis* | Flannelmouth sucker | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah; Wayne; | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Catostomus platyrhynchus* | Mountain sucker | BLM-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Gila robusta* | Roundtail chub | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Oncorhynchus clarkii pleuriticus* | Colorado River cutthroat trout | BLM-S | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Amphibians*** | | | | |
| *Bufo boreas* | Boreal toad | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Uintah, Wayne | **Potential for negative impact.** Approximately 10,590 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the STSAs. |
| *Hyla arenicolor* | Canyon treefrog | BLM-S | Garfield, Grand, Wayne, San Juan | **Potential for negative impact.** Approximately 15,984 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Rana luteiventris* | Columbia spotted frog | BLM-S | Utah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Amphibians (Cont.)*** | | | | |
| *Rana pipiens* | Northern leopard frog | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 840 acres of potentially suitable habitat for this species occurs in the STSAs. This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Spea intermontana* | Great basin spadefoot | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 356,572 acres of potentially suitable habitat for this species occurs in the STSAs. This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| ***Reptiles*** | | | | |
| *Elaphe guttata* | Corn snake | BLM-S; UT-SC | Grand, San Juan | **Potential for negative impact.** Approximately 6,547 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the STSAs. |
| *Liochlorophis vernalis* | Smooth greensnake | BLM-S; UT-SC | Carbon, Duchesne, Grand, San Juan, Uintah | **Potential for negative impact.** Approximately 3,331 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xantusia vigilis* | Desert night lizard | BLM-S; UT-SC | Garfield, San Juan | **Potential for negative impact.** Approximately 3,302 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Birds*** | | | | |
| *Accipiter gentilis* | Northern goshawk | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 103,433 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSA. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Ammodramus savannarum* | Grasshopper sparrow | UT-SC | Duchesne, Uintah, Utah, Wasatch | **No impact.** Suitable habitat for the species does not occur in the STSAs. |
| *Athene cunicularia* | Burrowing owl | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 154,858 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Buteo regalis* | Ferruginous hawk | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 135,373 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Centrocercus minimus* | Gunnison sage-grouse | ESA-C; UT-SC | Grand, San Juan | **Potential for negative impact.** Approximately 569 acres of potentially suitable habitat for this species occurs in the STSAs. This species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 30 mi (48 km) from the STSAs. |
| *Centrocercus urophasianus* | Greater sage-grouse | ESA-C; BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 107,660 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Charadrius montanus* | Mountain plover | BLM-S; UT-SC | Rio Blanco | **Potential for negative impact.** Approximately 9,024 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | ESA-C; BLM-S | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Cypseloides niger* | Black swift | BLM-S; UT-SC | Duchesne, Uintah | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 20 mi (32 km) from the STSAs. |
| *Dolichonyx oryzivorus* | Bobolink | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Haliaeetus leucocephalus* | Bald eagle | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 248,684 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Melanerpes lewis* | Lewis's woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 12,895 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Numenius americanus* | Long-billed curlew | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,420 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pelecanus erythrorhynchos* | American white pelican | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 3,473 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Picoides tridactylus* | Three-toed woodpecker | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 2,904 acres of potentially suitable habitat for this species occurs in the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals*** | | | | |
| *Brachylagus idahoensis* | Pygmy rabbit | BLM-S; UT-SC | Garfield, Wayne | **No impact.** Suitable habitat for the species does not occur in the STSAs, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Corynorhinus townsendii pallescens* | Townsend's big-eared bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 381,352 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Cynomys gunnisoni* | Gunnison's prairie dog | ESA-C; BLM-S; UT-SC | Grand, San Juan | **No impact.** Suitable habitat for the species does not occur in the project area, and it is not known to occur in the vicinity of the STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |
| *Cynomys leucurus* | White-tailed prairie dog | BLM-S; UT-S | Carbon, Duchesne, Emery, Grand, Uintah | **Potential for negative impact.** Approximately 130,846 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Euderma maculatum* | Spotted bat | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 297,077 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 4 mi (6 km) from the STSAs. |
| *Idionycteris phyllotis* | Allen's big-eared bat | BLM-S; UT-SC | Garfield, Grand, San Juan, Wayne | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Lasiurus blossevillii* | Western red bat | BLM-S; UT-SC | Carbon, Emery, Grand, Garfield, San Juan, Wayne | **Potential for negative impact.** Approximately 28 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences are within 10 mi (16 km) from the STSAs. |

**TABLE 6.2.4-5 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Mammals (Cont.)*** | | | | |
| *Myotis thysanodes* | Fringed myotis | BLM-S; UT-SC | Duchesne, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 407,185 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSA. |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-S; UT-SC | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 309,502 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSA. |
| *Vulpes macrotis* | Kit fox | BLM-S | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 31,641 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-C = candidate for listing under the ESA; UT-SC = species of special concern in the state of Utah; WY-SC.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from state natural heritage program offices (CNHP 2011; UDWR 2011; WYNDDB 2011a). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) and terrestrial vertebrate distribution models for the state of Wyoming (WYNDDB 2011b) were used to determine the presence of potentially suitable habitat in the STSAs.

wildlife described in Sections 6.2.4.7.1, 6.2.4.7.2, and 6.2.4.7.3, respectively. The most important difference is the potential consequence of the impacts. Because of their low population sizes, threatened and endangered species are far more vulnerable than more common and widespread species. Low population size makes them 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. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development. These impacts would be evaluated in detail in project-specific assessments and consultations conducted prior to leasing and development.

**TABLE 6.2.4-6 Potential Effects of Commercial Tar Sands Development under Alternative 4 on Federally Listed Threatened, Endangered, and Proposed Species**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants*** | | | | |
| *Cycladenia humilis* var. *jonesii* | Jones cycladenia | ESA-T | Emery, Garfield, Grand, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Erigeron maguirei* | Maguire daisy | ESA-T | Emery, Garfield, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. |
| *Pediocactus despainii* | San Rafael cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Pediocactus winkleri* | Winkler cactus | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 11 mi (18 km) from the STSAs. |
| *Penstemon grahamii* | Graham's beardtongue | ESA-PT; BLM-S | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Phacelia argillacea* | Clay phacelia | ESA-E | Wasatch | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 5 mi (8 km) from the STSAs. |
| *Schoenocrambe argillacea* | Clay reed-mustard | ESA-T | Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 6 mi (10 km) from the STSAs. |
| *Schoenocrambe barnebyi* | Barneby reed-mustard | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 9 mi (14 km) from the STSAs. |
| *Schoenocrambe suffrutescens* | Shrubby reed-mustard | ESA-E | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Sclerocactus brevispinus* | Pariette cactus | ESA-T | Duchesne, Uintah | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Sclerocactus glaucus* | Uinta Basin hookless cactus | ESA-T | Carbon, Duchesne, Uintah | **No impact.** Suitable habitat for this species is not known to occur in the vicinity of any STSAs. Nearest occurrences are approximately 40 mi (64 km) from the STSAs. |

**TABLE 6.2.4-6 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Plants (Cont.)*** | | | | |
| *Sclerocactus wrightiae* | Wright fishhook cactus | ESA-E | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences are within 4 mi (6 km) from the STSAs. |
| *Spiranthes diluvialis* | Ute ladies'-tresses | ESA-T | Duchesne, Garfield, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Townsendia aprica* | Last chance townsendia | ESA-T | Emery, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Fish*** | | | | |
| *Gila cypha* | Humpback chub | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Designated critical habitat occurs within 10 mi (16 km) from STSAs. Quad-level occurrences are within 5 mi (8 km) from the STSAs. |
| *Gila elegans* | Bonytail | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Designated critical habitat occurs within 10 mi (16 km) from the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Ptychocheilus lucius* | Colorado pikeminnow | ESA-E | Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Designated critical habitat occurs within 10 mi (16 km) from the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| *Xyrauchen texanus* | Razorback sucker | ESA-E | Carbon, Emery Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Suitable habitat may occur in the STSAs. Designated critical habitat occurs within 10 mi (16 km) from the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Birds*** | | | | |
| *Empidonax traillii extimus* | Southwestern willow flycatcher | ESA-E | Carbon, Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 20,539 acres of potentially suitable habitat for this species occurs in the STSAs. |
| *Gymnogyps californianus* | California condor | ESA-E | Grand | **Potential for negative impact.** Approximately 30,203 acres of potentially suitable habitat for this species occurs in the STSAs. |

**TABLE 6.2.4-6 (Cont.)**

| Scientific Name | Common Name | Status[a] | Utah Counties within the Study Area in Which Species May Occur | Potential for Effect[b] |
|---|---|---|---|---|
| ***Birds (Cont.)*** | | | | |
| *Strix occidentalis lucida* | Mexican spotted owl | ESA-T | Emery, Garfield, Grand, San Juan, Uintah, Wayne | **Potential for negative impact.** Approximately 105,184 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |
| ***Mammals*** | | | | |
| *Lynx canadensis* | Canada lynx | ESA-T | Emery, Uintah | **Potential for negative impact.** Suitable habitat for the species does not occur in the STSAs. Quad-level occurrences are within 13 mi (21 km) from the STSAs. |
| *Mustela nigripes* | Black-footed ferret | ESA-XN | Carbon, Duchesne, Emery, Grand, San Juan, Uintah Sublette, Sweetwater | **Potential for negative impact.** Approximately 10,319 acres of potentially suitable habitat for this species occurs in the STSAs. Quad-level occurrences of this species intersect the STSAs. |

[a] Status categories: BLM-S = listed by the BLM as sensitive; ESA-E = listed as endangered under the ESA; ESA-PT = proposed for listing as a threatened species under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population.

[b] Potential impacts are based upon the presence of potentially suitable habitat or recorded occurrences in the vicinity of the STSAs. Recorded occurrences were obtained as USGS quad-level or township range-level element occurrence records from the UDWR (2011). If available for terrestrial vertebrates, SWReGAP animal habitat suitability models (USGS 2007) were used to determine the presence of potentially suitable habitat in the STSAs. Spatial data for designated critical habitat were obtained from the USFWS Critical Habitat Portal (USFWS 2011).

### 6.2.4.8 Visual Resources

The lands that would remain available for application for leasing for commercial development of tar sands under Alternative 4 support a wide variety of visual resources (Section 3.9). These resources would not be affected by the amendment of land use plans to identify these potential lease areas. Visual resources in and around the identified areas, however, could be affected by subsequent commercial development of tar sands.

Several scenic resource areas are located within the areas identified as available for application for leasing under Alternative 4 (Figures 6.2.4-6 through 6.2.4-9). These scenic resource areas include:

- The White Canyon SRMA;
- The Dinosaur Diamond Prehistoric National Scenic Highway; and
- The Indian Canyon State Scenic Byway.

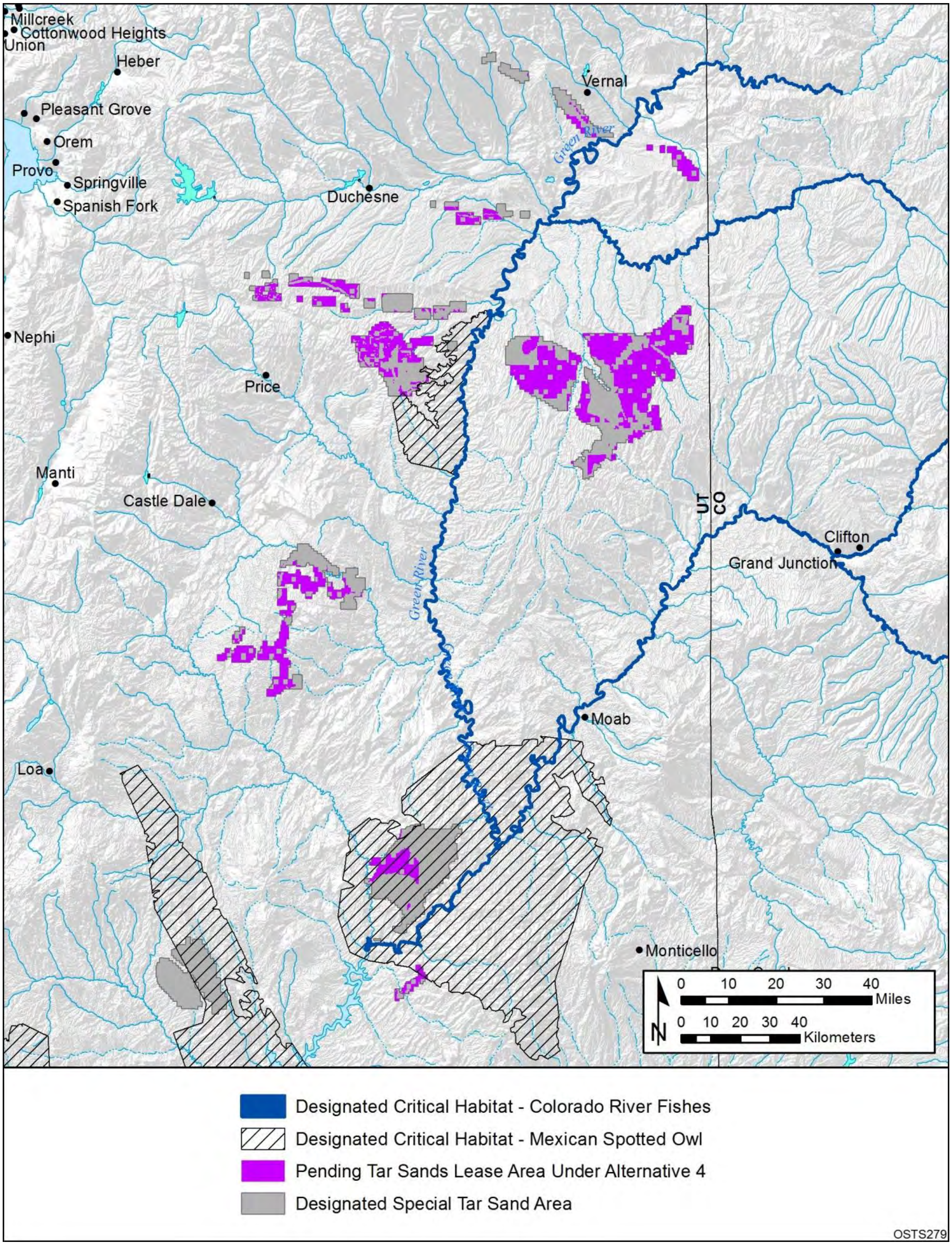


**FIGURE 6.2.4-4 Designated Critical Habitats of Threatened and Endangered Species That Are near Pending Tar Sands Lease Areas under Alternative 4**

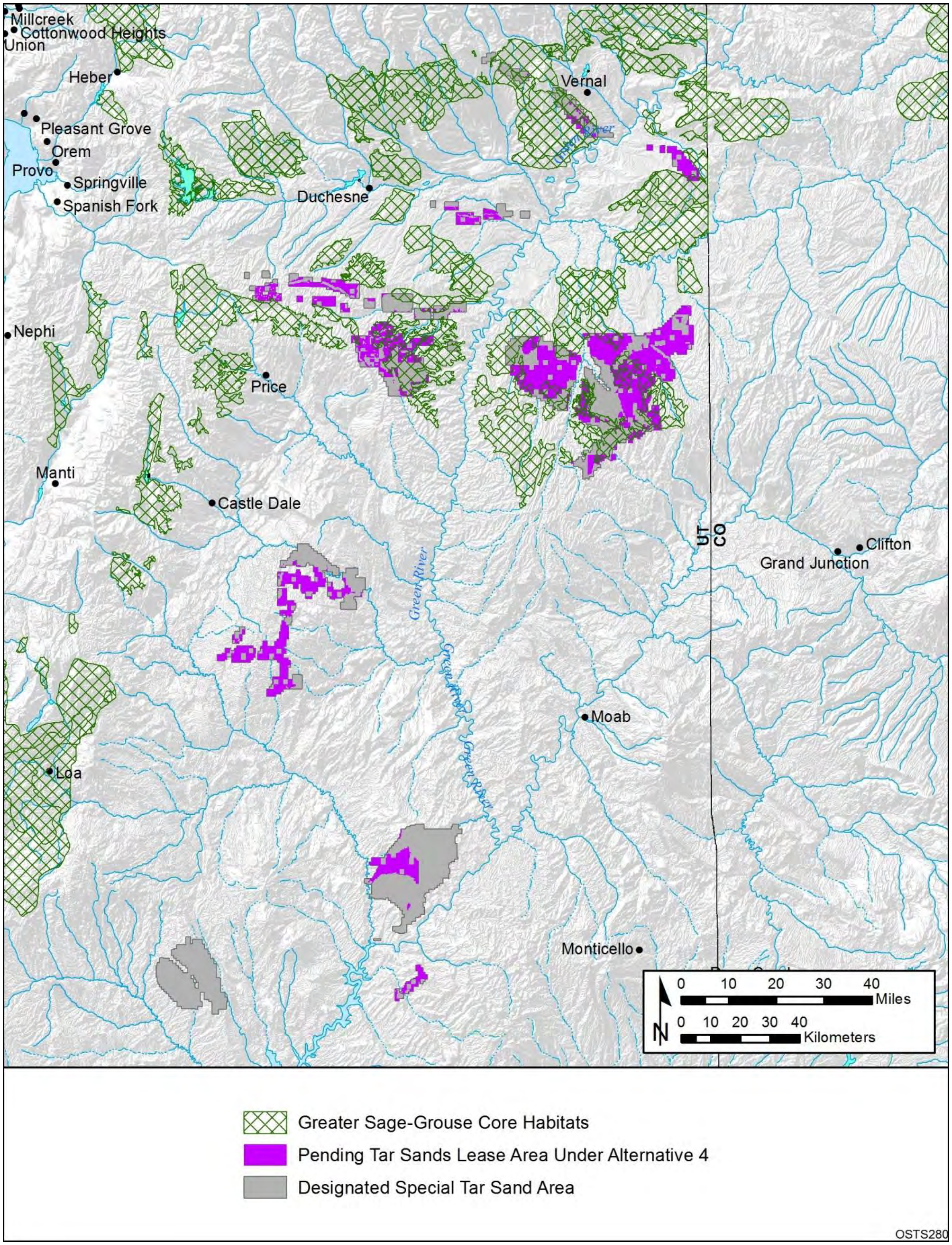


**FIGURE 6.2.4-5 Distribution of Core and Priority Habitat Areas for Greater Sage-Grouse That Are near Pending Tar Sands Lease Areas under Alternative 4**

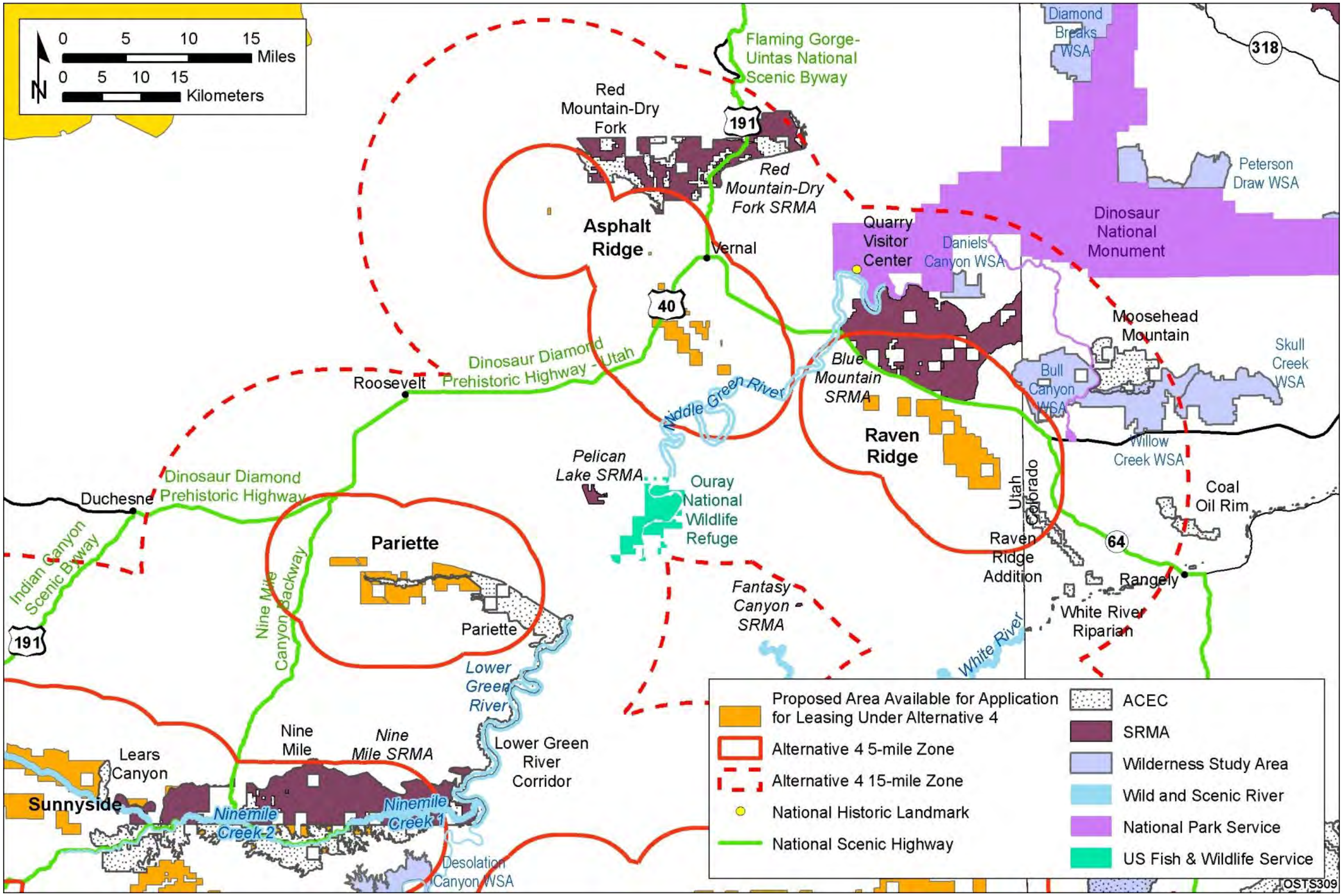


**FIGURE 6.2.4-6 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 for the Asphalt Ridge, Pariette, and Raven Ridge STSAs**

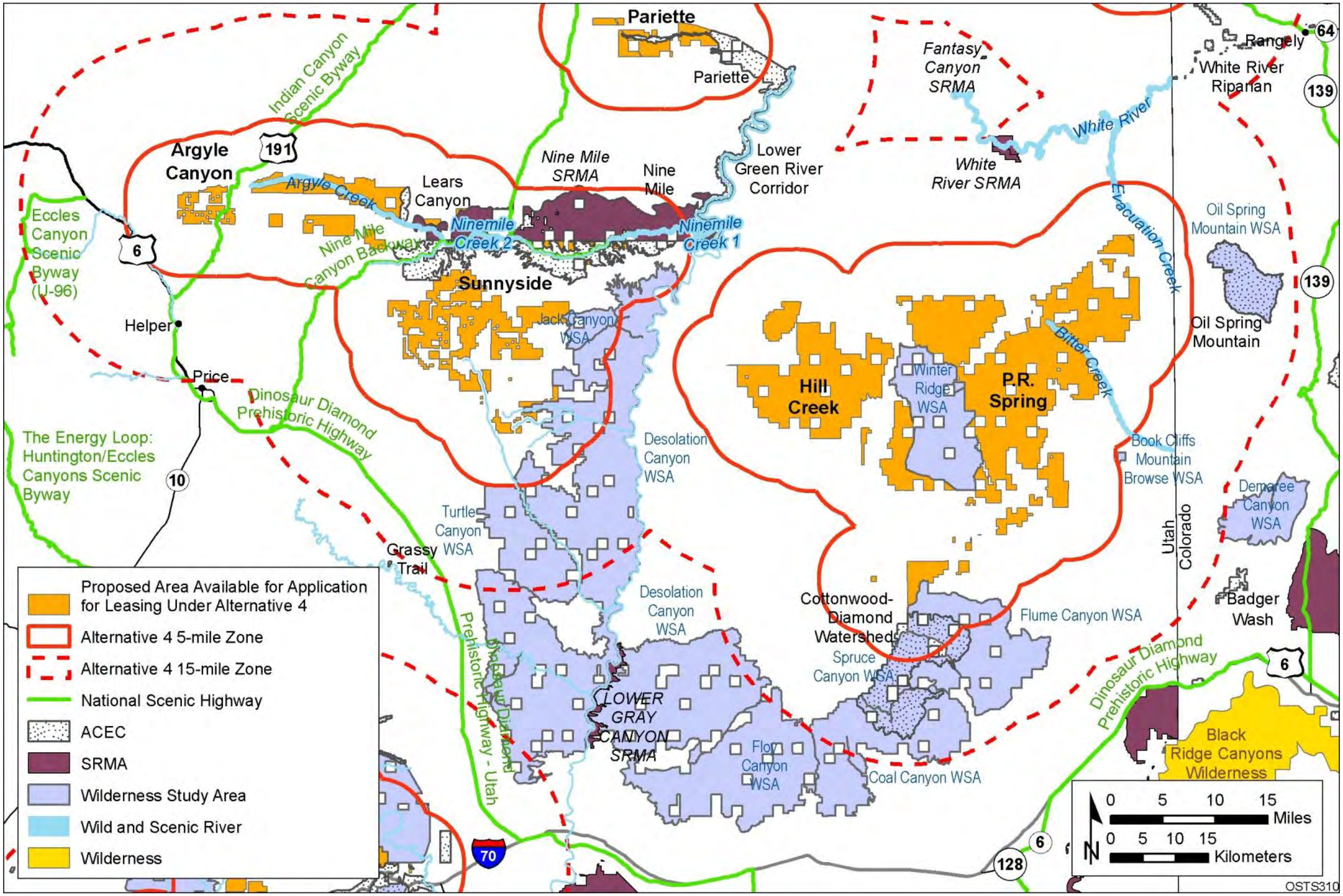


**FIGURE 6.2.4-7 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 for the Hill Creek, P.R. Spring, and Sunnyside STSAs**

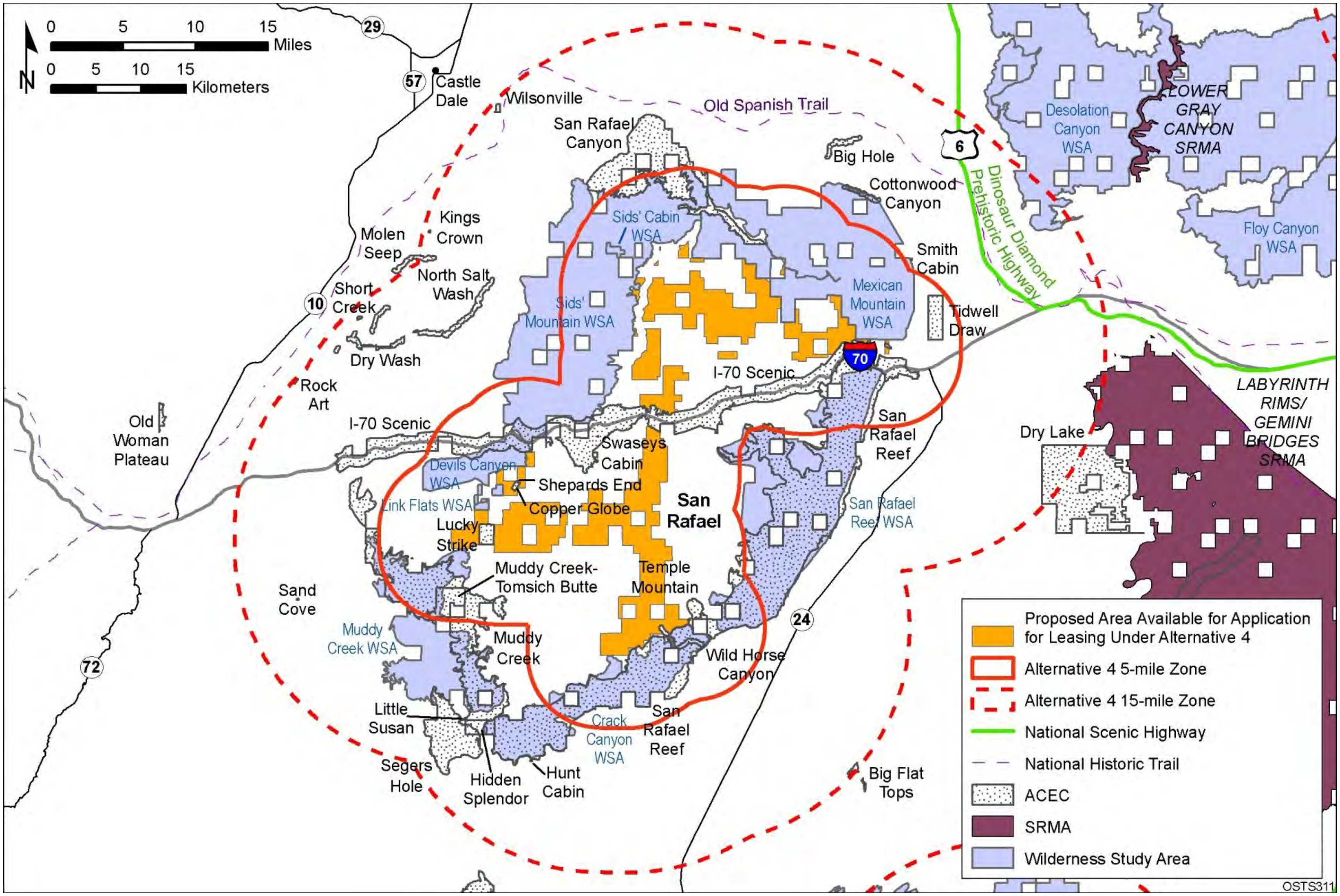


**FIGURE 6.2.4-8 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 for the San Rafael STSA**

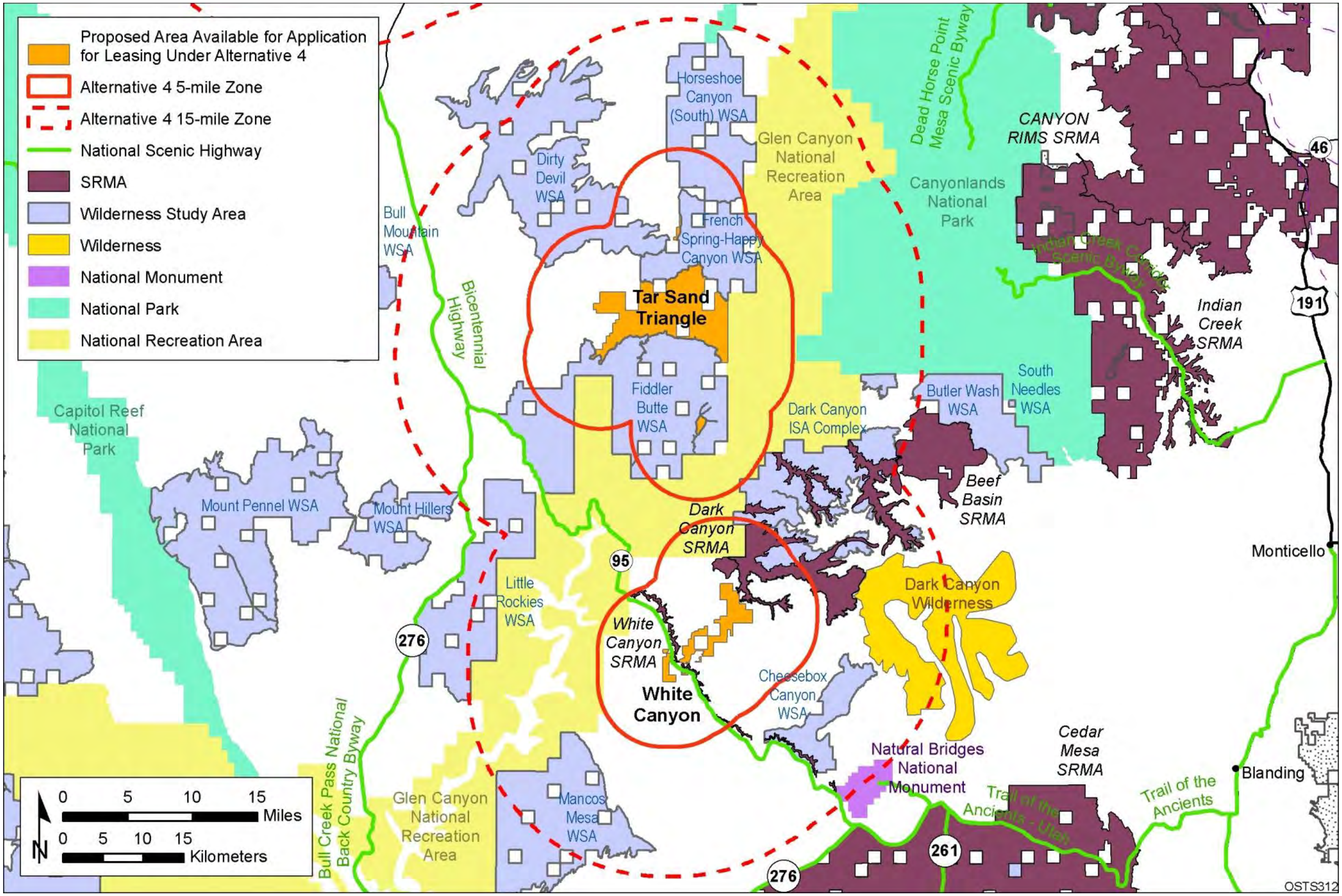


**FIGURE 6.2.4-9 Scenic Resource Areas within the 5- and 15-mi Zones around the Lands Available for Application for Leasing under Alternative 4 for the Tar Sand Triangle and White Canyon STSAs**

Additional scenic resource areas are located within 5 or 15 mi of the areas in Alternative 4 identified as available for commercial leasing (Figures 6.2.4-6 through 6.2.4-9). The 5-mi zone corresponds to the BLM's VRM foreground-middleground distance limit, and the 15-mi zone corresponds to the BLM's background distance limit. Based on the assumption of an unobstructed view of a commercial tar sands project, viewers in these areas would be likely to perceive some level of visual impact from the project; more impacts would be expected for resources within the foreground-middleground distance and fewer within the background distance. Beyond the background distance, the project might be visible but would likely occupy a very small visual angle and create low levels of visual contrast such that impacts would be minor to negligible. Table 6.2.4-7 presents the scenic resource areas within these zones.

Visual resources at these areas, as well as elsewhere within the areas available for application for leasing, could be affected at and near where commercial tar sands projects are developed and operated, and at areas where supporting infrastructure (such as and utility and pipeline ROWs) would be located. Visual resources could be affected by ROW clearing, project construction, and operation (see Section 5.9.1). Potential impacts would be associated with construction equipment and activity, cleared project areas, and the type and visibility of individual project components such as tar sands processing facilities, utility ROWs, and surface mines. The nature, magnitude, and extent of project-related impacts would depend on the type, location, and design of the individual project components.

#### 6.2.4.9 Cultural Resources

Under Alternative 4, a total of 425,790 acres of public land would remain available for commercial tar sands leasing. The lands that would remain available contain cultural resources (O'Rourke et al. 2007). More than 9% of public lands that would remain available for application for leasing in the STSAs under Alternative 4 have been surveyed for cultural resources (more than 37,841 acres in addition to 599 linear mi).[27] In those areas that have been surveyed, 440 sites have been identified. Additional cultural resources are likely in unsurveyed portions of the study area. On the basis of a sensitivity analysis conducted for the Class I Cultural Resources Overview (O'Rourke et al. 2007), a total of 239,054 acres within areas available for application for leasing in Alternative 4 have been identified as having a medium or high sensitivity for containing cultural resources.[28]

Impacts on cultural resources within these areas would be considered if leasing and future commercial development occur. Leasing itself has the potential to impact cultural resources to the extent that the terms of the lease limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed development on cultural properties. Impacts from future

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[27] This percentage was calculated using block acre surveys only and does not include approximately 598 linear mi of survey.

[28] The Argyle Canyon, Asphalt Ridge, Circle Cliffs, Raven Ridge, and White Canyon STSAs and portions of the Pariette, San Rafael, Sunnyside and Tar Sand Triangle STSAs had not been surveyed sufficiently to derive sensitivity information; therefore, these acreages have not been included in this percentage calculation. Out of 425,790 acres available under Alternative 4, sensitivity information is available for 359,362 acres (85%).

**TABLE 6.2.4-7 Visually Sensitive Areas That Could Be Affected by Commercial Tar Sands Projects Developed in Lease Areas under Alternative 4**

| Scenic Resources within 5 mi of Alternative 4 Lease Areas | Scenic Resources between 5 and 15 mi of Alternative 4 Lease Areas |
|---|---|
| Bull Canyon, Crack Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, Flume Canyon, French Spring-Happy Canyon, Horseshoe Canyon (South), Jack Canyon, Link Flats ISA, Mexican Mountain, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain, Spruce Canyon, and Winter Ridge WSAs. | Book Cliffs Mountain Browse ISA, Bull Canyon, Butler Wash, Cheese Box Canyon, Coal Canyon, Crack Canyon, Daniels Canyon, Dark Canyon ISA Complex, Desolation Canyon, Devils Canyon, Dirty Devil, Fiddler Butte, Floy Canyon, Flume Canyon, French Spring-Happy Canyon, Horseshoe Canyon (South), Jack Canyon, Link Flats ISA, Little Rockies, Mancos Mesa, Mexican Mountain, Mt. Hillers, Muddy Creek, San Rafael Reef, Sids Cabin 202, Sids Mountain, Spruce Canyon, Turtle Canyon, and Winter Ridge WSAs. |
| Copper Globe, Cottonwood-Diamond Watershed, I-70 Scenic, Lears Canyon, Lucky Strike, Muddy Creek, Muddy Creek-Tomsich Butte, Nine Mile, Pariette, Raven Ridge Addition, Red Mountain-Dry Fork, Rock Art, San Rafael Canyon, San Rafael Reef, Shepards End, Swaseys Cabin, Temple Mountain, Tidwell Draw, and Wild Horse Canyon ACECs. | Big Hole, Copper Globe, Cottonwood Canyon, Cottonwood-Diamond Watershed, Dry Lake, Hidden Splendor, Hunt Cabin, I-70 Scenic, Kings Crown, Lears Canyon, Little Susan, Lower Green River Corridor, Lucky Strike, Molen Seep, Muddy Creek, Muddy Creek-Tomsich Butte, Nine Mile, North Salt Wash, Pariette, Raven Ridge Addition, Red Mountain-Dry Fork, Rock Art, San Rafael Canyon, San Rafael Reef, Sand Cove, Segers Hole, Shepards End, Short Creek, Smith Cabin, Swaseys Cabin, Temple Mountain, Tidwell Draw, White River Riparian, Wild Horse Canyon, and Wilsonville ACECs. |
| Blue Mountain, Dark Canyon, Nine Mile, Red Mountain-Dry Fork, and White Canyon SRMAs. | Beef Basin, Blue Mountain, Dark Canyon, Labyrinth Rims/Gemini Bridges, Nine Mile, Pelican Lake, Red Mountain-Dry Fork, White Canyon, and White River SRMAs. |
| Dinosaur Diamond Prehistoric and Flaming Gorge-Uintas National Scenic Highways, Bicentennial and Indian Canyon State Scenic Highways, and Nine Mile Canyon BLM Backcountry Backway. | Dinosaur Diamond Prehistoric, The Energy Loop: Huntington/Eccles Canyons, and Flaming Gorge-Uintas National Scenic Highways, Bicentennial and Indian Canyon State Scenic Highways, Bull Creek Pass and Nine Mile Canyon BLM Backcountry Backways, and Eccles Canyon National Forest Scenic Byway. |
| Glen Canyon National Recreation Area | Canyonlands National Park, Dark Canyon Wilderness, Ouray National Wildlife Refuge, Glen Canyon National Recreation Area, Dinosaur and Natural Bridges National Monuments. |
| | Quarry Visitor Center National Historic Landmark and Old Spanish Trail National Historic Trail. |

development could include the destruction of individual resources present within development areas, degradation and/or destruction of near-surface resources in or near the development area, increased potential of loss of resources from looting or vandalism of resources as a result of increased human presence and activity in the sensitive areas, and visual degradation of the cultural setting (see Section 6.2.4.8). Any future leasing and development would be subject to compliance with Section 106 of the NHPA as well as all other pertinent laws, regulations, and policies. Compliance with these laws would result in measures to avoid, minimize, or mitigate impacts, or to denial of the lease or project. The cultural resources in the Circle Cliffs STSA would not be impacted by tar sands leasing and development because no leasing and development would occur in this STSA. The cultural resources in the Argyle Canyon, Hill Creek, Pariette, Raven Ridge, San Rafael, Tar Sand Triangle, and White Canyon STSAs are less likely to be impacted by tar sands leasing and development than those resources present in the Asphalt Ridge, P.R. Spring, and Sunnyside STSAs.

#### 6.2.4.10 Indian Tribal Concerns

Alternative 4 (Moderate Development) is similar in scale to Alternative 1. It would make a somewhat reduced 425,790 acres available for application for leasing. It would require amending the same four management plans as Alternative 1, and the same types of extractive technologies would be considered. In addition to the lands excluded from tar sands leasing under Alternative 1, Alternative 4 would exclude the ACEC acreage added during planning efforts in Utah since the 2008 OSTS PEIS ROD was issued. The withdrawal of these additional acreages from consideration for leasing would afford some added protection to any resources important to Native Americans that may be located there. The amending of the management plans to make this allocation decision would not in and of itself impact any resources important to Native Americans. The development of these parcels, however, would have the potential for the same kinds of effects discussed for Alternative 1, on a similar scale. The degree of adverse impact resulting from development would depend on the location of the development and the technology used. Both surface mining and in situ processes would be considered. To the extent that ground surface is disturbed, there is the potential for the loss of plant and mineral resources, the habitat of culturally important animals, archaeological sites, burials, rock art, and other physical features, while increased access and increased human activity could lead to increased vandalism and visual and auditory intrusion on sacred places. Adverse effects on resources important to Native Americans would be reduced by the implementation of legally required procedures in the amended management plans for cultural resources survey and government-to-government consultations with the affected tribes. Project-specific NEPA analyses that would be required could result in lease stipulations specific to the parcels considered for lease, resulting in avoidance and protection of the resources through changes in project design and development plans.

#### 6.2.4.11 Socioeconomics

Under Alternative 4, land use plans would be amended to identify 425,790 acres of land in Utah as available for application for commercial tar sands development. With the possible exception of an impact on property values, there is no socioeconomic impact from this action. Although the socioeconomic and transportation impacts of Alternative 4 would be dependent on the exact locations of future development, the types of impacts that could occur would be the same as those for Alternative 1 as described in Section 5.11 and summarized in Section 6.2.1.10. The specific impacts would be dependent upon the technologies employed, the project size or production level, development time lines, mitigation measures, and the location of employee housing.

Under Alternative 4, it is possible that there would be property value impacts simply from designating land as available or not available for application for leasing; these impacts could result in either decreased or increased property values (see Section 4.11.1.6).

#### 6.2.4.12 Environmental Justice

Although the environmental justice impacts of Alternative 4 would be dependent on the exact locations of specific developments, the types of impacts that would occur on lands made available for application for commercial leasing by the proposed land use plan amendments under Alternative 4 would be the same as those for Alternative 1, as described in Section 5.13 and summarized in Section 6.2.1.12.

#### 6.2.4.13 Hazardous Materials and Waste Management

The hazardous materials and waste management considerations for commercial tar sands operations under Alternative 4 would be the same as those under Alternative 1, presented in Section 6.2.1.13.

#### 6.2.3.14 Health and Safety

The worker health and safety and public health considerations for commercial tar sands operations under Alternative 4 would be the same as those under Alternative 1, presented in Section 6.2.1.14.

### 6.2.5 Comparison of Tar Sands Alternatives

As noted in the impact analysis sections for all alternatives, with the exception noted in the socioeconomic analysis regarding potential impacts on land values, these land use plan amendments also would not result in any impacts on the environment or socioeconomic setting. However, the future development of commercial tar sands projects that could be approved in all alternatives after subsequent NEPA analysis would have impacts on resources and resource values. The types of impacts associated with future commercial tar sands development are described in Chapter 5. The magnitude of the impacts cannot be quantified at this time because key information about the location of commercial projects, the technologies employed, the project size or production level, development time lines, and mitigation measures that would be applied is unknown. At the programmatic level Alternatives 2 and 3 are more protective of known resource values, but Alternatives 1 and 4 incorporate protections for many important resources.

#### 6.2.5.1 Land Use

None of the alternatives place a cap on the level of potential development, although Alternative 3 essentially does this since only 2,100 acres would be available for development. Consequently, the impacts on land use from Alternative 3 likely would be less than from the other alternatives assuming that tar sands development would occur in other areas under the other alternatives. Potentially, the level of impacts under Alternatives 1 and 4 is similar, while that for Alternative 2 would be proportionately lower, including the requirements for off-site infrastructure.

Alternative 1 potentially would have the largest impact on land use since it excludes the smallest amount of sensitive resource lands (i.e., LWC, ACECs, and potential ACECs); however, impacts on other mineral development, grazing, and recreation use could be the same as Alternatives 2 and 4.

If implemented, Alternative 3 would provide protection to the largest amount of sensitive lands and is most likely to have the least impact on ACECs, LWC, and potential ACECs than Alternatives 1 or 4. Alternative 2 also would provide substantially more protection to sensitive lands than Alternative 1 or 4. It is expected that Alternative 4 likely would have somewhat less impact than Alternative 1, although it is assumed that the implementation of Alternative 1 will be subject to the same or similar policies regarding protection of sage-grouse core habitat and LWC.

#### 6.2.5.2 Soil and Geologic Resources

Soils and geologic resources could be affected by future development of commercial tar sands projects in areas available for application for tar sands leasing under all four alternatives. Potential impacts, related primarily to construction and operation of project facilities and related infrastructure, could include soil disturbance, removal or compaction, and erosion.

Impacts on soil and geologic resources would be essentially identical between Alternatives 1 and 4 for similar projects located in areas common to the two alternatives (i.e., in areas where these alternatives overlap). Soil and geologic resources could be affected to a lesser degree by commercial tar sands development under Alternative 2. The lands excluded from application for leasing under Alternative 2 represent environmentally sensitive areas as identified in BLM land use plans that could be developed in the future under Alternatives 1 or 4. The nature, location, and magnitude of project-related impacts on soil and geologic resources would depend on the specific locations of leases undergoing commercial development as well as on the design of the projects. Alternative 3 represents a minimal level of impact compared to the other alternatives.

#### 6.2.5.3 Paleontological Resources

Under all the tar sands alternatives, there is a high potential to encounter stratigraphic units that contain significant paleontological resources. Although the types of impacts on paleontological resources would be the same for similar projects under each alternative, the total amount of resources potentially affected would vary because the acreage associated with each alternative is different and because fossils are not uniformly distributed within a particular formation. For example, the largest area affected would be under Alternative 1 where the footprints of future tar sands development, covering a total of 430,686 acres, overlie a total of 335,396 acres of geologic formations having a high potential to contain important paleontological resources. This is followed by Alternative 4, covering a total of 425,790 acres, where development footprints overlie a total of 331,171 acres of geologic formations having a high potential to contain important paleontological resources (Table 6.2.5-1).

Impacts from tar sands development could include the destruction of paleontological resources and loss of valuable scientific information within development footprints, degradation and/or destruction of resources and their stratigraphic context within or near the development area, and increased potential for loss of exposed resources from looting or vandalism as a result of increased human access and related disturbance in sensitive areas (Section 5.4). These impacts could be avoided or minimized by applying mitigation measures during project development. Such measures include on-site monitoring by qualified paleontologists to determine whether important paleontological resources are present and to collect data from any such resources uncovered during project activities. Therefore, most of the potential adverse effects on paleontological resources are expected to be mitigated.

#### 6.2.5.4 Water Resources

The land use plan decision considered under Alternatives 1 through 4 would not cause environmental impacts on water resources. However, water resources could be adversely affected by future commercial tar sands development on these lands.

**TABLE 6.2.5-1 Available Acreage Overlying Geologic Formations with High Potential to Contain Important Paleontological Resources by Tar Sands Alternative**

| Alternative | Development Area (acres) | Area Overlying Formations with High Potential | |
|---|---|---|---|
| | | Acres | Percentage |
| 1 | 430,686 | 335,396 | 78% |
| 2 | 91,045 | 80,429 | 88% |
| 3 | 2,100 | 1,458 | 69% |
| 4 | 425,790 | 331,171 | 79% |

Alternatives 1 and 4 would affect similar numbers of stream miles (185 and 188, respectively) and would therefore be expected to have similar overall levels of impact on water quality and water quantity issues. Each alternative would potentially affect 20 perennial streams. Alternative 2 would potentially affect 125 stream miles along 12 perennial streams. For each alternative, the impacts would depend on the degree of development, the technologies, and site-specific factors. For example, steep slopes and/or locally fragile or highly erosive soils could contribute to adverse effects on water quality if disturbed. Groundwater would be impacted under the alternatives in terms of use, dewatering, and contamination. Alternative 3 would result in a comparatively minimal impact on surface water and groundwater.

#### 6.2.5.5 Air Quality

Under Alternative 3, the area encompassed by one pending tar sands lease covering about 2,100 acres of land in Utah has been allocated for commercial tar sands development. There are no air quality impacts associated with this land use designation. Impacts could result, however, from post-lease construction and operation as described in Section 5.6. Previous analyses (summarized in Appendix A, Section A.5.3 [BLM 2006a–h; 2007a,b]) for tar sands RD&D lease with similar size of footprint indicated that no significant, adverse direct or cumulative air quality impacts are likely to occur from the six RD&D projects. Thus, the pending lease project for tar sands development is expected to have no significant air quality impacts under any of the four alternatives.

The identification of areas available for application for leasing for commercial tar sands development and the associated amendment of appropriate land use plans is not expected to affect air quality under Alternatives 1, 2, and 4. However, under these alternatives, local and regional air quality and AQRVs could be affected by the construction and operation of commercial tar sands projects in the areas available for application for leasing. Under Alternatives 1, 2, and 4, the commercial development of a similar project in an area where the areas of the alternatives overlap would be expected to affect local and regional impacts on air quality and AQRVs in the same manner.

Impacts on air resources of future commercial development would be identical among Alternatives 1, 2, and 4 for similar projects located in areas common to the alternatives (i.e., in areas where these alternatives overlap). Because of the difference in the areas identified as available for application for leasing under all four alternatives, local air quality could be affected by commercial development in more locations under Alternative 1 (followed by Alternative 4) than under Alternatives 2 or 3. Many of the lands identified under Alternative 1 as being available for application for leasing are excluded from application under Alternatives 2 and 4. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of regional air quality and AQRV impacts for future commercial development under all four alternatives. Thus, it is not possible to differentiate between these alternatives regarding regional air quality and AQRV impacts.

### 6.2.5.6 Noise

Under Alternative 3, localized noise impacts (i.e., increased noise levels) would occur at the pending tar sands lease project location as a result of construction activities, mining activities, operation activities, and vehicular traffic. These same impacts would also occur under Alternatives 1, 2, and 4.

Under Alternative 3, there are no noise impacts associated with the previous designation of lands as available for application for oil shale development. Impacts could result, however, from post-lease construction and operation as described in Section 5.7. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects.

The identification of areas available for application for leasing for commercial tar sands development and the associated amendment of appropriate land use plans would not affect noise levels under Alternatives 1, 2, and 4. However, under these alternatives, local noise levels could be affected by the future construction and operation of commercial tar sands projects in the potentially leasable areas.

Impacts on noise levels from future commercial development would be identical among Alternatives 1, 2, and 4 for similar projects located in areas common to the alternatives (i.e., in areas where these alternatives overlap). Because of the difference in the areas identified under all four alternatives as available for application for leasing, local noise levels could be affected by commercial development at more locations under Alternative 1 (followed by Alternative 4) than under Alternatives 2 or 3. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of noise impacts under these alternatives or to differentiate between them.

### 6.2.5.7 Ecological Resources

**6.2.5.7.1 Aquatic Resources.** The identification of areas available for application for leasing for commercial tar sands development and the associated amendment of appropriate land use plans would not affect aquatic resources in the areas available for application for leasing. Although there are no impacts on aquatic resources associated with identifying lands available for application for leasing, impacts could result from post-lease construction and operation, as described in Section 5.8.1.1. These impacts would be considered in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The types of impacts on aquatic resources associated with construction and operations would be similar for all four alternatives. However, differences exist among these alternatives in the amount of lands that would be made available for application for leasing and the location of potential lease areas. As a consequence, there are differences among the alternatives relative to the amount of aquatic habitat that is immediately within or adjacent to the footprint of the allocation areas and in the amount of such habitat within a 2-mi zone surrounding the allocation areas. These differences are described in this section.

The greatest area of aquatic habitat affected by future commercial tar sands development would be under Alternatives 1 and 4, while Alternative 3 would affect the least amount of aquatic habitat. Immediately within areas that would be made available for application for leasing under Alternative 1, there are 9 perennial streams and about 29 total mi of perennial stream habitat that could be affected by future development. There are 9 perennial streams and about 23 total mi of perennial stream habitat immediately within the areas that would be considered for leasing under Alternative 4. When a 2-mi buffer around the areas that would become available for application for leasing is considered, there are 20 perennial streams and about 185 mi of perennial stream habitat under Alternative 1, and 20 streams and 188 total mi of stream habitat under Alternative 4 (Table 6.2.1-5). There are 7 perennial streams and about 7 total mi of perennial stream habitat immediately within the areas that would be considered for leasing under Alternative 2. When a 2-mi buffer around the areas that would become available for application for leasing is considered, there are 12 perennial streams and about 125 mi of perennial stream habitat under Alternative 2. Under Alternative 3, no perennial stream habitat is located immediately within areas that would be made available for application for leasing or within 2 mi of the lease area (Table 6.2.1-5). The specific nature and magnitude of impacts under the alternatives, as well as the specific resources affected, would depend on the location of the areas where project construction and facilities occur, the aquatic resources present in those areas, and the mitigation measures implemented.

**6.2.5.7.2 Plant Communities and Habitats.** The identification of areas available for application for leasing for commercial tar sands development and the associated amendment of appropriate land use plans would not affect plant communities and habitats in the areas available for application for leasing under any of the alternatives. However, under all four alternatives, plant communities and habitats could be affected by future construction and operation of commercial tar sands projects in the areas available for application for leasing, as described in Section 5.8.1.2. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The types of impacts associated with construction and operations would be similar for all alternatives. Potential impacts on plant communities and habitats from future project construction and operation would be identical among the alternatives for similar projects located in areas common to the two alternatives (i.e., in areas where these alternatives overlap).

Because of the difference in the areas identified under the alternatives as available for application for leasing, plant communities and habitats could be affected by future commercial development at more locations under Alternative 1 than under the other alternatives. Plant communities and habitats in Alternative 1 potential lease areas could be impacted by the construction and operation of commercial tar sands projects. Included in this acreage are about 6,874 acres of land identified in land use plans for the protection of riparian habitats, floodplains, and special status plant species. In contrast, nearly 340,000 acres of land identified under Alternative 1 (including all of the 6,874 acres identified for protection of riparian habitats, floodplains, and special status plant species) would be excluded from availability for leasing under Alternative 2. About 4,896 acres of land identified under Alternative 1 (including 15 acres identified for protection of floodplains) would be excluded from availability for leasing under Alternative 4.

Oil shale endemic plant species occur on oil shale outcrops within the available lease areas identified under Alternatives 1, 2, and 4. Because Alternatives 1 and 4 include more land area in the vicinity of oil shale outcrops than Alternative 2, there is a greater potential for impacts on oil shale endemic species under Alternatives 1 and 4.

Many ACECs located within or near the STSAs include rare plant species and/or rare or important plant communities. Under Alternative 1, one such ACEC is partially included within the footprint of lands available for application for leasing (Table 6.2.5-2). Direct and/or indirect impacts could occur within this ACEC, although stipulations addressing sensitive resources apply to this area. Six additional ACECs are located adjacent to or near (within 5 mi) the Alternative 1 footprint and could be impacted indirectly; impacts would generally decrease with increasing distance. Five ACECs are located adjacent to or near the Alternative 2 footprint, and seven ACECs are located adjacent to or near the Alternative 4 footprint. Sensitive plant species or communities within these ACECs could be impacted indirectly. No ACECs are located adjacent to or near the Alternative 3 footprint.

**6.2.5.7.3 Wildlife.** There would be no impacts on wildlife species associated with identifying lands as available for application for commercial tar sands leasing. Impacts could result, however, from post-lease construction and operation as described in Section 5.8.1.3. These impacts would be considered in greater detail in project-specific NEPA analyses that would be conducted at the commercial lease and development phases of projects. The types of impacts on wildlife species associated with construction and operation would be similar for all alternatives. Differences among alternatives exist in the amount of lands that would be made available for application for leasing and the location of areas protected from lease development. These differences are described in this section.

Impacts on wildlife and their habitats (see Section 5.1.8.3) would be identical under all four alternatives for similar projects located in areas common to the alternatives (i.e., in areas where land available for development overlap). Because of the difference in the areas identified

**TABLE 6.2.5-2 ACECs with Sensitive Plant Species and/or Sensitive Plant Communities in or near Lands Available for Lease Application under the Tar Sands Alternatives**

| ACEC | Distance from Footprint (mi) | | | |
|---|---|---|---|---|
| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| Red Mountain-Dry Fork | 3.1 | >5 mi | >5 mi | 3.1 |
| Raven Ridge | 1.9 | 2.3 | >5 mi | 1.9 |
| Pariette Wetlands | Adjacent | 0.9 | >5 mi | Adjacent |
| Nine Mile Canyon | Within | Adjacent | >5 mi | Adjacent |
| Cottonwood-Diamond Watershed | 0.6 | >5 mi | >5 mi | 0.6 |
| San Rafael Reef | Adjacent | 0.3 | >5 mi | Adjacent |
| Leers Canyon | Adjacent | 2.9 | >5 mi | Adjacent |

under the alternatives as available for application for leasing, wildlife and their habitats could be affected by subsequent commercial development at more locations under Alternative 1 than under the other three alternatives. Alternative 1 identifies 430,686 acres as available for application for leasing; Alternative 2 identifies 91,045 acres as available for application for leasing; Alternative 3 identifies 2,100 acres as available for application for leasing; and Alternative 4 identifies 425,790 acres as available for application for leasing. Wildlife and their habitats in these areas could be impacted by the construction and operation of commercial tar sands projects.

Table 6.2.5-3 shows the comparison among the four alternatives in the amount of wildlife habitat identified for protection by stipulations identified in BLM RMPs. Table 6.2.5-4 shows the acreage of state-identified mule deer and elk habitat present in the oil shale lease areas identified under the four alternatives. The number of acres of wild horse and burro HMAs present in the tar sands lease areas for each alternative are as follows: 77,409 for Alternative 1, 17,572 for Alternative 2, none for Alternative 3, and 77,287 for Alternative 4.

**6.2.5.7.4 Threatened, Endangered, and Sensitive Species.** The amendment of land use plans to identify areas available for application for leasing for commercial tar sands development would not affect threatened and endangered species in the areas available for application for leasing identified under any of the four alternatives. However, under all alternatives, threatened and endangered species and their habitats could be affected if the construction and operation of commercial tar sands projects occur in the lease areas in the future.

Of the four alternatives under consideration, the least amount of land would be available for application for commercial leasing under Alternative 3 (2,100 acres), intermediate amounts

**TABLE 6.2.5-3 Wildlife Habitat Protected by Stipulations in BLM RMPs within the Alternative 1, 2, 3, and 4 Tar Sands Lease Areas**

| | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| Habitat Description | Alternative 1[a] | Alternative 2 | Alternative 3 | Alternative 4[a] |
| ***Birds*** | | | | |
| Raptor nests | 7 | 0 | 0 | 5 |
| ***Mammals*** | | | | |
| Elk crucial winter range | 112,809 | 0 | 0 | 112,809 |
| Elk calving habitat | 26,804 | 0 | 0 | 26,804 |
| Mule deer crucial winter range | 96,564 | 0 | 0 | 96,564 |
| Mule deer fawning habitat | 23.584 | 0 | 41 | 23,584 |
| Mule deer migration corridor | 41,588 | 0 | 0 | 41,588 |

[a] Acreages may be overestimated because of the unknown degree of habitat overlap among species or habitat types for a species. For these reasons, columns should not be totaled.

**TABLE 6.2.5-4 State-Identified Elk and Mule Deer Habitat Present in the Tar Sands Lease Areas Identified under Alternatives 1, 2, 3, and 4**

| Habitat Description | Area of Habitat (acres) | | | |
|---|---|---|---|---|
| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
| ***Mule Deer*** | | | | |
| Winter habitat | 228,122 | 57,708 | 1,729 | 225,508 |
| Summer habitat | 77,172 | 17,110 | 0 | 77,172 |
| ***Elk*** | | | | |
| Winter habitat | 194,354 | 52,361 | 0 | 198,324 |
| Summer habitat | 65,366 | 17,170 | 0 | 65,366 |

under Alternatives 2 and 4 (91,045 and 425,790 acres, respectively), and the most under Alternative 1 (430,686 acres). The difference in acreage results in a potential difference in the number of threatened and endangered species that could occur in the STSAs.

There are 71, 63, 36, and 66 federal candidate, BLM-designated sensitive, or other special status species that potentially occur in areas that are available for application for leasing under Alternatives 1, 2, 3, and 4, respectively. There are 20, 20, 7, and 22 federally listed species that potentially occur in areas that are available for leasing under Alternatives 1, 2, 3, and 4, respectively (Table 6.2.5-5).

Alternatives differ in the amount of critical habitat for the Mexican spotted owl that is contained within areas available for application for commercial leasing. There are approximately

**TABLE 6.2.5-5 Threatened and Endangered Species and Selected Habitats Present in Potential Lease Sale Areas That Could Be Affected by Future Commercial Tar Sands Development**

| Resource That Could Be Affected by Development in the STSAs | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Number of federal candidates, BLM-designated sensitive species, and other special status species | 58 | 50 | 23 | 53 |
| Number of federally listed species | 20 | 20 | 7 | 22 |
| Acres of critical habitat for the Mexican spotted owl | 2,200 | 471 | 0 | 27,200 |
| Acres of core and priority habitat areas for the greater sage-grouse | 117,716 | 0 | 2,123 | 87,780 |

2,200, 471, and 27,200 acres of critical habitat for the Mexican spotted owl associated with Alternatives 1, 2, and 4, respectively. There are no critical habitats associated with Alternative 3 (Table 6.2.5-5). The amount of core and priority habitats for the greater sage-grouse also differs by alternative. The greatest amount of core and priority habitat for the greater sage-grouse is associated with Alternative 1 (117,716 acres); there are intermediate amounts of core and priority habitats associated with Alternatives 3 and 4 (2,123 and 87,780 acres, respectively). There are no core and priority habitats for the greater sage-grouse associated with the lands available under Alternative 2 (Table 6.2.5-5).

#### 6.2.5.8 Visual Resources

Under all alternatives, the amendment of land use plans to identify areas available for application for leasing for commercial tar sands development would not affect visual resources within or in the vicinity of the lease areas identified. However, a number of potential sensitive visual resources are present within, and in the vicinity of, the potential lease areas identified by the alternatives. These sensitive visual resource areas could be affected if construction and operation of commercial tar sands projects occur in the future in the areas identified as available for commercial leasing.

The visual resources that could be affected by the future construction and operation of commercial tar sands projects would be identical under the alternatives for similar projects located in potential lease areas common to the alternatives (i.e., where the lease areas would overlap). Under Alternative 1, 430,686 acres of public land would remain available for application for commercial tar sands leasing. Under Alternative 4, the BLM would designate 425,790 acres available for application for leasing, or 12,248 fewer acres than the 430,686 acres available under Alternative 1. While Alternative 4 has fewer acres of land than Alternative 1, there is relatively little difference between the alternatives in the number and types of sensitive visual resource areas that could be affected by future commercial development.

Under Alternative 2, the BLM would designate 91,045 acres of public land available for application for commercial tar sands leasing, about 340,000 fewer acres than under Alternative 1 and about 340,000 fewer acres than under Alternative 4. Thus the numbers of sensitive visual resource areas that could be affected by future commercial development in or near these lands would be expected to be much smaller under Alternative 2 than under Alternative 1 or 4.

Under Alternative 3, the BLM would designate only about 2,100 acres of public land available for application for commercial tar sands leasing, about 429,000 acres less than under Alternative 1, about 89,000 fewer acres than under Alternative 2, and about 417,000 fewer acres than under Alternative 4. Thus the number of sensitive visual resource areas that could be affected by future commercial development in or near these lands would be expected to be extremely small under Alternative 3 relative to Alternative 1, 2, or 4.

#### 6.2.5.9 Cultural Resources

Table 6.2.5-6 identifies the amount of available acreage that has the potential to contain important cultural resources under each of the alternatives. Under Alternative 1, 35,749 acres of the 430,686 acres available for application for commercial leasing have been surveyed for cultural resources. This acreage includes existing ACECs not closed to mineral development that contain important cultural resources. Adverse effects on cultural resources, as described in Sections 4.10 and 6.1.2, could occur in these areas as a result of future commercial development.

Alternative 2 excludes areas with sensitive resources and special designations from consideration, resulting in 91,045 acres being available for application for leasing and development. Approximately 5,640 acres of the area identified under Alternative 2 have been surveyed for cultural resources. These surveys found 154 sites.

Under Alternative 3, 2,100 acres in the Asphalt Ridge STSA in Utah could be impacted by the pending tar sands lease or any future lease in this area. Cultural resource surveys have not examined the area in Utah. Three archaeological sites are reported in the Asphalt Ridge STSA but not within the Alternative 3 area (Section 6.2.3.9). Mitigation may be required to be applied in the development of these projects should significant cultural resources be encountered. Therefore, most of the possible adverse effects on cultural resources are expected to be mitigated. Any impacts from the pending tar sands lease activities, or future lease activities in this area, as well as the mitigation measures, would also occur under the other alternatives.

**TABLE 6.2.5-6 Available Acreage under Each Alternative with the Potential to Contain Cultural Resources**

| Parameter | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Acres available for application for leasing and development | 430,686 | 91,045 | 2,100 | 425,790 |
| Acres surveyed[a] | 35,749 | 5,642 | 0 | 37,841 |
| Percentage of area surveyed | 8% | 6% | 0 | 9% |
| Number of sites recorded | 577 | 154 | 3 | 440 |
| Acres of high or medium sensitivity to contain cultural resources | 242,200 | 59,568 | NA[b] | 239,054 |
| Percentage of area with high or medium sensitivity | 56% | 65% | NA | 57% |

[a] This acreage is from block acre surveys only and does not include linear miles of survey.

[b] NA = not applicable.

Under Alternative 4, the amount of acreage available for application for commercial leasing is reduced from that of Alternative 1 to 425,790 acres, out of 430,686 acres. The amount of land surveyed for cultural resources under Alternative 4 is comparable to that under Alternative 1. The relative amount of survey for Alternative 4 is 9%, while Alternative 1 has 8% of the area surveyed. Therefore, based on current information, the potential for effects on cultural resources is expected to be similar under Alternatives 1 and 4. Alternatives 2 and 3 offer the greatest protection to cultural resources within the study areas.

#### 6.2.5.10 Indian Tribal Concerns

The types of impacts on resources important to Native Americans would be similar under all four tar sands alternatives. The variation would be mostly in scale. Archaeological sites associated with Native Americans and features such as rock art would be identified in cultural resources surveys. Table 6.2.5-5 shows how much land with a high or medium sensitivity for cultural resources would be available for application for leasing in each alternative. Broadly speaking, the more culturally sensitive land that is available for application for leasing, the higher the probability that resources important to Native Americans could be potentially impacted. As shown in Table 2.4.2-1, the largest amount of land would be available under the No Action Alternative (Alternative 1). Alternative 4 (Moderate Development) makes a similar amount available, while Alternative 2 (Conservation Focus) would make less than a quarter of the amount available under Alternatives 1 and 4 available for application for leasing. The least land would be made available under Alternative 3 (Pending Commercial Lease). Conversely, the most proactive protection of lands through special designation and attendant use restrictions would occur under Alternative 2. Fewer lands are protected by exclusion under Alternatives 1 and 4. Alternative 1 restricts exclusions to those in the current land use plans, while Alternative 4 would add ACEC acreage identified since the 2008 OSTS PEIS and ROD. All proposed tar sands extraction technologies would involve widespread surface disturbance. Surface mining, with the highest potential for disturbing resources important to Native Americans, would be considered under all alternatives with the possible exception of Alternative 3. Under all alternatives, project-specific NEPA evaluations and NHPA Section 106 surveys would be required, along with their attendant consultation requirements. These procedures and other BLM regulations would ensure that Native Americans would be given an opportunity to identify culturally important resources and propose means of eliminating or mitigating adverse impacts; this could result in lease stipulations specific to the parcels being considered for leasing and in avoidance and/or protection of culturally important resources through changes in design and development plans.

#### 6.2.5.11 Socioeconomics

Alternative 1, with 430,686 acres, would make the greatest amount of land available for application for leasing, and Alternative 3, with 2,100 acres, the least amount of land. Alternative 4, with 425,790 acres, would provide nearly as many acres as Alternative 1, while Alternative 2, with 91,045 acres, would provide an intermediate amount of land available for leasing. However, because of the need for project- and site-specific information, it is not possible to identify the nature and magnitude of socioeconomic or transportation impacts of commercial tar sands development under Alternatives 1 through 4. Thus, it is not possible to differentiate among these alternatives regarding either socioeconomic or transportation impacts.

Also, since none of the alternatives impose a cap on the level of development that may occur, the level of future development could be the same under each alternative.

### 6.2.5.12 Environmental Justice

Because it is not possible to quantify the environmental justice impacts of the commercial development that would be made possible under any alternative at this time, it is not possible to definitively conclude which of these alternatives would result in the greatest impacts.

### 6.2.5.13 Hazardous Materials and Waste Management

The amendment of land use plans to identify areas available for application for leasing for commercial tar sands development would not result in hazardous material and waste being generated within or in the vicinity of the areas available for application for leasing under Alternatives 2, 3, and 4. However, the construction and operation of commercial tar sands projects in the areas available for application for leasing would use hazardous materials and generate wastes under all three alternatives.

Because the use of hazardous materials and the generation of wastes are related to the specific design of a commercial tar sands project rather than project location, it is not possible to differentiate among all four alternatives as to the hazardous materials and waste that could be used or generated during commercial tar sands construction and operation. For similar commercial tar sands projects (similar in design and operation), the hazardous materials and wastes associated with projects developed under all alternatives would be similar. Because of the larger amount of land that would be made available for leasing under Alternatives 1 and 4, the use and/or generation of hazardous materials and wastes could occur at more locations under Alternatives 1 and 4 than under Alternatives 2 and 3. For a given tar sands development, the impacts of hazardous material and waste handling (storage, use, and disposal) would be expected to be similar under all alternatives regardless of project location (Section 5.13.1).

### 6.2.5.14 Health and Safety

The amendment of land use plans to identify areas available for application for leasing for commercial tar sands development also would not result in health and safety issues within or in the vicinity of the areas identified as available for application for leasing under Alternatives 2 through 4. The future construction and operation of commercial tar sands projects, however, would have identical health and safety concerns under all alternatives for projects with identical plans of development located in potential lease areas common to the alternatives (i.e., where the areas would overlap). Potential impacts could occur from accidents causing injuries and fatalities, possible hearing loss from high noise levels, and inhalation of particulates and/or VOCs emitted from the facilities. Construction and operation of individual facilities under any alternative statistically would be expected to result in less than 1 fatality per year, and approximately 100 injuries per year during construction and 30 injuries per year during operations. The general public could have health impacts associated with exposure to emissions from tar sands facilities, but in the absence of site-specific and process-specific data, no differences among the health and safety impacts of all four alternatives can be identified.

Differences in health and safety concerns among the four alternatives would be largely associated with differences in individual project designs and, to a lesser degree, differences in the locations of individual projects. For example, projects requiring longer transportation routes and longer utility and pipeline ROWs would have a greater potential for transportation accidents as well as ROW construction-related accidents. It is not possible to quantify differences in health and safety impacts under Alternatives 1, 2, 3, or 4 in this PEIS. Under any of the alternatives, health and safety issues would be evaluated at the project level (i.e., as part of project-specific NEPA analyses), and comprehensive facility health and safety plan and worker safety training would be required as part of the plan of development for every proposed commercial tar sands project.

### 6.2.6 Cumulative Impacts

In its regulations implementing the procedural provisions of NEPA (40 CFR Part 1508.7), the CEQ (1997) defines cumulative effects as follows:

> "the impact on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The proposed action analyzed in this PEIS is to amend land use plans to allow certain lands to be considered for commercial leasing for tar sands development and identify certain lands as being excluded from such future consideration. That is, the decision made at the plan level does nothing more than remove (or leave in place) the administrative barrier (plan conformance) to the BLM considering any applications for leasing. The plan amendments would open the areas in question for leasing. The phrase "available for application for leasing" is used above, and throughout the PEIS, rather than simply "available for leasing" to highlight that, unlike the BLM's practice with respect to oil and gas leasing, additional NEPA analysis would be required prior to the issuance of any lease of oil shale or tar sands resources. Amendment of the RMPs does not authorize any ground-disturbing activities and is not an irreversible or irretrievable commitment of resources under NEPA (see 40 CFR 1502.16). Moreover, amendment of RMPs does not constitute the granting of any property right. In this respect, the limited scope and scale of the proposed action of amending the land use plans—and any potential environmental impacts of these amendments—necessarily results in the need for only a limited cumulative effects analysis in this PEIS. Analysis of the cumulative effects in this PEIS will be qualitative to reflect the limited and highly speculative character of the information available, and the limited nature of the decision to be made on the basis of this PEIS.[29] At the leasing decision and at the decision to approve a plan of development, more specific cumulative effects analyses would be appropriate, and such analysis would be able to be completed because specific technical and environmental information for those analyses should be available.

As stated above and in Sections 6.2.2 and 6.2.3, with the possible exception of a change in local property values, there would be no environmental or socioeconomic impacts under Alternative 2, 3, or 4 from the amendment of land use plans to identify lands as available or not available for application for commercial tar sands leasing. Therefore, there would be no cumulative impacts from these alternatives. However, direct, indirect, and cumulative impacts could occur as a result of future commercial tar sands development that could be facilitated by such land use plan amendments. The focus of this cumulative impacts assessment, then, is the impacts from this future development, rather than the impacts from the land use plan amendment decision. That is, the purpose of this cumulative impacts assessment is to discuss, in a qualitative way, how the environmental and socioeconomic conditions within the study area might be incrementally affected over the next 20 years (the study period) by tar sands development that could occur on lands made available for application for commercial leasing by the land use plan amendments under any of Alternatives 2 through 4.

This section describes, in a preliminary way, the possible cumulative impacts of potential commercial tar sands development that could occur over the next 20 years. More specific information regarding impacts, including cumulative impacts, would be provided by the analysis conducted at any future leasing stage and at the review of any project-specific plan of development. The impacts presented here are in the context of other major activities in the study areas on both BLM-administered and nonfederal lands that could also affect environmental resources and the socioeconomic setting. The cumulative impacts assessment also would be applicable for tar sands development that could occur on CHL leases. The study areas considered usually include the lands managed by a BLM field office that contain tar sands resources and the ROI counties associated with them, as defined in Table 3.10.2-1. Larger areas are considered for certain resources (e.g., land, air, and water). This section considers five major categories of activities that could have cumulative impacts: oil and gas development, coal mining and preparation, other minerals development, energy infrastructure development, and other activities (e.g., tar sands development, grazing, fire management, forestry, and recreation). Section 6.2.6.3 presents the possible cumulative impacts of potential commercial tar sands development that could occur under each of the alternatives and addresses the same resources analyzed in Sections 5.2 through 5.14.

The current status of resources (including past and present actions) is described in Chapter 3. This section focuses on the cumulative impacts of the possible tar sands development that could occur under Alternatives 2, 3, and 4, when added to a set of reasonably foreseeable future actions that are projected to occur or that could occur over the next 20 years (as described

[29] Oil shale and tar sands development could not occur until a leasing decision has been made and implemented (leases issued). After leases are issued, additional permits and environmental analysis would be required before operations could begin.

in Section 6.2.6.2). These projections were drawn from a variety of sources, as indicated in the text, but include developments on both BLM-administered and nonfederal lands. The accuracy of such projections is greatest during the first few years of the 20-year period and decreases over the time frame assessed. In particular, future levels of tar sands development are unknown. For the purposes of analysis, this cumulative impacts assessment looks at the incremental impacts of a single tar sands facility (as described in Section 5.1), recognizing that more than one of these facilities may be brought into operation during the study period. While the cumulative impacts described in this section represent an initial estimate of impacts for activities projected to occur in the 20-year time frame, the assessment would require reevaluation if the planned level of development changes drastically in the future.

However, because under all alternatives, there is a lack of information on the magnitude of future actions on public land, the number of projects that might be undertaken, and the likely locations for future development, the magnitude of the differences among the cumulative effects of the alternatives cannot be identified (i.e., the same level of future development might occur under each alternative).

### 6.2.6.1 Overview of Assumptions and Impact-Producing Factors of Major Activities in the Study Area

**6.2.6.1.1 Oil and Gas Development.** For both federal and nonfederal lands, oil and gas development is associated with impact-producing factors in resource areas such as water use, the production of wastes and water, contaminant emissions to air and water, the use and alteration of land, and potential oil spills. The environmental impacts of oil and gas drilling are highly variable and depend on the depth of drilling, drilling methods used, and whether multiple wells per drill pad are constructed. Table 6.2.6-1 summarizes the estimated impacts of oil and gas drilling on a per-well basis for select resource areas.

**TABLE 6.2.6-1 Assumptions Associated with Oil and Gas Drilling**

| Impact-Producing Factor | Values Used in Impact Analysis (per well drilled) | Reference |
|---|---|---|
| Surface disturbance (acres) | 2.5–15 | Thompson 2006a; DOE 2006; BLM 1994, 2002a, 2005a, 2006i |
| Water use (ac-ft/yr) | 0.55 | BLM 2006i |
| Drilling waste (bbl) | 4,100 | DOE 2006 |
| Regulated emissions ($CO$, $SO_2$, $NO_x$) (tons) | 0.37 | DOE 2006 |
| $CO_2$ emissions (tons) | 97 | DOE 2006 |
| Other nonregulated emissions ($CH_4$, non-$CH_4$ hydrocarbons) (tons) | 0.17 | DOE 2006 |
| Amount of oil spilled (gal) | 24 | DOE 2006 |
| Employment (direct FTEs) | 3 | BLM 2006i |

Rough estimates of overall resource requirements for oil and gas drilling are available from several sources. The BLM is continuing to improve the way it manages oil and gas operations, in particular, establishing BMPs to minimize environmental effects. Many of these specific mitigation measures reduce surface impacts and are applied as conditions of approval prior to operations on a lease. For wells on federal lands, the amount of surface disturbance for each well has been decreasing from about 3 to 1.5 acres per well or less. It is expected that standard industry practices in accordance with existing regulations are used for installation of oil and gas wells on private lands. For the purpose of analysis, it is assumed that the amount of land disturbed for oil and gas well installation on either federal or nonfederal lands varies from 2.5 to 15 acres per well. The higher end of the range is certainly an overestimate in locations where multiwell pads would be used (e.g., the Roan Plateau amendments call for 17 wells per pad atop the plateau) (BLM 2006i). In addition, only about 60% of the initially disturbed area would have long-term surface disturbance; the other 40% generally would be revegetated within 2 years (BLM 2006i).

**6.2.6.1.2 Coal Mining and Preparation.** Impact-producing factors for coal mining and preparation (e.g., removal of sulfur) on either federal or nonfederal lands include water use, contaminant emissions to air and water, use and alteration of land, and occupational hazards. These factors are discussed in DOE (1988) and summarized for select resource areas in Table 6.2.6-2. As is the case with oil and gas operations, the BLM is improving its management of coal operations by establishing BMPs to minimize environmental effects. Many specific mitigation measures reduce surface impacts and are applied as conditions of approval prior to operations on a lease.

**6.2.6.1.3 Other Minerals Development.** Although several metals and minerals materials are mined in Utah, most are not mined in the counties that might experience tar sands development. The predominant materials currently mined in these areas are sand and gravel.

Sand and gravel deposits are found in river and stream terraces, floodplains, and channels, both current and ancient. These deposits are a type of salable mineral. Extraction of instream sand and gravel deposits could result in adverse environmental impacts, such as changes in streamflow and increased turbidity, which would affect fisheries and recreational use. Extraction of sand and gravel from floodplains or low terraces could create new channels and alter sediment deposition, again adversely affecting the ecology of the nearby river or stream. Other general impacts from sand and gravel mining could include land disturbance, changes in groundwater quality, noise, dust, and visual changes. The proper management of sand and gravel mining and the application of mitigation could decrease impacts such that there would be minimal adverse impacts. For example, siting mining locations high up in the landscape (on floodplains and terraces rather than in stream channels) would decrease adverse impacts on stream hydrologic processes (Langer 2002).

Other materials mined in on near the potential tar sands development area include clay, gilsonite, gold, sandstone, sodium minerals, and uranium. These metals and minerals may be obtained through underground mining, surface (open pit) mining, or solution mining. Gold is

**TABLE 6.2.6-2 Assumptions Associated with Coal Mining and Preparation[a]**

| Impact-Producing Factor | Values Used in Impact Analysis: Per Million Tons Surface Mined | Values Used in Impact Analysis: Per Million Tons Underground Mined |
|---|---|---|
| Surface disturbance (acres) | | |
| Areas for facilities | 4.3 | 4 |
| Strip mining | 20 | NA[b] |
| Waste storage | 2.6 | 1 |
| Water use (million gal) | | |
| Coal preparation | 20 | 20 |
| Dust control | 35 | 35 |
| Air emissions (tons)[c] | | |
| CO | 15 | 6.3 |
| $SO_2$ | 4.9 | 0.59 |
| $NO_x$ | 76 | [d] |
| Particulates | 4 | 0.48 |
| Fugitive dusts[e] | 1,870 | [d] |
| Hydrocarbons | 4.8 | 0.48 |
| Aldehyde | 1.2 | d |
| Diesel fuel use ($10^3$ gal) | 3,021 | 38 |
| Electricity use ($10^6$ MWh) | 6 | 39 |
| Employment (direct FTEs) | 180 | 460 |
| Occupational hazards (deaths per 100,000 workers, disabling injuries per 100 workers) | 0.07, 8 | 0.37, 45 |

[a] Coal is prepared to increase its quality and heating value by removing sulfur and ash-forming constituents.

[b] NA indicates information not available.

[c] Surface mining values are for the western United States; underground values are for the eastern United States.

[d] Unquantified or negligible.

[e] Based on estimates for an Illinois surface mine with the following controls: paved access roads, watered and unpaved haul roads, and enclosed coal dumps with baghouse. Without these controls, estimated fugitive dust emissions would be 3,030 tons.

Source: DOE (1988).

mined by using both surface and underground methods. Mining of these substances can cause a variety of adverse environmental impacts, including the production of high volumes of solid and potentially hazardous waste; the contamination of surface water and groundwater; uncontrolled releases of produced water; land subsidence; physical instability of mine units; and air quality degradation, especially from particulate emissions. Uranium has an added potential for radiologically contaminating environmental media, leading to the subsequent possibility of exposures of biota and humans.

Metal mining historically has also caused contamination of surface water. The sources of contamination have included waste rock disposal, tailings, leaching sites (locations where valuable metals are collected by running solutions through the ore), and mine water. Depending on the local geology, the waste rock may contain other naturally occurring minerals that could be toxic to biota, including arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and nickel. In addition, cyanide (a highly toxic substance composed of carbon and nitrogen) is used extensively in the mining industry to aid in metal extraction. Serious adverse impacts on surface water from metal mining have occurred when runoff from waste sources has entered nearby water bodies; these impacts have included degradation of aquatic habitat and contamination of drinking water supplies. Additional adverse impacts can occur as a result of erosion and increased sedimentation of surface water.

An environmental impact from metal mining is the large volume of waste generated. The product-to-waste ratio can be very high; for example, in gold mining, almost all the material removed from the earth (99.99%) is waste rock and tailings. Another area of concern is air quality degradation. Many metal mining operations generate large volumes of fugitive dust from ore crushing and loading, blasting, and, over time, from dried-up tailings ponds.

Many of the adverse impacts from mining discussed above occurred primarily in the past, and mitigation measures have been adopted to minimize their occurrence in present practice. Because of the wide variety of possible contaminants and impacts from mining of metals and other minerals, generic impacts (e.g., on a “per-ton-mined” basis) are not discussed in this section. Cumulative impacts are discussed in Section 6.2.6.3 on the basis of the specific types of minerals being developed in each region.

#### 6.2.6.1.4 Energy Infrastructure Development.

***Energy Corridors.*** The western states have an extensive infrastructure of oil and gas pipelines and electricity transmission ROWs. Most of the existing ROWs cross public lands (National Energy Policy Development Group 2001). As of 2010, Colorado had 6,738, Utah had 6,040, and Wyoming had 18,852 ROWs crossing public lands (BLM 2010a). These ROWs serve as either long-distance paths or subregional and local distribution lines. It is projected that the growing demand for additional energy and electricity will result in an increased number of ROWs across public lands in the future (National Energy Policy Development Group 2001). Other federal agencies authorized to grant ROWs for electric, oil, and gas transmission include the USFS, the NPS (electric only), the USFWS, the BOR, and the Bureau of Indian Affairs.

The BLM, along with DOE, issued a PEIS (DOE and DOI 2008) to support designation of public lands for potential use for long-distance energy transmission corridors in the West. This was an effort to expedite permitting of transmission systems, such as oil and gas pipelines and power lines (DOE and DOI 2008). The ROD for that PEIS (BLM 2009) designates federal energy corridors on public lands in areas that would be beneficial for energy development but excluded sensitive lands (such as National Parks and National Monuments, ACECs, and roadless areas) to the extent practicable. Consideration is given to the locations of tar sands deposits, and possible corridor locations have been designated relatively near to these areas for future use if the tar sands resource is developed. The designation of public lands for potential use in energy transmission ROWs as proposed under the West-wide Energy Corridor PEIS (DOE and DOI 2008) would not have direct impacts, with the possible exception of affecting current land use within the corridors and property values on private lands adjacent to or between corridor segments.

The eventual construction and operation of energy transmission ROWs, whether within federally designated energy corridors, within energy corridors on federal lands currently identified in land use plans, or at locations on nonfederal lands identified by industry and evaluated and authorized by appropriate federal agencies (e.g., BLM, USFS, and tribes), could result in adverse environmental impacts on federal and nonfederal lands. The specific types, magnitudes, and extent of project-specific impacts would be determined by the project type, that is, transmission line or pipeline and its length and location on federal and nonfederal lands; thus, the impacts could be evaluated only at the project level. However, general potential impacts typical of project construction and operation include the use of geologic and water resources; soil disturbance and erosion; degradation of water resources; localized generation of fugitive dust and air emissions from construction and operational equipment; noise generation; disturbance or loss of paleontological and cultural resources and traditional cultural properties; degradation or loss of fish and wildlife habitat; disturbance of resident and migratory fish and wildlife species, including protected species, degradation or loss of plant communities, increased opportunity for invasive vegetation establishment, alteration of visual resources, land use changes, accidental release of hazardous substances, and increased human health and safety hazards. Construction and operation of energy-transmission ROWs could also affect minority and low-income populations on both federal and nonfederal land as well as local and regional economies in the vicinity of the projects.

***Electric Power Plants.*** Impacts from electric power generating plants include emissions of air pollutants, water use, production of large volumes of solid waste (e.g., coal combustion products [ash] and flue-gas cleanup waste), use and alteration of land, emissions and accidents associated with the transportation of raw materials and wastes, and socioeconomic impacts. Air emissions differ depending on the quality of feed coal utilized. Electric power plants are generally sited on private lands. Table 6.2.6-3 summarizes the estimated impacts on various resource areas from the construction and operation of electric power plants. In the near term, it is most likely that low-sulfur Wyoming coal would be utilized for power plants in the study area. In this PEIS, it is assumed that the tar sands projects considered under all alternatives would be powered from existing power plants. However, additional electric power might be required over the study period to support new development.

1 **TABLE 6.2.6-3 Assumptions Associated with Coal-Fired Power Plants[a]**

| | Assumed Values | |
|---|---|---|
| Impact-Producing Factor | 1,500-MW Plant[b] | 360-MW Current Design Plant and 425-MW NSPS Plant[c] |
| Land use (acres) | 3,000 total (includes construction acreage) | NA[d] |
| Water use (ac-ft/yr) | 8,000 ac-ft/yr | NA |
| Fuel source and composition | Wyoming-grade low-sulfur coal (0.47% sulfur, 6.4% ash); heat of combustion, 8,220 Btu/lb[e] | Illinois No. 6 bituminous (4% sulfur, 0.1% chlorine, 1.1% nitrogen, 10% ash dry basis); heat of combustion, 10,800 Btu/lb |
| Fuel requirements | 3.75 million tons/yr (2,330 tons/yr/MW)[f] | Current plant, 1.6 million tons/yr (4,320 tons/yr/MW); NSPS plant, 1.7 tons/yr (3,950 tons/yr/MW) |
| Coal combustion products (ash)[g] | NA | Current plant, ~36,000 kg/GWh; NSPS plant, ~33,000 kg/GWh |
| Solid waste (flue-gas cleanup) | NA | Current plant, ~86,000 kg/GWh; NSPS plant, ~92,000 kg/GWh |
| Emissions | | |
| $SO_2$ | Meet NSPS standards, 258 g/GJ heat input (0.6 lb/million Btu) | Current plant, 6,400 kg/GWh; NSPS plant, 2,229 kg/GWh |
| $NO_x$ | Meet NSPS standards, 258 g/GJ heat input (0.6 lb/million Btu) | Current plant, 3,039 kg/GWh; NSPS plant, 2,041 kg/GWh |
| CO | NA | Current plant, 134 kg/GWh; NSPS plant, 123 kg/GWh |
| $CO_2$ | NA | Current plant, ~970,000 kg/GWh; NSPS plant, ~890,000 kg/GWh |
| Particulates | Meet NSPS standards, 13 g/GJ heat input (0.03 lb/MMBtu) | Current plant, 135 kg/GWh; NSPS plant, 123 kg/GWh |
| VOCs | NA | Current plant, 16 kg/GWh; NSPS plant, 14 kg/GWh |
| Employment (direct FTEs)[h] | Construction, 800 average over 4 yr (1,200 peak); operations, 135 | NA |

**TABLE 6.2.6-3 (Cont.)**

| | Assumed Values | |
|---|---|---|
| Impact-Producing Factor | 1,500-MW Plant[b] | 360-MW Current Design Plant and 425-MW NSPS Plant[c] |
| Transportation | 12 trains/week; 100 cars/train; 10,000 tons/train | 13–14 trains/week; 17 cars/train; 1,445 tons/train |

[a] Power plants are assumed to operate at 60% efficiency; thus, a 1,500-MW plant generates approximately 7,900 GWh/yr; a 325-MW plant generates 1,900 GWh/yr; and a 425-MW plant generates 2,200 GWh/yr.

[b] Source: BLM (2007d).

[c] NSPS = new source performance standard. Source: Spath et al. (1999).

[d] NA indicates information not available.

[e] Representative data from Powder River Basin coal. Source: Ellis et al. (1999).

[f] Sources for fuel requirement and transportation assumptions are Thompson (2006b,c).

[g] Coal combustion products may not require disposal in landfills. The EPA sponsors a beneficial reuse program (EPA 2008).

[h] Source for FTE employment values is Thompson (2006b).

Sources: BLM (2007d); Ellis et al. (1999); Spath et al. (1999); Thompson (2006b,c).

***Renewable Energy.*** The BLM and USFS have proposed a program to facilitate geothermal leasing on lands administered by the BLM and the USFS that have geothermal potential in 12 western states, including Alaska. Under the proposal, the BLM and USFS would identify public and NFS lands with geothermal potential as being legally open or closed to leasing; issue or deny geothermal lease applications pending as of January 1, 2005; identify public lands that are administratively closed or open, and under what conditions; develop a comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands; and amend BLM land use plans to adopt the resource allocations, stipulations, BMPs, and procedures. The program is described and analyzed in the Final PEIS for Geothermal Leasing in the Western United States published in October 2008 (BLM 2008g). A ROD for the program was issued in December 2008 (BLM 2008h).

On March 11, 2009, the Secretary of the Interior issued Secretarial Order 3285, which announced a policy goal of identifying and prioritizing specific locations best suited for utility-scale production of solar energy on public lands (Secretary of the Interior 2010). The Secretarial Order directs the DOI to work with individual states, tribes, local governments, and other interested stakeholders to identify appropriate areas for generation and necessary transmission of solar energy, to develop BMPs for renewable energy and transmission projects on public lands to ensure the most environmentally responsible development and delivery, and to establish clear policy direction for authorizing the development of solar energy on public lands. The proposed

Solar Energy Development Program has been designed to meet these requirements and to serve as an analytical tool to assist the BLM in considering replacement of its current solar energy development policy with a comprehensive Solar Energy Development Program that would allow the permitting of future solar energy projects to proceed in a more standardized and efficient manner. The program is described and analyzed in the Draft Solar PEIS published in December 2010 (BLM and DOE 2010) and the Supplement to the Draft Solar PEIS published in October (2011).

**6.2.6.1.5 Other Activities.**

***Oil Shale Development.*** This PEIS addresses the environmental and socioeconomic impacts of land use plan amendments and potential development for both oil shale and tar sands, and thus potential oil shale development must be considered in the cumulative impact assessment for tar sands development. Because the level of oil shale development over the next 20 years is unknown, this assessment has assumed that one oil shale facility could be constructed and operated in or near any one of the Utah STSAs during the study period. This oil shale facility could be on the PRLA associated with the Utah RD&D facility, on federal land within the footprint of all four oil shale Alternatives 1 through 4, or on nonfederal land. Impact-producing factors for such an oil shale facility include surface disturbance, water use, waste generation, and local changes in employment and population density. The assumptions used for these factors are given in Section 4.1.

***Grazing.*** Public and private lands in the study area are used extensively for livestock grazing. Environmental impacts of note associated with livestock grazing include potential degradation of soil, vegetation, wildlife habitat, and surface water quality (Krueger et al. 2002; BLM 2006k). For example, overgrazing could result in increased rates of erosion and topsoil losses. Allowing grazing during the nesting seasons of some species could result in trampling of the eggs and decreased viability of those species in the study area. Livestock could also degrade surface water quality if their manure and urine were deposited directly into the water or on land nearby. Good management practices can eliminate or mitigate many of these impacts. On BLM lands, grazing permits that are required specify the species allowed to graze, amount of grazing permitted, and other requirements to minimize environmental impacts. Today, the BLM manages livestock grazing in a manner aimed at achieving and maintaining public land health. To achieve desired conditions, the agency uses rangeland health standards and guidelines that the BLM developed in the 1990s with input from citizen-based Resource Advisory Councils across the West. Standards describe specific conditions needed for public land health, such as the presence of stream bank vegetation and adequate canopy and ground cover. Guidelines are the management techniques designed to achieve or maintain healthy public lands, as defined by the standards. These techniques include such methods as seed dissemination and periodic rest or deferment from grazing in specific allotments during critical growth periods.

***Fire Management.*** Fire management is used on public and private lands to aid in wildfire suppression. Underbrush is burned at regular intervals to avoid the buildup of large amounts of fuel on these lands. Fire is considered to have a natural role in the ecosystems and is used as a tool in managing those ecosystems. However, fires have potential environmental impacts that should be considered, particularly air quality impacts and impacts on threatened and endangered species (BLM 2005l). In general, impacts would be lower from more frequent, less intense, controlled fires than from infrequent wildfires.

***Forestry.*** In Colorado, Utah, and Wyoming, the BLM administers approximately 14.2 million acres of forested lands of various types. Forested land is defined as being 10% stocked with live trees and at least 1 acre in size and 120 ft wide. A 2006 report on the status and condition of these forests states that the national priorities for them include "maintaining and restoring forest health, salvaging dead and dying timber, providing high-quality wildlife and fish habitat, and providing economic opportunities in rural communities by making timber and other forest products, including biomass, available from vegetation management treatments" (BLM 2006l). Management techniques for BLM-administered forest lands include grazing restrictions, selective thinning of undergrowth and dead wood, prescribed burns, and selective harvesting of trees. Adverse environmental impacts on air quality, water quality, habitat, and threatened and endangered species could occur as a result of these management practices. For example, increased erosion after land clearing could cause siltation in streams and decrease water quality.

***Recreation.*** One mission of the BLM is to accommodate recreational use of public lands, such as fishing, hiking, horseback riding, mountain biking, camping, and OHV use. However, these uses can have adverse environmental impacts. For example, OHV use can result in soil compaction, increased erosion, and the proliferation of non-native plant species. Overuse of trails in primitive areas can also result in erosion and disturbance of threatened and endangered species habitat. Other ways by which recreational visitors could affect the environment include producing waste, emitting air pollutants from motorized vehicles, and using water. However, recreational use also has benefits, including allowing visitors to enjoy outdoor wilderness areas and to reduce their stress, and stimulating economic growth in the area. The BLM works to minimize the adverse environmental impacts of recreational use by managing the activity. Examples of plan requirements include habitat improvement projects in recreational areas, construction of recreational use facilities that lead to decreased random use and degradation of wild areas, and waste management (BLM 2006m).

#### 6.2.6.2 Projected Levels of Major Activities in the Study Area

Data on past, current, and planned future activities on BLM-administered lands and also on nonfederal lands were obtained from various BLM RMPs and EISs available through the field offices to obtain their best current estimates for projected activities in the areas of oil and gas development (both on public and private lands), coal development, other minerals development, energy development, and other activities (e.g., grazing, fire management, forestry, and recreation) over the 20-year time period between 2012 and 2032. Field office staff were also contacted. The projected levels of major activities in Utah are summarized in Table 6.2.6-4.

**6.2.6.2.1 Oil Shale and Tar Sands Development.** As stated in Section 6.1.6.1.5, in the future one PRLA with an area of 4,960 acres may be eligible for oil shale development using underground mining techniques, based on the assumption that the RD&D leaseholder can meet requirements of the existing lease. In 2009, the BLM issued a second round of solicitations and received one new RD&D lease proposal for the Uinta Basin in Utah, which is currently being evaluated. In addition, an unknown level of oil shale and tar sands development could occur on nonfederal lands in the future.

**6.2.6.2.2 Oil and Gas Development.** The largest amount of oil and gas development is projected for the Vernal Planning Area, about 440 wells per year; the total projected maximum number of new oil and gas wells for applicable field offices in the state is 620 per year (see Table 6.2.6-4, which includes wells both on federal and nonfederal lands; projections for nonfederal lands are not available for all field offices).

**6.2.6.2.3 Coal Mining.** The largest coal reserves are in the Henry Mountain Planning Area, with smaller amounts in the San Rafael Planning Area (Table 6.2.6-4). Predicted production for all field offices combined is about 30 to 34 million tons per year. About half of this production would be from surface mines, and half from underground mines.

**6.2.6.2.4 Other Minerals Development.** Metals produced in Utah include copper (one mine), iron (two mines), phosphate (one mine), molybdenum (one mines), potash (three mines), silver (four mines), and uranium (one mine) (EPA 1997). In the ROI counties (Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, and Wayne), only sand and gravel, gilsonite, clay, gypsum, dimension sandstone, lime, helium, and gold are produced (USGS 2004b). Phosphate production occurs in the Diamond Mountain area and gilsonite production in the Book Cliffs area. Uranium/vanadium has a high potential for development in the Henry Mountain and San Juan Planning Areas; it would result in at least 30 acres/yr of surface disturbance. A limited amount of other minerals development is expected (Table 6.2.6-4).

**6.2.6.2.5 Energy Development.** The DOE estimates that 690 mi of corridors could be sited on public lands in Utah, with a total surface area of 370,000 acres (DOE 2008). As of 2010, there were 6,040 existing ROWs crossing public lands in Utah (BLM 2010a).

Table 6.2.6-5 summarizes the electric generating units operating in oil shale ROI counties in Utah in 2008, including the primary fuel source for each plant and its electric power generating capacity. Of the 3,277 MW of nameplate power available from 15 generating units, 98% was from nine coal-fired generators.

**TABLE 6.2.6-4 Projected Levels of Major Activities for Seven Planning Areas Considered on BLM-Administered and Nonfederal Lands in the Cumulative Impacts Assessment for Tar Sands Development in Utah[a]**





| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Oil Shale and Tar Sands*** | | | | |
| Oil shale development on PRLA (federal lands) | Potential for one underground mining project on 5,120 acres of PRLA; up to one additional RD&D project (total of 160 to 640 acres | | None | None |
| Oil shale and tar sands development on nonfederal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown |
| ***Oil and Gas*** | | | | |
| Recoverable oil and gas reserves | NA | NA | NA | NA |
| Potential oil wells drilled per year over next 20 yr (2012–2032)[b] | 76 wells (based on 2,055 total in VPA, 1,130 in DM only over 15 yr [2003–2017] as projected by BLM [2005b]) | 62 wells (based on 2,055 total in VPA, 925 in BC only over 15 yr [2003–2017] as projected by BLM [2005b]) | 30 wells total in RPA; 3 in HM only (includes oil, gas, and CBNG; based on 454 total over 15 yr [2005–2020]; 3/yr in HM only, as projected by BLM [2005c]) | Few oil wells drilled (based on only 8 currently producing wells); discussion that no significant oil production is expected in the future (BLM 2004b; Appendix 21) |
| Potential gas wells drilled per year over next 20 yr (2012–2032)[b] | 147 wells (based on 4,035 total in VPA, 2,195 in DM only over 15 yr [2003–2017] as projected by BLM [2005b]) | 143 wells (based on 4,035 total in VPA, 2,150 in BC only over 15 yr [2003–2017] as projected by BLM [2005b]) | Included with potential oil wells drilled for HM PA | 55–95 wells (includes CBNG; based on 1,100–2,000 over 20 yr [2005–2024] as projected by BLM (2004b; Table 4-2; BLM 2008b) |

TABLE 6.2.6-4 (Cont.)

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Oil and Gas (Cont.)*** | | | | |
| Potential CBNG wells drilled per year over next 20 yr (2012–2032)[b] | 4 wells (based on 130 total in VPA, 50 in DM over 15 yr [2003–2017] as projected by BLM [2005b]) | 6 wells (based on 130 total in VPA, 80 in BC over 15 yr [2003–2017] as projected by BLM [2005b]) | Included with potential oil wells drilled for HM PA. HM coal field not likely to be developed for CBNG in the next 15 yr (2005–2020) (BLM 2005d) | Included with potential gas wells drilled for San Rafael PA. Numbers above include Price Project, 545 wells/10 yr on 1,609 acres, 20–70 jobs; Ferron Project, 335 wells/ 5 yr, acres unknown; impacts on mule deer populations and winter habitat (BLM 2004b) |
| Annual surface disturbance over next 20 yr (2012–2032) (acres/yr)[c] | 570–3,400 (190–1,100 oil; 370–2,200 gas; 10–60 CBNG) | 540–3,200 total (160–930 oil; 360–2,100 gas; 15–90 CBNG) | 75–450 RPA total; 9–45 HM (includes oil, gas, and CBNG) | 140–1,400 (includes gas and CBNG) |
| Wells to be abandoned annually over next 20 yr (2012–2032)[d] | 57 wells total (19 oil; 37 gas; 1 CBNG) | 54 wells total (16 oil; 36 gas; 2 CBNG) | 8 wells in RPA total, 1 in HM (includes oil, gas, and CBNG) | 14–24 wells (includes gas and CBNG) |
| Seismic exploration projects[e] | 2–3 projects per year (based on 45–75 total for Vernal, assume half in DM) over 15 yr [2003–2015] [BLM 2002a]); 200–300 acres/yr disturbance | 2–3 projects per year (based on 45–75 total for Vernal, assume half in BC) over 15 yr [2003–2015] [BLM 2002a]); 200–300 acres/yr disturbance | 340 acres/yr disturbance (based on 5,100 total over 15 yr as projected by BLM [2005c]) | 150 acres/yr disturbance (based on 2,236 total over 15 yr as projected by BLM [2004b]) |

**TABLE 6.2.6-4 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Coal*** | | | | |
| Recoverable reserves (million tons) | Tabby Mountain coal field: ~320 million tons (BLM 2002a) | No known reserves (BLM 2002a) | Includes south part of Wasatch Plateau Coal Field: ~6,000 million tons; HM Coal Field: 20 million tons (Jackson 2006); Emery Coal Field: reserve information not available | Includes northern part of Wasatch Plateau Coal Formation: ~690; BC Coal Field: ~280; Emery Coal Field: ~240 (all 3 in million tons) (BLM 2004b; Section 3.3.5.2) |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | None (BLM 2002a) | None (BLM 2002a) | Wasatch Plateau Coal Field, 25; no production planned for HM (Jackson 2006); Emery Coal Field, no production information available | Lila Canyon, 0.8–1; North Horn, 2–4; Willow Creek, 2–4 (BLM 2004b; Chapter 4) |
| Surface area potentially leasable (acres) | NA | None | NA | NA |
| Surface mining area potentially disturbed annually (acres/yr) | None | None | None | None |
| Surface area potentially disturbed for underground mining support facilities (total acres, 2012–2032)[f] | None projected | None projected | 500 acres | Most coal would be mined through underground mining methods (BLM 2004b; Section 3.3.5.2); 500 acres |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Coal (Cont.)*** | | | | |
| Other coal impacts | None known | None known | None known | Lila Canyon, 5-mi road, 550 round-trips/day on US 6, 150–200 jobs; North Horn, road, power line, and infrastructure construction, EIS ongoing, start of operations unknown; Willow Creek, not currently leased, if operations begin, 250–300 jobs, surface disturbance, safety issues (BLM 2004b; Chapter 4) |
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals)*** | | | | |
| Phosphate production over next 20 yr (2012–2032) | 5,800 acres on BLM-administered land; 14,000 acres on private land (BLM 1993; 2002a); assume 50% surface mining (i.e., 10,000 acres) | None (BLM 2002a) | None | None |
| Gilsonite production rate over next 20 yr (2012–2032) (tons/yr) | None (BLM 2002a) | 60,000 (based on BLM projections for 2003–2017) (BLM 2002a) | None | None |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals) (Cont.)*** | | | | |
| Locatable minerals (e.g., precious metals/gems, uranium, bentonite, gypsum, limestone, salt) | Minor to no activity (BLM 2002a) | Minor to no activity (BLM 2002a) | Uranium/vanadium/gold/copper, high potential for occurrence and development in HM area; exploration for economic quantities is continuing (BLM 2005d); one salt mine on west side of RPA to continue operations; gypsum and salt production unlikely in next 15 yr, especially in HM area (BLM 2005d) | Gypsum, fairly large areas in south and central parts of PA have high potential for development over next 15 yr (2005–2020) (BLM 2004b; Section 3.3.5.1); number of acres: NA |

**TABLE 6.2.6-4 (Cont.)**





| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals) (Cont.)*** | | | | |
| Salable minerals (gravel, sand, clay) | Stone, 30 tons/yr (based on 60 tons/yr total for VPA, 2003–2017 (BLM 2002a); limestone, 30,000 tons/yr (based on USFS land production, most in DM (BLM 2002a); sand and gravel: some production, quantity unknown (BLM 2002a) | Stone, 30 tons/yr (based on 60 tons/yr total for VPA, 2003–2017 (BLM 2002a); sand and gravel, some production, quantity unknown (BLM 2002a) | For planning period of 2006–2020, 57 active sand and gravel disposal sites on BLM-administered land; likely to continue producing ~20,000 $yd^3$/yr, additional sites on public land (BLM 2005d); assume 2 permits at 6 acres/permit, 12 acres/yr; clay, only small-scale development; stone, continue at current rate of about 1–1,000 tons/yr (BLM 2005d); humate production to continue on small scale at Factory Butte in HM (BLM 2005d) | Clay, current areas of active mining would continue over next 15 yr (2005–2020), unlikely that new deposits would be developed (BLM 2004b; Section 3.3.5.1); sand and gravel, stone, and humate: high potential areas near major paved roads would be developed 2005–2020 (BLM 2004b; Section 3.3.5.3) |

**TABLE 6.2.6-4 (Cont.)**

| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Energy Development*** | | | | |
| Energy corridors | NA | NA | NA | NA |
| Electric generating utilities | NA | NA | NA | NA |
| Existing power plants | NA | NA | NA | Hiawatha Cogeneration Plant, Questar Pipeline Dewpoint Plant, Sunnyside Cogeneration Facility, coal-fired PacifiCorp Hunter, Huntington and Carbon plants: all provide employment, emit $NO_X$, use water, and decrease water quality; planned PacifiCorp Hunter expansion: add 350 long-term jobs, increase $NO_X$, and $SO_X$ emissions, use and degrade water (BLM 2004b) |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity | | | |
|---|---|---|---|---|
| | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Other*** | | | | |
| Forestry | NA | NA | NA | Logging on private lands (not quantified) (BLM 2004b; Section 4.2.2) |
| Fire management | 5,500–7,800 acres/yr prescribed burns annually, based on 11,000 acres total in VPA as projected by BLM for 2002–2006 (BLM 2005b; Section 3.4) or 156,425 acres/decade total in VPA (BLM 2005b; Table 2.3) | 5,500–7,800 acres/yr prescribed burns annually (based on no action of 11,000 acres total in VPA projected by BLM for 2002–2006 (BLM 2005b; Section 3.4) and 156,425 acres/decade total in VPA (BLM 2005b; Table 2.3) | NA | One prescribed burn of 5,000 acres every 2 yr (based on last 20-yr data) (BLM 2004b; Section 3.2.10.4) |
| Land and realty | NA | NA | NA | Utah Department of Transportation: road improvements between 2006 and 2025 on U.S. 6 between Green River and Spanish Fork (~3-mi widening, 12 mi of new asphalt); also SR 10 corridor (5 mi) (BLM 2004b; Section 4.2.2) |
| Livestock | NA | NA | NA | NA |

TABLE 6.2.6-4 (Cont.)

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Other (Cont.)*** | | | | |
| Special management areas, recreation | 4–27 mi/yr nonmotorized recreational trails and 54 mi/yr motorized trails would be developed total in VPA (between 2006 and 2020; BLM 2005b; Table 2.3); assume half in DM | 4–27 mi/yr nonmotorized recreational trails and 54 mi/yr motorized trails would be developed total in VPA (between 2006 and 2020; BLM 2005b; Table 2.3); assume half in BC | NA | NA |
| Vegetation | 2,300–3,400 acres/yr vegetation treated total in VPA (between 2006 and 2020; BLM 2005b; Table 4.18.2); assume half in DM | 2,300–3,400 acres/yr vegetation treated total in VPA (between 2006 and 2020; BLM 2005b; Table 4.18.2); assume half in BC | NA | NA |
| Soils/watersheds | NA | NA | NA | NA |
| Miscellaneous | NA | NA | NA | NA |
| ***Oil Shale and Tar Sands*** | | | | |
| Oil shale development on PRLAs (federal lands) | None | None | None | See Vernal |
| Oil shale and tar sands development on nonfederal lands | Potential unknown | Potential unknown | Potential unknown | Potential unknown |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity: San Juan (Area Similar to Monticello PA) | Grand Staircase–Escalante NM | Moab PA | Summary for Utah PAs and GSENM |
|---|---|---|---|---|
| ***Oil and Gas*** | | | | |
| Recoverable reserves | NA | >270 million bbl (Allison 1997) | NA | NA |
| Potential oil wells drilled per year over next 20 yr (2012–2032)[b] | 5–21 wells (includes gas, average of 13/yr, 195 total from 2006–2020 [BLM 2005e]) | Few (only 47 exploratory wells currently in GSENM; ~ 200,000 acres of old leased land are under review) (BLM 1999) | 12–40 wells (includes gas, average of 26/yr, 390 total from 2006–2020 [BLM 2005a]) | 190–230 oil wells drilled per year |
| Potential gas wells drilled per year over next 20 yr (2012–2032)[b] | Included with potential oil wells drilled for San Juan PA | None (BLM 1999) | Included with potential oil wells drilled for MOAB PA | 350–390 gas wells drilled per year |
| Potential CBNG wells drilled per year over next 20 yr (2012–2032)[b] | None (BLM 2005f) | None (BLM 1999) | 1 well (based on three 5-spot well clusters between 2006 and 2020 (BLM 2005g); assume same annual rate) | 11 CBNG wells drilled per year |
| Annual surface disturbance over next 20 yr (2012–2032) (acres/yr)[c] | 13–320 (includes oil and gas) | NA | 33–620 total (30–600 oil and gas; 3–15 CBNG [similar to 225 total acres CBNG between 2006 and 2020]) (BLM 2005g) | 1,400–9,400 |
| Wells to be abandoned annually over next 20 yr (2012–2032)[d] | 2–8 wells (includes oil and gas) (BLM 2005e) | NA | 6–20 wells (BLM 2005a) | 140–170 wells abandoned per year |

**TABLE 6.2.6-4 (Cont.)**



| | Level of Activity | | | |
|---|---|---|---|---|
| Type of Activity | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Oil and Gas (Cont.)*** | | | | |
| Seismic exploration projects[e] | 150 acres/yr disturbance (based on 2,236 total over 15 yr as projected by BLM [2005e]) | NA | 240 acres/yr disturbance (based on 3,600 total over 15 yr [2006–2020] as projected by BLM [2005a]) | NA (~1,500–2,100 acres/yr of temporary vegetation and habitat disturbance)[d] |
| ***Coal*** | | | | |
| Recoverable reserves (million tons) | San Juan coal field (530,000 acres; 60% privately owned) (BLM 1991a), 77 million tons available to surface mining; no current production because of poor quality/lack of rail transport (BLM 2005f) | NA | NA (Sego Formation produced ~3 million tons up through the 1950s) (BLM 2005g) | ~7.6 billion tons |
| Predicted production over next 20 yr (2012–2032) (million tons/yr) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 30–34 million tons/yr (approximately 87% from underground mining; 13% from surface mining) |
| Surface area potentially leasable (acres) | NA | NA | NA (Sego Formation may be attractive for future production because of low sulfur content, close to railway) | NA |
| Surface mining area potentially disturbed annually (acres/yr) | NA | NA | NA | NA |

TABLE 6.2.6-4 (Cont.)

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Coal (Cont.)*** | | | | |
| Surface area potentially disturbed for underground mining support facilities (total acres, 2012–2032)[f] | None projected | None projected | None projected | 1,000 |
| Other coal impacts | None known | None known | None known | See San Rafael PA. |
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals)*** | | | | |
| Phosphate production over next 20 yr (2012–2032) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 10,000 acres surface disturbance (see DM) |
| Gilsonite production rate over next 20 yr (2012–2032) (tons/yr) | None (BLM 2005f) | None (BLM 1999) | None (BLM 2005g) | 60,000 tons/yr gilsonite (see BC) |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Other Minerals (e.g., phosphate, gilsonite, locatable minerals, salable minerals) (Cont.)*** | | | | |
| Locatable minerals (e.g., precious metals/gems, uranium, bentonite, gypsum, limestone, salt) | Uranium/vanadium, 4.2 million tons in reserves in Four Corners area, estimated disturbance of 20 acres/yr for next 15 yr (2005–2020) (BLM 2005f); gold, 5–20 acres total disturbed for next 15 yr in Recapture Creek and Johnson Creek (BLM 2005f); limestone, 20,000–30,000 tons/yr, 20–50 acres total disturbed for next 15 yr (BLM 2005f) | Uranium/vanadium, deposits present (Allison 1997), not to be developed (BLM 1999); alabaster, ongoing production of 300 tons/yr, from surface, not usually quarried | Uranium/vanadium, >1 million tons ore reserves, estimated disturbance of 10 acres/yr for next 15 yr (2005–2020) (BLM 2005g); copper, Lisbon Valley Project, produce for 10 yr (2006–2015); disturb 110 acres/yr (1,103 total, includes 266-acre pad for leaching, processing plant, ponds, and 11-mi power line); salt/potash, 3.3 acres/yr (50 acres disturbance total over next 15 yr [2006–2020] BLM 2005g) | Uranium/vanadium, high potential for development with at least 30 acres/yr surface disturbance; gold, at least 5 acres/yr disturbed; limestone, at least 20 acres/yr disturbed; gypsum, high potential for development, acres NA; alabaster, 300 tons/yr, acres NA; salt, at least 3 acres/yr disturbed; copper, at least 110 acres/yr disturbed; total, at least 170 acres/yr disturbed |
| Salable minerals (gravel, sand, clay) | Sand and gravel, 4 permits/yr producing ~127,000 $yd^3$/yr, 6 acres/permit, thus 24 acres/yr disturbed over next 15 yr (2005–2020) (BLM 2005f); building stone, 5–10 acres/yr over next 15 yr (2005–2020) (BLM 2005f) | Sand and gravel, limited production for local use (Allison 1997) | Sand and gravel, 4 permits/yr producing ~60,000 $yd^3$/yr, 6 acres/permit, thus 24 acres/yr disturbed over next 15 yr (2005–2020) (BLM 2005g); building stone, ~0.5 acres/yr over next 15 yr (1 new facility, producing 5,000–10,000 tons/ yr for 5 yr between 2006 and 2020) (BLM 2005g) | Sand and gravel, at least 60 acres/yr disturbed; stone, at least 6 acres/yr disturbed; clay, no new deposits to be developed |

**TABLE 6.2.6-4 (Cont.)**

| Type of Activity | Level of Activity: Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
|---|---|---|---|---|
| ***Energy Development*** | | | | |
| Energy corridors | NA | NA | NA | Estimated 690 mi (370,000 acres) in Utah; a portion of the corridor is expected to be sited near the tar sands resources (DOE 2008) |
| Electric generating utilities | NA | NA | NA | ~3,300 MW currently produced in region (98% from coal) (EIA 2011a). |
| Existing power plants | NA | None | NA | See San Rafael PA |
| ***Other*** | | | | |
| Forestry | NA | NA | NA | See San Rafael PA |
| Fire management | NA | NA | NA | NA (at least 13,500 acres/yr prescribed burn) |
| Land and realty | NA | NA | NA | See San Rafael PA (road planned) |
| Livestock | About 1.8 million acres used for grazing (BLM 2008i) | NA | NA | NA (about 1.8 million acres used for grazing in Monticello PA) |

TABLE 6.2.6-4 (Cont.)

| Type of Activity | Level of Activity | | | |
|---|---|---|---|---|
| | Diamond Mountain (Western Half of Vernal PA) | Book Cliffs (Eastern Half of Vernal PA) | Henry Mountain (Southeast Portion of Richfield PA) | San Rafael (Area Similar to Price PA) |
| ***Other (Cont.)*** | | | | |
| Special management areas, recreation | NA | ~6 acres/yr disturbed (total of 85 acres over 15 yr [2000–2014] for recreation and campsites) (BLM 1999) | NA | NA (some motorized and nonmotorized trails and campsites to be developed) |
| Vegetation | NA | 1,000–3,000 acres/yr for vegetation restoration through burning (20,000 acres total for 2000–2014) | NA | At least 3,300 acres/yr vegetation treatment or burning for restoration |
| Soils/watersheds | NA | <1 acre/yr (10 sites at 1 acre/site) (BLM 1999) | NA | NA (at least 1 acre/yr disturbance) |
| Miscellaneous | NA | ~17 acres/yr for utility and road ROWs and communications sites (260 acres total over 15 yr [2000–2014]) (BLM 1999) | NA | NA (at least 17 acres/yr disturbance) |

Abbreviations: ACEC = Area of Critical Environmental Concern; BC = Book Cliffs; BCF = billion cubic feet; CBNG = coal bed natural gas; DM = Diamond Mountain; GSENM = Grand Staircase–Escalante National Monument; HM = Henry Mountain; NA = information not available; PA = planning area; RPA = Richfield Planning Area; SM = surface mining; SR = surface retort; UM = underground mining; USFS = Forest Service; VPA = Vernal Planning Area.

[a] The activities listed are those considered in addition to tar sands development on federal lands as described for all four alternatives. In general, values are rounded to two significant figures.

[b] Includes projections for federal lands and, where available, nonfederal lands.

**Footnotes continue on next page.**

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TABLE 6.2.6-4 (Cont.)

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[c] Assumes a range of 2.5 to 15 acres/well for well pads, roads, and pipelines (representative range based on 2.5 acres from DOE [2006]), 3 acres from Vernal Mineral Potential Report (BLM 2002a), and 15 acres from Moab PA (BLM 2005a). The 2.5- to 15-acre range encompasses estimates for San Rafael of 7.9 acres/well plus 20 acres/ancillary facility (BLM 2004b, Appendix 21); Henry Mountain (4 acres/well plus 8 acres/well for roads) (BLM 2005c); and Monticello (9.6 acres/well) (BLM 2005e).

[d] Generally assumes that 25% of new wells would be abandoned (based on estimate provided for the Rawlins Wyoming Field Office [Allison 2006]). Assumes 50% for Moab (BLM 2005a) and 40% for Monticello (BLM 2005e). All surface disturbance is assumed to be reclaimed within 10 years of abandonment.

[e] If information is not available, assume approximately 1 to 2 geophysical exploration projects/50 wells drilled annually (based on Wyoming estimates); 100 acres disturbed/project (this is short-term disturbance such as crushed vegetation, uprooted brush, and minor soil disturbance; disturbance is generally unidentifiable within 1 yr). At 550 to 630 wells drilled per year, expect 11 to 26 projects/yr for Utah overall.

[f] For areas where coal mining is ongoing and subsurface, a limited amount of surface disturbance over the 20-year study period was assumed (i.e., 500 acres).

**TABLE 6.2.6-5 Electric Power–Generating Units in ROI Counties in Utah in 2005[a]**

| Primary Fuel | No. of Generating Units | Combined Power (MW-nameplate) |
|---|---|---|
| Coal | 9 | 3,214 |
| Waste coal | 1 | 58 |
| Water | 5 | 5.4 |
| Total | 15 | 3,277 |

[a] ROI counties include Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, and Wayne.

Source: EIA (2011).

**6.2.6.2.6 Other (Oil Shale Development, Grazing, Forestry, Fire Management, and Recreation).** Potential oil shale development in Utah (whether on PRLAs, other federal lands, or nonfederal lands) could affect development of tar sands resources. The assumptions used for impact-producing factors for a single oil shale facility are given in Section 4.1.

Although information is not available for every planning area, at least 13,500 acres/yr are planned to be used for prescribed burns under current management practices. Large tracts of land are used for grazing in the Monticello Planning Area.

The BLM manages more than 8 million acres of forest lands in Utah; the majority are in the southern half of the state, including the planning areas addressed in this PEIS. Most (more than 90%) of the forests are woodlands. The net annual growth in forest lands has been estimated at 9.2 million $ft^3$ (BLM 2006l). The major cause of tree mortality has been fires, followed by insect damage.

### 6.2.6.3 Cumulative Impacts Assessment for the Possible Tar Sands Development That Could Occur under Alternatives 2, 3, and 4

As stated above and in Sections 6.2.2, 6.2.3, and 6.2.4, with the possible exception of a change in local property values there would be no environmental or socioeconomic impacts under Alternatives 2, 3, and 4 from the amendment of land use plans to identify lands as available or not available for application for commercial tar sands leasing. Therefore, there would be no cumulative impacts from these alternatives. However, direct, indirect, and cumulative impacts could occur as a result of future commercial tar sands development that could be facilitated by such land use plan amendments. This cumulative impacts assessment then focuses on the impacts from this future development, rather than on the impacts from the land use plan amendment decision. That is, the purpose of this cumulative impacts assessment is to discuss, in a qualitative way, how the environmental and socioeconomic conditions within the study area might be incrementally affected over the next 20 years (the study period) by tar sands development that could occur on lands made available for application for commercial leasing by the land use plan amendments under Alternative 2, 3, or 4.

**6.2.6.3.1 Land Use.** Potential land use impacts associated with a single commercial tar sands facility include the exclusion of grazing, recreation, other mineral development land uses from lands used for tar sands development facilities and associated off-lease facilities (e.g., employer-provided housing and ROWs). Tar sands development could also alter the quality of LWC. Tar sands development facilities would disturb up to 5,760 acres of public lands for the facilities themselves, and up to an additional 3,750 acres of lands for ROWs and employer-provided housing (locations where these facilities would be sited are unknown but are not expected to be on public lands). While the total amount of ground disturbance for a tar sands facility using in situ technology could equal that of a facility using surface mining, surface acreage disturbed at any one time might be considerably less for in situ facilities depending on the cycle of preparation, production, and reclamation.

Table 6.2.6-6 presents estimates of the amount of land needed for other major industrial activities in the study area over the 20-year study period. These lands may be federal or nonfederal lands. As this table shows, land use in Utah is characterized by an extensive amount of industrial activity, which is expected to continue into the future. Depending on the number and types of tar sands facilities constructed and operating, future commercial tar sands development could contribute a substantial increment to the cumulative land use and disturbance impacts. Over a 20-year time horizon, a single tar sands facility could contribute an approximately 5 to 42% increase in land disturbance (i.e., up to about 9,500 acres for a single tar sands project compared with the range of other disturbances of 42,000 to 202,000 acres). If several tar sands leases are eventually granted within relatively close proximity to one another, this amount of leasing within a relatively small area would result in substantial changes in land use in that area. Oil shale development, if it occurs, would also contribute to cumulative land disturbance impacts. Note that the projections given in Table 6.2.6-6 are very sensitive to the amount of disturbance due to oil and gas development that would occur, with the large range of possible disturbance making the estimates quite uncertain.

As discussed in Section 6.2.6.2, many public lands are currently used as ROWs for short- and long-distance energy transmission. The West-Wide Energy Corridor PEIS (DOE and DOI 2008) designated additional regional corridors on public lands for long-distance energy transmission ROWs. Under that PEIS, the corridors include about 370,000 acres in Utah, a portion of which falls within the tar sands development area. Not all lands designated as energy corridors would be developed and/or disturbed; however, the percentage of potential disturbance is currently unknown. Should these proposed corridors be developed for energy-related ROWs, additional land use impacts in the region could be substantial.

**6.2.6.3.2 Soil and Geologic Resources.** Tar sands development could result in impacts on soil and geologic resources by increasing soil removal, soil compaction, and erosion. Erosion of exposed soils could also lead to increased sedimentation of nearby water bodies and to the generation of fugitive dust, which could affect local air quality. Project areas would remain susceptible to these impacts until completion of construction, mining, tar sands processing, and

**TABLE 6.2.6-6 Summary of Cumulative Long-Term Land Use for Tar Sands Development and Other Major Industrial Activities**

| Activity | Estimated Acres Disturbed[a] |
|---|---|
| Commercial tar sands development on federal or nonfederal lands[b] | Up to 9,500 per project |
| Commercial oil shale development on federal lands or nonfederal lands[b] | Up to 14,000 per project |
| Oil and gas development (acres/yr) | 1,400–9,400 |
| Coal development (acres/yr) | 50 |
| Sodium minerals (nahcolite and dawsonite) development (acres/yr) | 0 |
| Phosphate production | 10,000 |
| Proposed power plants[c] | 3,100 |
| Annual total excluding tar sands and oil shale development | 14,600–22,600 |
| 20-yr totals, excluding tar sands and oil shale development | 42,000–202,000 |
| Single tar sands facility percentage of 20-yr total | 5–42% |

[a] Except where otherwise indicated, acreage estimates are the maximum projected totals from Table 6.2.6-4.

[b] Acreage estimates represent the maximum possible disturbance for individual tar sands facilities (Section 5.1) and oil shale facilities (Section 4.1).

[c] The acreages represent the estimated footprint of projected new power plant development as discussed in Section 6.2.6.2, assuming all would be coal-fired plants requiring 3,000 acres per 1,500 MW of capacity.

site stabilization and reclamation activities (e.g., revegetation of pipeline ROWs and surface mine reclamation). Impacts on soil and geologic resources would be limited to the specific project location as well as areas where associated off-site infrastructure (such as access roads and utility ROWs) would be located.

Oil and gas development, other minerals development, oil shale development, and construction of additional power plants would cause similar impacts on soil and geologic resources in the Utah study area. Table 6.2.6-6 gives estimates of the amount of land that could be disturbed for these activities over the 20-year study period. Additional types of land use could also disturb soil, including, but not limited to, agricultural development, grazing, recreation, forestry, and residential development. The potential impacts from these types of land use have not been quantified. Also as discussed in Section 6.2.6.2.4, large areas might be designated as energy corridors, and their development would contribute to total soil disturbance. All these activities may result in soil being displaced, stockpiled, eroded, or compacted through various site activities. The disturbance could yield increased sediment to surface waters, and, in areas with high salinity in the soils, the salt content in surface water may also increase.

Impacts on soil and geologic resources from tar sands development could add a substantial increment to cumulative impacts on this resource. Impacts would increase with increasing numbers of tar sands facilities. A single facility could be associated with soil disturbance of up to about 9,500 acres.

**6.2.6.3.3 Paleontological Resources.** Disturbances from tar sands development, combined with other surface- and subsurface-disturbing activities in the region, could uncover and/or destroy fossils on BLM-administered land and on other lands. Given the land disturbance projected from tar sands development and from other activities in the study area during the 20-year study period (Table 6.2.6-6), it is likely that many sites will require paleontological evaluations and mitigation measures. Based on the assumption that these evaluations and mitigation measures are conducted in accordance with existing regulations and BLM policies, there would be increased knowledge of paleontological resources in the region and increased protection of resources based on this knowledge. Adverse cumulative impacts therefore are not expected.

**6.2.6.3.4 Water Resources.** Many activities projected to occur in the study area could increase sediment and dissolved solid loads in streams downstream of disturbed sites (e.g., ROW construction and other construction projects, mining, and construction of access roads and river crossings). After the protective layers of soils are disturbed, the soils become vulnerable to erosion by surface runoff. Leaching from mine tailings and waste, overburden piles, and source rock piles would potentially bring organic and metal contaminants to nearby streams. Potential leaks (or spills) of oil or other petroleum products from pipelines would be additional risks for contamination of surface water resources. Modification of surface drainage and water extraction could also cause flow regime and morphological changes of stream channels. Most of the impacts would occur in the vicinity of the water bodies close to project sites and would be incremental.

If oil and gas development, mining activities, and power plant construction continue to grow as projected from 2007 to 2027, the disturbed areas are estimated to increase by a total of 42,000 to 202,000 acres in Utah (Table 6.2.6-6). If a single tar sands facility is developed, it will contribute about 5 to 42% of additional ground disturbance in Utah. Some of the impacts near construction sites and mining sites would be local and could be managed and mitigated. The incremental impacts on water resources caused by tar sands and ancillary facilities development could be significant relative to the other activities. The incremental and cumulative impacts would depend on the location and size of tar sands development and would be evaluated in future environmental assessments.

The water uses and losses in the Upper Colorado River Basin states of Colorado, Utah, and Wyoming are shown in Figures 6.1.6-1 through 6.1.6-4. From the 1970s to the 1990s, the water uses increased, reflecting growth in agricultural and in municipal and industrial water uses (Figures 6.1.6-1 and 6.1.6-2). The export of Colorado River water to outside the Upper Colorado River Basin also increased gradually with time (Figure 6.1.6-3). From 1990 to 2008, the combined water use and losses in Colorado, Utah, and Wyoming within the Upper Colorado Basin fluctuated between about 3,500 and 4,400 thousand ac-ft (Figure 6.1.6-4). This includes water losses from major and minor reservoirs, agricultural and municipal and industrial water uses, and water transfers out of the basin. Fluctuations were primarily due to variation in export and declining agricultural water use because of drought conditions (BOR 2004, 2005, 2006, 2010).

To preliminarily assess cumulative water use in the study area over the next 20 years and the potential incremental impacts of tar sands development, water use projections for oil and gas development, coal mining, and power generation were compared with water use for individual tar sands facilities and with available water in the Upper Colorado River Basin (see Table 6.2.6-7). The sustainable, annually available water in the Upper Colorado River Basin was assumed to be 6,000 thousand ac-ft/yr (SWCA 1997) (a prolonged drought condition may decrease this water availability). The total amount of legally apportioned water available to Colorado, Utah, and Wyoming is 5,280 thousand ac-ft/yr. The water transfer out of the Upper Colorado River Basin fluctuates but was assumed to remain in the same range (540 to 800 thousand ac-ft/yr) as for 1990 to 2008 (Figure 6.1.6-3). Also, the currently combined water uses for agricultural, municipal, and industrial activities were assumed to remain at the same level as those found in 1990 to 2008 (i.e., 3,500 to 4,400 thousand ac-ft/yr; Figure 6.1.6-4). This could occur as water is transferred from agricultural to municipal and industrial use. Therefore, currently available water would be 80 to 1,040 thousand ac-ft/yr in the three states. The water requirement for individual commercial tar sands facilities is estimated to be from less than 1 to 5.4 thousand ac-ft/yr of water, depending on the technology being used, while the combined water needed for oil and gas, coal mining, and new power plants would be about 68 thousand ac-ft/yr (Table 6.1.6-10). Additional water will be needed to support regional population growth, potential water exports to areas outside the Upper Colorado River Basin, new instream flow water rights for protecting endangered species, and possibly oil shale development. The level of tar sands development that could be supported by available water over the next 20 years depends on the type of technology used, the scale of the development, and the other competing uses of water at the time of development. Another alternative to make more water available is to transfer water from current agricultural use to industrial use. Any water transfer and new water development must meet different state and federal regulations. Eventually, whether enough water is available for tar sands development depends on the results of negotiations among various parties, including water right owners, state and federal agencies, and municipal water providers, as well as the developers.

**TABLE 6.2.6-7 Major Water Uses in the Next 20 Years in the Three-State Study Area Compared with Use for Potential Tar Sands Development**

| Available Water and Water Use | Annual Volume (× 1,000 ac-ft/yr) |
|---|---|
| Amount of legally available water from the Colorado River | 5,280 |
| Consumption uses, including export, agricultural, M&I, and evaporation | 4,140–5,200 |
| Range of net amount available | 80–1,040 |
| Water use estimates | |
| Commercial tar sands development on federal or nonfederal lands (individual 20,000 bbl/day tar sands facility)[a] | <1–5.4 |
| Commercial oil shale development on federal or nonfederal lands (individual 200,000 bbl/day in situ facility and ancillary facilities, including power plant)[a] | 19–35 |
| Commercial oil shale development on federal or nonfederal lands (individual 50,000 bbl/day surface mine/surface retort or underground mine/surface retort facility and ancillary facilities)[a] | 4.9–7.4 |
| Other development | |
| Oil and gas[b] | 1.6 |
| Coal mining[c] | 13.4 |
| Power plants[d] | 53 |
| Total other development | 68 |

[a] Includes processing and human consumption.

[b] Assumes that 3,000 wells are drilled per year and that each uses 0.55 ac-ft of water.

[c] Assumes 82 million tons of production per year; 20 million gal of water per million tons of coal mined is assumed for coal preparation, and 35 million gal of water per million tons of coal mined is assumed for dust control.

[d] Assumes a total of 9,940 MW new production from coal-fired power plants; water consumption of 8,000 ac-ft/yr per 1,500 MW (see Section 6.1.6.1-4).

Sources: SWCA (1997); BOR (2004, 2005, 2006, 2010).

Meeting the water requirements also depends on how many facilities are constructed, the technologies being used, and the locations of the sites. Using water conservation practices and transferring agricultural water rights to industrial rights (including tar sands development) could make more water available if extensive tar sands development is desired. Currently, most of the water use in the Upper Colorado River Basin is for agricultural purposes. The agricultural component ranges from 55% in the Upper Main Stem (Colorado River and its tributaries above the mouth of the Green River) to 87% in the San Juan–Colorado area (Colorado River and its tributaries below the mouth of the Green River and above Lee Ferry, Arizona) (BOR 2004, 2005, 2006, 2010).

**6.2.6.3.5 Air Quality.** Air resources in and around the study area would be affected by subsequent commercial development of tar sands. Local, short-term air quality impacts could be incurred as a result of PM and exhaust emission releases during construction activities. Similar short-term impacts could also occur in other areas where electric transmission or oil pipeline ROWs and other infrastructure would be developed. Longer term impacts on local and regional air quality and AQRVs could occur during normal project operations, such as mining and processing of the tar sands, and construction and operation of off-lease infrastructure, resulting in emissions of criteria pollutants and HAPs.

Oil and gas development, other minerals development, and other activities (e.g., agricultural development and residential development) would all involve impacts on local air quality during land clearing and construction because of increased PM emissions and exhaust emissions from construction equipment. There could also be regional impacts on air quality and AQRVs if these activities involved long-term emissions of criteria pollutants or HAPs at substantial levels. GHG emissions from oil shale development could contribute to climate change to some extent. The incremental impact of tar sands development activities to total cumulative impacts would be assessed during future site-specific NEPA analyses.

**6.2.6.3.6 Noise.** Noise is a transient problem; its impacts do not accumulate in the environment as do air and water pollutants. Attenuation mechanisms, such as geometric spreading, ground effects, and air absorption, dissipate noise energy within short distances form noise sources. In general, noise, except extremely loud noise, can travel a few miles even under nighttime temperature inversion conditions. However, cumulative noise impacts could occur with oil shale and tar sands development on federal and nonfederal lands, oil and gas development, surface and underground mining of coal, production of other minerals, and energy development (see Table 6.2.6-4); such impacts would depend critically on site-specific considerations and the proximity of the operations being considered to each other. The cumulative impacts of sufficiently separated noise sources are essentially the same as the noise impacts of each source considered separately.

Cumulative impacts also depend upon which phases in the lifetime of the sources being considered are occurring simultaneously. For example, construction associated with a tar sands facility would cause only a slight cumulative increase in the preexisting noise levels associated with a pumping station on an oil pipeline, while operation of the tar sands facility could cause a large increase over the preexisting levels around the facility and along nearby roads.

The construction noise impacts discussed in Section 5.7 are based on general considerations and are applicable to a wide range of construction projects. For many tar sands development projects, the leased area would be large enough that noise levels would be below EPA guideline levels at the site boundaries or at nearby sensitive receptors. Because of the probable large distance between projects, it is unlikely that construction of tar sands facilities would cause a substantial incremental increase in noise impacts over those associated with existing and reasonably foreseeable future projects. However, the construction of large-scale commercial tar sands projects involving the drilling of many wells could produce higher noise levels, with cumulative impacts. Also, if tar sands development is close to other projects and construction and worker vehicles from both projects use the same roads, there could be cumulative noise increases due to increased traffic on local roads. An estimate of cumulative impacts must be made during the assessment of site-specific impacts.

As noted in Section 5.7, adverse noise impacts could be associated with commercial tar sands facilities. Drilling and pumping in oil and gas recovery fields could also contribute to high cumulative noise levels, and mining operations could cause high noise levels in the vicinity of the mine. If these other activities occur in close proximity to tar sands development operations, the possibility of substantial cumulative impacts exists. However, these impacts cannot be estimated at this time given the lack of quantitative estimates for tar sands facilities and the lack of data on specific locations of other development activities. An estimate of cumulative impacts must be made during the assessment of site-specific impacts.

**6.2.6.3.7 Ecological Resources.** Cumulative impacts of commercial tar sands development on ecological resources in the three-state study area would result from the past, present, and future impacts of a wide variety of human activities, including agricultural development and production, grazing activities, range management, timber harvest and management, residential and commercial development, recreational activities, water resource development projects, mineral resource development, and energy development. The current status of ecological resources as described in Section 3.7 reflects the cumulative impacts of past and present activities. This section focuses on the incremental impacts of the tar sands development alternatives and a set of reasonably foreseeable future actions that are expected to occur or that could occur over the next 20 years if commercial tar sands projects are developed. Reasonably foreseeable future projects include oil and gas development, coal mining, mining of metals and minerals, energy transmission, electrical generation, and other activities, including grazing, fire management, forestry, and recreation as described in Section 6.2.6.2.

The cumulative impacts of greatest concern on ecological resources in the study area include loss or degradation of habitat and habitat fragmentation related to land disturbance, loss of individuals in populations (especially those of rare species), and changes in the availability and quality of surface water resources. All other factors described in Section 4.8.1 have the potential to contribute to cumulative impacts, but their contributions would be relatively minor and more localized.

Section 6.2.6.2 presents available information on the projected levels of development for major activities in the study area. Major increases in land disturbance from reasonably foreseeable projects total approximately 200,000 acres for the projected 20-year study period (Table 6.2.6-6). Land disturbance associated with individual commercial tar sands facilities could be up to about 9,500 acres.

Water depletions associated with reasonably foreseeable future actions over the next 20 years represent significant increases in cumulative water use in the study area (more than 68,000 ac-ft/yr of the 80,000 to 1.1 million ac-ft/yr potentially available). Existing water uses represent about 4.1 to 5.2 million ac-ft/yr. Water consumption associated with individual commercial tar sands development facilities would range from less than 1,000 to 5,400 ac-ft/yr;

water consumption associated with individual commercial oil shale development facilities would range from 5,000 to 35,000 ac-ft/yr (see Table 6.2.6-6).

Cumulative impacts on aquatic resources; plant communities and habitats; wildlife; and threatened, endangered, and sensitive species are discussed below.

***Aquatic Resources.*** The analysis of cumulative impacts on aquatic habitats and the organisms that inhabit those habitats considered the potential impacts of tar sands development in Utah together with impacts from other anticipated development activities, as described in Section 6.2.4.2. The types of impacting factors associated with these activities would be similar to those described for the direct and indirect effects of tar sands development, including (1) direct disturbance of aquatic habitats; (2) sedimentation of aquatic habitats as a consequence of soil erosion from nearby areas; (3) changes in water quantity or water quality as a result of changes in surface runoff patterns, depletions or discharges of water into nearby aquatic habitats, or releases of contaminants into nearby aquatic systems; or (4) changes in human access to aquatic habitats.

Direct disturbance of aquatic habitats can result from activities that occur within water bodies or within the active channel of streams and rivers. Such disturbance can occur as a result of mineral (e.g., gravel) extraction from streambeds; construction of stream crossings for pipelines, transmission lines, and roads; driving vehicles through or using heavy machinery within active channels; and from livestock that walk through waterways. There is a potential for all these activities to occur within STSAs, although it is generally anticipated that the related impacts would be relatively small and localized. Activities such as oil and gas development, mining, energy development, grazing, fires and fire management, and logging all affect erosion potential by disturbing soils and removing or altering vegetated cover. Such activities associated with other future projects are expected to result in a considerable increase in land disturbance in the vicinity of STSAs over the 20-year project time frame and could result in a considerable increase in sediments entering aquatic habitats.

As described in Section 5.8.1.1, construction activities for tar sands development could also directly disturb aquatic habitats and alter the potential for erosion and sedimentation within affected areas, depending upon the specific locations of leased parcels; the routes selected for transmission lines, roads, and pipelines; and the configuration of structures used for crossing those habitats. Although the direct disturbance and sedimentation of aquatic habitats resulting from tar sands development would likely be somewhat localized, such development could contribute substantially to the cumulative level of such impacts within affected watersheds.

In the absence of project-specific information, it was assumed that the potential for direct habitat disturbance and soil erosion and the resulting sediment loading of nearby aquatic habitats would be proportional to the amount of surface disturbance, the condition of disturbed lands at any given time, the proximity to aquatic habitats, and measures implemented to control impacts of erosion and sedimentation. Individual tar sands projects may contribute substantially to additional surface disturbance over the 20-year development period as compared with other activities planned within the study area, depending on location and size.

Activities within stream channels and the construction or placement of roads, culverts, and water diversion devices across or in waterways have a potential to fragment aquatic habitats by blocking upstream or downstream movements of aquatic organisms, as identified in Section 5.8.1.1. From a cumulative standpoint, some roadways, dams, water diversion devices, pipeline crossings, and other structures associated with existing development activities in the drainages associated with the STSAs may already contribute to such habitat fragmentation, and a large increase in such infrastructure would likely increase aquatic habitat fragmentation in the future. Areas surrounding and within the tar sands areas for which allocation alternatives are being considered in this PEIS currently contain a large proportion of oil and gas wells, and the associated structures (such as roads and pipelines) that occur within the Green River basin and the addition of tar sands development would be expected to further increase such fragmentation. The application of appropriate mitigation measures, such as controls on the designs of stream crossings, would reduce the potential for significant cumulative impacts to occur.

From a cumulative perspective, water quality within the vicinity of STSAs could also be affected by many human activities that introduce excess nutrients or contaminants into water bodies, including oil and gas development, coal mining, the construction of additional power plants, and grazing of livestock. Tar sands development has the potential to contribute to the degradation of water quality through the introduction of contaminants, either as leachate from spent tar sands or from spills or releases of oil, lubricants, and herbicides.

Within the arid regions of Utah where proposed tar sands development would occur, water availability is of great concern and results in conflicts over balancing water needs for current and future development with water needed to maintain ecological conditions in aquatic habitats. The anticipated water needs for individual tar sands facilities would range from less than 1,000 to 5,000 ac-ft/yr. One or more tar sands facilities utilizing amounts of water at the higher end of the range could contribute to adverse cumulative impacts on water availability.

Cumulative impacts on fisheries could result from increased public access to remote areas via newly constructed access roads and utility corridors and from the increased population levels that are likely to occur over the 20-year study period as a combined result of the reasonably foreseeable actions. The BLM has some limited means of mitigating the effects of increased fishing pressure. The State of Utah routinely monitors the condition of specific fisheries within the state and establishes and enforces regulations to maintain or improve the condition of those fisheries. Examples of regulations include limits on open fishing seasons and on the numbers, sizes, and species of fish that can be harvested from specific bodies of water. The state can also close streams to fishing. Assuming that the effects of such regulations are monitored and adjusted effectively, the overall incremental and cumulative impacts on fishery resources associated with increased access under the tar sands development alternatives are expected to be minor.

***Plant Communities and Habitats.*** Since the 1700s, wetland habitats have been severely impacted throughout the lower 48 states as a result of drainage and fill activities associated with agriculture, resource extraction, urban development, and other human activities; however, the rate of loss throughout the United States is currently much lower than historic levels

(Dahl 1990). Losses of wetland habitat have been fairly high in Colorado, Utah, and Wyoming. From the 1780s to 1980s, wetland losses in Colorado have been estimated to be approximately 50%, losses in Utah about 30%, and losses in Wyoming about 38% (Dahl 1990). Over the past several decades, federal agencies, such as the BLM, and state and private organizations have made considerable efforts to protect and restore wetlands and riparian habitats, and ongoing and planned wetland and riparian management programs are expected to continue to contribute to the improvement in wetland and riparian habitat function (BLM 2005j).

Human activities have also been impacting terrestrial habitats in Colorado, Utah, and Wyoming for many years. Species composition and diversity have been affected by fire suppression, heavy grazing, introduction of invasive species, and other factors (BLM 2005j). Habitat losses, fragmentation, and degradation have historically resulted from oil and gas development, mining, and other resource extraction activities that disturb surface soils. Although the BLM and other land management agencies have made considerable advances in habitat protection and restoration, ongoing resource extraction and other land uses are expected to continue to result in losses or changes to plant communities and habitats.

The factors that would affect plant communities and habitats as a result of tar sands development activities are also associated with a number of other activities that occur both within and outside of the STSAs. The ecoregions and associated plant communities that include the STSAs extend well beyond the STSA boundaries, and activities that occur outside the STSAs can also affect these habitats. Direct losses of habitat can occur as a result of oil and gas development, coal mining, mining of metals and minerals, energy development, and other activities. Approximately 200,000 acres could be directly impacted in Utah. Native plant communities can also be indirectly impacted or degraded by these activities. Impacts on water quality, surface water or groundwater flows, or air quality could adversely affect terrestrial or wetland plant communities, and changes in community characteristics, such as species composition or distribution, could result from vegetation disturbances related to some activities, such as grazing. Commercial tar sands development would constitute a substantial incremental increase to the impacts associated with other foreseeable activities.

***Wildlife.*** This section evaluates the potential cumulative impacts of tar sands development on wildlife, including wild horses and burros. The current status of wildlife and their habitats, as described in Section 3.8, reflects the cumulative impacts of past and present activities. This section focuses on the incremental impacts of tar sands development alternatives and a set of reasonably foreseeable federal and nonfederal activities as described in Section 6.2.6.2 that could occur over the 20-year study period. In addition to these activities, natural events (e.g., floods, droughts, and fires), disease, predation, and fluctuations in prey are among the natural phenomena that contribute to cumulative impacts on wildlife.

In general, the types of cumulative impacts on wildlife would be similar to the direct and indirect impacts associated with tar sands development (Section 5.8.1.3). Thus, cumulative impacts on wildlife resources would include (1) habitat loss, alteration, fragmentation, or enhancement; (2) disturbance or displacement; (3) mortality; (4) obstruction to movement; and (5) exposure to contaminants. The effects of these actions may include (1) immediate physical injury or death; (2) increased energy expenditures or changes in physiological condition that may reduce survival or reproduction rates; or (3) long-term changes in behavior, including the traditional use of ranges. Potential differences between cumulative impacts on wildlife and the impacts arising from the tar sands development activities alone would depend on the intensity (magnitude), scale (geographic area), duration, timing, and frequency of development activities. Although habitat protection and restoration activities are incorporated into most projects, some losses of or modifications to habitats are expected from most activities. Even without the potential impacts of commercial tar sands development, the projected major increases in land disturbance and water depletions resulting from other reasonably foreseeable future activities, taken together with the impacts of past and present actions, could result in significant cumulative impacts on wildlife.

Cumulative impacts of greatest concern on wildlife and their habitats include loss or degradation of habitat and habitat fragmentation related to land disturbance and changes in the availability and quality of surface water resources. The cumulative effects of numerous land use activities (e.g., livestock grazing, crop production, and energy development and associated infrastructure) have caused widespread habitat loss and fragmentation of sagebrush ecosystems (Knick et al. 2003). The avoidance by wildlife of areas near industrial developments that might otherwise be usable habitat (i.e., functional habitat loss) would also contribute to the cumulative loss of habitat associated with facility development. Also, developments could further obstruct wildlife movements. Habitat loss and fragmentation can be particularly devastating to sagebrush-dependent species such as sage-grouse and to big game species or other wildlife that have large home ranges or that make annual migrations among various habitats. Impacting factors can act synergistically and compound the importance of cumulative impacts. For instance, developments can result in extensive fragmentation that may leave only small, isolated areas of native vegetation. These areas are often more prone to invasive plant species and grazing by livestock, wild horses, or feral animals (BLM 2007g; Hobbs 2001).

Wildlife disturbance and mortality associated with activities such as recreation also could have significant and widespread impacts because of the high number of recreation use days. For example, more than 1.3 million visitor days were spent hunting, and nearly 1.6 million visitor days were spent snowmobiling or other winter motorized traveling on BLM-administered lands within Colorado, Utah, and Wyoming during FY 2004 (BLM 2007g). The other impacting factors discussed above have the potential to contribute to cumulative impacts, but their contribution would be relatively minor and more localized.

Other industrial developments could result in more workers within remote areas and increased public access because of new roads and ROWs. Increased access could result in increased hunting pressure and illegal poaching, depending on the locations and extent of development projects. Repeated intrusions (e.g., from recreationists) within a specific area have been shown to cause progressive declines in avian richness and abundance (Riffell et al. 1996). Traffic associated with industrial activities and recreation could result in additional roadkills. Also, structures associated with other industrial activities could increase the number of bird collisions. Increased densities of predators and scavengers attracted to areas of human activity may result in increased predation pressure on prey populations. Increased predation would be in addition to impacts associated with habitat loss, displacement, roadkills, collisions with structures and transmission lines, and other factors.

Site-specific mitigation, standard operating procedures, wildlife-related stipulations, reclamation and rehabilitation, and monitoring would minimize cumulative impacts on wildlife and their habitats (BLM 2006j, 2007g; DOI and USDA 2006; WGFD 2004). These measures would reduce the contribution of tar sands impacts to cumulative impacts throughout the project area. Also, implementation of state comprehensive wildlife conservation strategies and regional conservation plans would provide means of proactively minimizing cumulative impacts on wildlife and their habitats. For example, the *Heart of the West Conservation Plan* (Jones et al. 2004) identifies areas where habitat is critical for the continued viability of key species and communities and areas where development can occur with low risk to the welfare of ecosystems. The plan also presents means of restoring and maintaining the health and function of lands within the study region. Management of game populations and enforcement of hunting laws have reduced the risk of declines in the number of game species compared with historic levels (BLM 2007g).

***Threatened, Endangered, and Sensitive Species.*** In general, the cumulative impacts on threatened, endangered, and sensitive species would be similar to those described for other ecological resources. However, for many of the species, there would be a difference in the potential consequence of the impacts. Because of their small populations, threatened, endangered, and sensitive species are far more vulnerable to impacts than more common and widespread species.

The current status and distribution of ESA-listed species, BLM-designated sensitive species, and state-listed species are presented in Section 3.7. Current status and distribution reflect the cumulative effects of past and present human activities and natural limiting factors. Some species are considered threatened, endangered, or sensitive in the area because cumulative impacts have resulted in a reduction in numbers that has increased the chances the species would become extinct in the near future (e.g., black-footed ferret, Canada lynx, and whooping crane). Other species (e.g., Graham's beardtongue) are considered vulnerable because their specific ecological requirements result in limited distributions and smaller population sizes that are less resilient. For either group of species, any incremental addition to cumulative impacts could be considered significant.

The potential direct and indirect impacts of commercial tar sands development on threatened, endangered, and sensitive species are listed in Table 5.8.1-4 and discussed in Section 5.8.1.4. The evaluation in that section indicates the potential for adverse impacts on most of the species in the study area. Contributions to cumulative impact are associated with direct effects (e.g., vegetation clearing, habitat fragmentation, and water depletion) and indirect effects (e.g., sedimentation from runoff, fugitive dust, and disruption of groundwater flow patterns). Even without the potential impacts of commercial tar sands development, the projected major increases in land disturbance and water depletions resulting from reasonably foreseeable future activities, taken together with the impacts of past and present actions, could result in significant cumulative impacts on these species.

Each alternative would require adherence to BLM policy on the protection of sensitive species and appropriate project-specific ESA Section 7 consultation with the USFWS. These latter consultations must include a consideration of direct, indirect, and cumulative effects on listed species under the ESA. Adherence to BLM policy and consultation with the USFWS are expected to reduce, but not eliminate, the contribution of commercial tar sands development to cumulative impacts both under NEPA and the ESA.

**6.2.6.3.8 Visual Resources.** Visual impacts associated with construction and operation of commercial tar sands projects that may occur on federal and nonfederal lands in Utah would likely have cumulative impacts in the context of other development activities under way or planned in the affected areas, as described in Section 6.2.6.2. These development activities could have large visual impacts where concentrated development activity occurs. Where construction and operation of a commercial tar sands project on federal lands occurs in the same areas as these other development activities, the visual absorption capability of some landscapes could be exceeded. Incremental visual impacts may be of particular concern where tar sands projects, related infrastructure, and other development activities would be located near sensitive visual resources in landscapes with low visual absorption capability, and/or where the tar sands and other development would be located in the viewsheds of visually sensitive linear features such as scenic and historic trails, highways, or scenic rivers. Careful siting of facilities and application of mitigation measures along with conformance with BLM VRM classes would protect visual values in more sensitive areas from large impacts associated directly with the tar sands projects. However, the addition of the impacts from the tar sands projects to the impacts from other development activities could considerably degrade visual qualities. For VRM Classes I through III, the classifications would likely change; Class IV areas would likely degrade further. Also, the VRM classes of surrounding areas within view of the facilities may change.

Further cumulative visual impacts could occur because the presence of the tar sands projects would likely bring workers and their families to live in local communities and to recreate in the surrounding areas. Also, the roads and other infrastructure associated with the projects could cause increased visitation and usage of remote areas (e.g., OHV use). The increases in population and access could result in urbanized development that would contrast sharply with more natural-appearing existing landscapes; add to visual clutter around existing urbanized areas; increase visible human and vehicular activity in remote areas; degrade air quality (thereby negatively affecting long-distance views); and result in litter, erosion, and other visual changes that would not harmonize with the naturally occurring forms, lines, colors, and textures of existing landscapes.

**6.2.6.3.9 Cultural Resources.** Disturbances from tar sands development, combined with other surface-disturbing development activities, could uncover or destroy cultural resources on BLM-administered land and on other lands. Given the large areas of surface disturbance projected from tar sands development and from other activities (Table 6.2.6-6) in the study area during the 20-year study period, it is likely that many locations would require cultural resource evaluations and subsequent mitigative actions. Conducted according to professional standards, these evaluations and mitigations would increase knowledge about cultural resources in the region. However, there would inevitably be some loss of information about individual sites. Unless a concentration of unique resources is found to exist within a small area and that area is the location of tar sands development, these individual site losses from construction and operation of an oil shale facility would be unlikely to have a major incremental adverse impact on cultural resources in the area.

**6.2.6.3.10 Indian Tribal Concerns.** Tar sands development combined with other development activities could destroy, damage, or degrade resources important to Native Americans. Surface-disturbing activities could destroy or damage archaeological sites and burials and plant, animal, mineral, and water resources important to Native American culture and religious practices. The very presence of industrial development facilities could result in visual and auditory intrusions into sacred locations, landscapes, and viewsheds important to Native Americans. The extent to which these resources would be disturbed would be dependent on their location relative to development. Given the amount of development projected for the study area in the next 20 years, it is likely that resources important to Native Americans could be affected. The incremental adverse effect of the construction and operation of tar sands operation on these resources would depend on site-specific factors. Consultation with affected federally recognized tribes by the BLM and tar sands developers could result in the avoidance or amelioration of adverse effects. A major incremental impact on resources important to Native Americans from the construction and operation of a tar sands facility in the area is unlikely.

**6.2.6.3.11 Socioeconomics.** Economic impacts can be measured in terms of changes in employment in the study area in which tar sands resources are located. Because of the relative economic importance of tar sands developments in small rural economies and the consequent lack of available local labor and economic infrastructure, tar sands development may mean a large influx of population. Because population increases are likely to be rapid and local communities would be unable to quickly absorb new residents, there would also be impacts on housing in the study area.

The impacts of tar sands development include wage and salary expenditures associated with the construction and operation of the facilities, material procurement and wage and salary expenditures associated with the construction of temporary housing in the ROI for workers and family members, and wage and salary spending associated with indirect workers required to provide goods and services resulting from increases in economic activity in the ROI. Overall, tar sands development could produce a substantial number of jobs, depending on the scale of development (e.g., for an individual facility, about 550 jobs during the construction of temporary housing, about 1,800 jobs during construction of tar sands facilities, and about 750 jobs during operations [see Table 5.12.1-1]).

Population in-migration would occur also with tar sands resource development. Workers would be required to move into the region during construction and operation of tar sands facilities. Workers would also be required to move into the region to facilitate the demand for goods and services resulting from the spending of tar sands worker and housing construction worker wages and salaries.

A substantial number of oil and gas wells are projected for the area beginning in 2008, producing about 8,900 direct jobs, and an estimated 23,000 total (direct and indirect) jobs in each year through 2027 (Minnesota IMPLAN Group, Inc. 2007). Development of coal resources in the three-state area is also expected to produce 15,000 direct jobs and 33,000 total jobs each year between 2008 and 2027. Oil and gas and coal development alone could result in an increase of about 10 to 20% in total employment in the region over 20 years, and in a population increase of about 2 to 4%, if these activities require population in-migration. It is not known whether development of oil and gas and coal resources in the three-state region would require the in-migration of construction and operations workers, or the construction of additional temporary housing.

Rapid population growth in small rural communities hosting large resource development projects could also produce social and psychological disruption and undermine established community social structures (see Section 5.12.1.2). Various studies have suggested that social disruption may occur in small rural communities when annual population increases are 5 to 15%.

On the basis of the employment estimates given above, reasonably foreseeable oil and gas and coal production in the study area is estimated to have a larger socioeconomic impact than a single tar sands facility. However, depending on the future level of tar sands development and given the estimated population increases due to construction and operation of a single tar sands facility, there may be substantial incremental socioeconomic impacts (e.g., interruption of community services, impacts on availability of housing, social disruption, decreases in property value and loss of employment and income in the recreation sector) from tar sands development when considered in conjunction with the other ongoing and reasonably foreseeable activities in the study area.

Cumulative impacts on transportation systems and traffic levels would be related to both employment and freight requirements to service projects. Overall, tar sands development could produce a substantial number of jobs, depending on the scale of development (see above). Transportation impacts would be additive to other activities taking place on private and public lands. Substantial increases in traffic flow and in transportation infrastructure maintenance requirements would be expected to support tar sands operations.

**6.2.6.3.12 Environmental Justice.** Construction and operation of tar sands facilities and employer-provided housing could impact environmental justice if any adverse health and environmental impacts resulting from either phase of development were high and if these impacts disproportionately affected minority and low-income populations. Disproportionality is determined by comparing the proximity of high and adverse impacts with the location of low-income and minority populations. As described in Sections 6.2.6.3.1 through 6.2.6.3.10, tar sands development in conjunction with other ongoing and reasonably foreseeable activities may potentially have high and adverse effects on several resources, including local demographics, social disruption, property values, noise and visual impacts, land use and water quality, and air quality.

There are a number of census block groups in Utah with low-income and minority populations, where the minority population exceeds 50% of the total population in each block group. There are also block groups in the state where the minority share of total block group population exceeds the state average by more than 20 percentage points (see Section 3.10). Given the potential for high and adverse incremental impacts on a number of resource areas from tar sands development in conjunction with oil, gas, coal, and potential oil shale development and given the existence of environmental justice populations in the state, impacts on these resources could disproportionately affect minority and low-income populations. Of particular importance would be the impact of large increases in population in small rural communities on social disruption, the undermining of local community social structures, and the resulting deterioration in quality of life. The impacts of facility operations on air and water quality and on the demand for water in the region could also be important. Impacts on low-income and minority populations may also occur with the development of transmission lines associated with tar sands facilities in each state, depending on the location of these infrastructures. Land use and visual environmental justice impacts might be significant depending on the locations of land parcels impacted by all these activities. Cumulative impacts on environmental justice would be evaluated in future NEPA analyses when the locations and sizes of the projects in relation to low-income and minority populations are known.

#### 6.2.6.3.13 Hazardous Materials and Waste Management.

***Wastes Associated with Oil and Gas Development.*** Table 6.2.6-4 estimates that an average maximum of 230 oil wells would be drilled per year among the seven Utah study areas addressed in this analysis. Oil and gas development can involve three basic stages: exploration, well development, and production. Exploring for and locating and characterizing the petroleum resource can involve the installation of a relatively small number of small-bore wells to collect geologic cores for inspection and analysis. Increasingly, exploration is conducted with nonintrusive technologies, and wastes associated with exploration are limited and inconsequential.

Well development produces the greatest volume and array of wastes. Wells drilled on BLM-administered lands would be subject to the requirements and BMPs contained in the BLM *Gold Book* (DOI and USDA 2006) and any additional requirements established as lease stipulations by the BLM field office. Waste management for wells installed on private property is expected to be in accordance with accepted industry practice. Each well installed would generate well development fluid wastes and waste cuttings, some of which may have oil contamination from the formation being exploited. However, unless the well progresses through previously contaminated subsurface zones or encounters contaminated groundwater, the waste typically associated with well installation would not exhibit hazardous character and can be expected to be managed according to standard practices.

Well development fluids[30] would be collected on-site for reuse and/or disposal; free water separated from development fluids and drilling muds would be verified as being free of unexpected contamination and released to the ground surface; drilling muds such as bentonite clays would be accumulated on-site for recovery and reuse; and drill cuttings would be verified as being free of contamination and disposed of at the land surface, usually in the vicinity of the well.[31] Special management would be required for development fluids, drilling muds, and produced water that exhibit contamination from NORM or brackish character. All NORM-contaminated wastes would be collected and delivered to properly permitted treatment and disposal facilities. Brackish water would be either reinjected down the well (or an injection well) or collected for delivery to treatment facilities. Likewise, downhole equipment removed from the well and found to have NORM contamination would be managed in the same manner. It is assumed that all the drill rigs used for well development would be portable and would not undergo routine servicing (except for maintenance of fluid levels) at the well site. No wastes associated with drill rig operation and maintenance (e.g., maintenance of the rig's diesel engine) are expected to be generated at wellheads, but may be generated elsewhere in the study area where the rigs are serviced.

Oil and gas formation fracturing also produces large volumes of liquids wastes. Fracturing (known as "fracking" in the oil and gas industry) is a process that uses high hydraulic pressure to crack the hydrocarbon-containing formation. This process increases the flow rate and volume of hydrocarbon fluids that move from the producing formation into the wellbore and aids extraction of oil and gas deposits that might otherwise be left behind. Hydraulic fracturing is a 60-year-old process that is now being used more commonly as a result of advanced technology.

Fracturing fluids carry sand or other small particles of material (proppants) into the newly created crevices to keep the fractures open when the pressure is relieved. Hydraulic fracturing fluids generally consist of 90% water, 9.5% sand, and 0.5% chemical additives. The chemicals are used to enhance fracturing and to protect the well integrity (API 2010). As many as 750 different chemicals were used by the oil and gas industry for hydraulic fracturing between 2005 and 2009. A list of chemicals used is provided in *Chemicals Used in Hydraulic Fracturing*, prepared by the U.S. House of Representatives Committee on Energy and Commerce (2011).

To protect groundwater from potential contamination from oil and gas drilling on public lands, including fracking operations, the BLM approves and regulates all drilling and completion operations, and related surface disturbance. Prior to approving a drilling permit, a BLM geologist

[30] Well development fluids are water-based (most frequently used), petroleum-based (used primarily in very deep wells where high temperatures may be encountered [usually > 10,000 ft], or in directional drilling where greater lubricity is required for the drill bit), or composed entirely of synthetic chemicals (e.g., linear alkyl olefins, synthetic paraffins, and alkybenzenes). They perform a number of functions, including cooling and lubricating the drill bit, carrying cuttings up the borehole to the surface, and temporarily filling the well bore with material that is sufficiently dense to prevent the premature inflow of groundwater, other fluids (e.g., oil), or subsurface materials that would collapse the borehole before casings are installed. Development fluids will also typically contain various other chemicals, such as naturally occurring clays (referred to as drilling muds), dispersants, corrosion inhibitors, flocculants, surfactants, and biocides, to enhance their overall performance.

[31] Although drill cuttings will, in most cases, be nonhazardous, care must nevertheless be exercised in their disposal so as not to significantly alter surface drainage patterns or release sediments to area surface waters.

identifies all potential subsurface formations that will be penetrated by the wellbore and provides that information to a BLM petroleum engineer who reviews proposed casing and cementing programs. During drilling, the BLM is on location during the casing and cementing of the groundwater surface and other critical intervals.

The 2005 Energy Policy Act exempted the injection of fracking fluids from the Safe Drinking Water Act's Underground Injection Control Program. The Act, however, did allow the EPA to continue regulating the use of diesel fuel in fracking fluids. In addition, the EPA is studying the potential impacts of hydraulic fracturing on drinking water resources while developing permitting guidance. A database of BMPs for hydraulic fracturing is available on the Intermountain Oil and Gas BMP Project Web site (University of Colorado Law School 2011).

Onshore Order No. 2 details national standards for levels of performance expected from lessees and operators when conducting drilling operations on federal and Indian lands, including casing and cementing requirements to ensure well integrity. The BLM's casing and cementing programs are conducted such that they protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. The State of Colorado, through the Colorado Oil and Gas Conservation Commission (COGCC), has established regulations that require wells to be cased with steel pipe and the casing to be surrounded by cement to create a hydraulic seal with the well bore. About 95% of new oil and gas wells in Colorado, Utah, and Wyoming are fractured. The majority of fluids used in the fracturing process are recycled, and no fluids are sent to wastewater treatment plants. Of the remaining fluids, 60% goes into deep waste injection wells, 20% evaporates from lined pits, and 20% is discharged as usable surface water under permits from the Colorado Water Quality Control Commission (BLM 2011).

As of September 2010, the Wyoming Oil and Gas Conservation Commission (WOGCC) required disclosure of the types and amounts of chemicals used in fracking operations (University of Colorado Law School 2011). In Utah, oil and gas development would be subject to ongoing groundwater protections as outlined in BLM Instruction Memorandum UT 2010-055, *Protection of Ground Water Associated with Oil and Gas Leasing, Exploration and Development* (BLM 2010).

Products recovered from oil and gas wells are typically complex mixtures of oil, hydrocarbon gases, other gases such as $H_2S$, water, suspended solids such as sand and silt, chemicals injected to enhance recovery, and water/oil emulsions. Actions to separate these phases are performed at the wellhead or at a central processing facility.

Produced water (water recovered from the oil- or gas-bearing formations or other subsurface formations) is by far the largest volume of waste produced during well production. Produced water is typically discharged back down the well or through a second injection well completed in the same formation. Produced water can also be used for nonpotable purposes, such as fugitive dust control, provided it is free of contamination from polar organics (e.g., benzene, naphthalene, toluene, and phenanthrene), inorganics (e.g., lead, arsenic, and sulfide), or NORM and exhibits no brackish character. Produced water may also need special management because of high concentrations of sodium, chloride, calcium, or magnesium. Discharge of high-salinity waters to the ground surface or surface waters would be prohibited, and capture and treatment or reinjection would be required.

The exact natures and volumes of well development–related wastes would depend on numerous site-specific factors; however, reliable approximations are possible. Over the study period, it is projected that about 3,000 wells per year would be installed in the study area, resulting in the generation of large volumes of development fluids and produced water. Some tar sands facilities might also generate large volumes of produced water. If all the wastes are managed appropriately, incremental cumulative impacts from disposal of these wastes should be minimal. All the wastes are expected to be managed in much the same manner as the wastes of these types currently being generated within the study area.

***Wastes Associated with Mining of Coal and Other Minerals.*** Wastes associated with coal mining include landscape wastes from clearing active mine areas, solid industrial wastes resulting from the maintenance and repair of mining equipment, overburden soils (topsoils and subsoils) removed to gain access to the coal resource,[32] and domestic solid wastes resulting from support of the workforce,[33] produced water, and wastes from coal preparation (e.g., shale, coal fines, and other impurities). Produced water would likely require treatment because of the leaching of metals from the coal resource or to adjust its pH. Treatment might result in the generation of metal-bearing sludge that would require off-site disposal in most instances. Coal preparation wastes are typically disposed of on-site or stockpiled for later use in mine reclamation.

Recoverable coal deposits exist primarily in two study areas, Henry Mountain and San Rafael. Projected coal production within those two study areas over the entirety of the study period (2012 to 2032) is projected to be 25 million tons per year at Henry Mountain and 4.8 to 9 million tons per year from deposits with the San Rafael study area. The amounts of solid wastes generated are proportional to total coal mined, but would vary significantly with the particular mining techniques employed and the extent of coal preparation occurring at the mine site. Tar sands development using surface mining would generate waste streams similar to those produced during coal mining. At the PEIS level, it is not possible to estimate the nature or volumes of solid wastes within tons of coal or tar sands mined. Cumulative impacts of hazardous materials generation and waste management would be evaluated in future NEPA analyses when the locations and sizes of the projects are known.

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[32] Although overburden must be managed carefully to avoid adverse impacts (primarily increased sediment loading to area surface water bodies due to erosion), it is not considered a waste; it is typically stockpiled over the active life of the coal mining operation and replaced (in the order of the original soil horizon) as part of mine reclamation.

[33] It is assumed that the workforce would not be quartered at or near the coal mine but instead would live in nearby communities. Consequently, wastes related to workforce support would be minimal, consisting primarily of kitchen/food preparation solid wastes, small amounts of administrative (office) solid wastes, and small amounts of sanitary wastes.

Only limited production of noncoal minerals is projected to occur. Phosphate mining is expected to occur only in the Diamond Mountain study area; gilsonite is expected to occur only within the Book Cliffs area (at 60,000 tons/yr). Although there is high potential for occurrence of uranium, vanadium, gold, and copper in the Henry Mountain study area, no significant production is predicted; gypsum production is expected to occur only in the San Rafael study area. However, stone, sand, and gravel would occur throughout all the study areas.

Mineral (e.g., copper, gold, and silver) mining and processing can generate wastes during recovery (i.e., mining), beneficiation (separation of mined material), and processing. Recovery can result in large volumes of overburden materials needing management, as discussed above for coal mining. Although those materials are generally not considered waste, they must be managed properly to avoid adverse impacts. Beneficiation can result in the generation of relatively large volumes of potentially hazardous material. This material, referred to as tailings, is processed through dump leaching, in which solutions containing strong acids or cyanides are sprayed onto the tailings to "leach" the metal of interest for capture. The tailings can be voluminous (EPA 1994) and hazardous. Processing of the mineral ore involves a variety of chemical and physical manipulations that produce a wide variety of wastes, many of them capable of producing significant adverse environmental impacts if not managed properly. In 1985, the EPA published a *Report to Congress* on the environmental aspects of non-coal-mining activities; the report provides relatively comprehensive discussions of possible environmental impacts, including the types of wastes resulting from typical recovery, beneficiation, and processing schemes for selected metals (EPA 1985).

Phosphate mining involves a complex array of washing, flotation, and separation actions to produce the desired product, each step also resulting in waste. The EPA has published a report in which typical phosphate mining and beneficiation activities are defined (EPA 1994). After brush and overburden have been removed to expose the phosphate deposit known as a matrix ore (mixture of clays and phosphate), draglines excavate the matrix ore and deliver it for beneficiation and processing. This is accomplished through a series of washing steps, followed by a flotation step, augmented by the addition of a mixture of fatty acids and re-refined oil and ammonium hydroxide (for pH adjustment). Sulfuric acid and amines are used to further separate and purify products recovered from the initial flotation steps. The solids recovered from initial flotation steps are technically "tailings." However, clays and other minerals such as magnesium oxide are also recovered from flotation steps and are typically sold as by-product materials rather than disposed of as wastes. Solids recovered from final flotation steps are typically managed as wastes, although some beneficial uses (e.g., construction materials and fill) have been identified. The phosphate solution recovered from the final flotation steps is dewatered to produce the final product. Most chemicals added to enhance flotation can be recovered for reuse, but many become contaminants in tailings wastes. Those tailings not put to beneficial use are typically disposed of on the mine site.

Similar to metallic ores and phosphate development, tar sands development could generate produced water and large volumes of overburden; however, tailings would not be generated. Cumulative impacts of hazardous materials generation and waste management would be evaluated in future NEPA analyses when the locations and sizes of the projects are known.

***Wastes Associated with Designation and Development of Energy Corridors.*** The designation of energy corridors within the study area is not, in and of itself, expected to have any waste consequences. Waste would, however, be generated during actual corridor development for gas and liquid pipelines and for electric power transmission systems on public and private lands.

Solid wastes associated with gas and liquid pipelines and with power transmission systems would be generated during construction, operation, and decommissioning. The majority of wastes would be generated during the construction phases. Construction wastes would include wastes generated during preparation of the ROW (consisting primarily of removed vegetation) and during installation of the pipeline or cables (primarily, maintenance-related wastes for vehicles and equipment, dunnage, packaging, some chemical cleaner wastes). Support of the workforce would result in the production of domestic solid wastes and sanitary wastewaters. It is expected that the majority of construction-related wastes would be nonhazardous and would be managed in existing local landfills or in existing municipal or specially built sewage treatment facilities.

Operational wastes result from the maintenance of equipment (e.g., change-outs of lubricating oils, coolants, and hydraulic fluids from equipment utilizing such materials, and sludge from the periodic cleaning of the insides of the pipelines through the use of pigs). The frequency of cleaning and the amount of waste generated are a function of the commodity being transported, with the greatest amounts of pipeline cleaning–related wastes generated for pipelines conveying crude oil.

Solid wastes associated with the decommissioning of pipelines or power transmission systems include wastes from the cleaning of equipment, as well as some of the pipeline components. For pipelines, it is expected that much of the underground pipeline may be abandoned in place, and for those pipeline components that are removed, the majority would be put into service in other pipeline systems or sold for scrap. As is the case during the construction phase, solid domestic and sanitary wastes would be generated (albeit in lesser amounts because decommissioning is expected to take substantially less time than initial construction) in support of the workforce, and all such wastes would likely be managed or disposed of in existing facilities. Finally, a certain volume of remedial wastes can be expected to result from the cleanup of spills or leaks that were not removed during operation or occurred during decommissioning.

The construction of gas and liquid pipeline ROWs and transmission ROWs to support tar sands development would generate similar types of waste to those discussed above. Large numbers of gas and liquid ROWs are already present on public lands in the study area, and many more areas may be designated as corridors for ROWs during the study period (see Section 6.2.4.2). Incremental impacts from waste generation and disposal would depend on the level of tar sands development and would be assessed in future site-specific environmental evaluations.

***Wastes Associated with Oil Shale Development.*** Wastes that would be generated from oil shale development would be of the same nature as those described in Section 4.13.

Incremental impacts from waste generation and disposal due to tar sands development would depend on the level of tar sands development and would be assessed in future site-specific environmental evaluations.

**6.2.6.3.14 Health and Safety.** Given the large amount of development for oil and gas, coal mining, and other mineral production projected in the study area over 20 years, many workers will be needed. The types of industries being developed, especially mining, have been associated with relatively high numbers of worker injuries and fatalities in the past (see Section 5.14). Tar sands production activities would add to worker injuries and fatalities in proportion to the level of development. Without more detailed information on future production levels for tar sands as well as the other industries, quantitative estimates of incremental health and safety impacts due to tar sands development are not possible. However, all these industries are required by law to protect worker health and safety using adequate engineering controls and personal protective devices.

## 6.2.7 Other NEPA Considerations

### 6.2.7.1 Unavoidable Adverse Impacts

The amendment of land use plans to identify public lands as available or not available for application for leasing for commercial tar sands development would not result in unavoidable adverse environmental impacts under Alternative 2, 3, or 4, but there may be impacts on land values. Under any of the alternatives, the future development of commercial tar sands projects could also result in unavoidable adverse impacts on natural resources. The magnitude of these unavoidable adverse impacts, as well as the degree to which they could be mitigated, would vary by project type and location. Many of the project-specific impacts could be reduced through implementation of the mitigation practices identified in this PEIS (see Chapter 5).

**6.2.7.1.1 Land Use.** No adverse impacts on land use would occur from the identification of lands as available or not available for application for leasing and associated land use plan amendments under Alternative 2, 3, or 4. However, the future development of commercial tar sands projects within the areas identified as available for leasing would result in unavoidable changes in land use in the areas undergoing project development. Land uses that could be affected by the construction and operation of commercial tar sands projects may include livestock grazing, agriculture, oil and gas leasing, minerals extraction, and recreation.

**6.2.7.1.2 Soil, Geologic, and Paleontological Resources.** No adverse impacts on geologic and paleontological resources would occur under Alternative 2, 3, or 4 from the identification of lands as available or not available for application for leasing and the associated land use plan development. Unavoidable adverse impacts could occur in the future under any of the alternatives as a result of commercial project construction and operation. Project construction could result in unavoidable impacts on natural topography, soil erosion, drainage patterns, and slopes, as well as discovery damage or destruction of paleontological resources within project footprints. Project construction could also result in the compaction, excavation, and removal of soil from the project area. The likelihood, magnitude, and extent of unavoidable impacts could be reduced under both alternatives through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.3 Water Resources.** The identification of lands as available or not available for application for leasing and associated land use plan amendments would not adversely impact water resources (either surface water or groundwater) under any of the alternatives. Unavoidable adverse impacts could occur as a result of construction and operation of commercial tar sands projects in the lease areas. Water quality could be impacted as a result of soil erosion from construction sites; runoff from mine areas, tar sands processing, and waste storage locations; and accidental spills of hazardous liquids (such as fuels, lubricating oils, solvents, and other industrial liquids) and accidental oil spills from project-related pipelines. Although there is a potential for unavoidable adverse impacts on water resources from future commercial development under any of the alternatives, the likelihood, magnitude, and extent of impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.4 Air Quality and Ambient Noise Levels.** No adverse impacts on air quality or ambient noise would occur from the identification of lands as available or not available for application for leasing and associated land use plan amendments under Alternative 2, 3, or 4. Unavoidable adverse impacts could be incurred during the construction and operation of future commercial tar sands projects in the lease areas under any of the alternatives. Construction, clearing and grading, trenching, excavation and blasting, and construction vehicle traffic would result in fugitive dust and vehicle emissions as well as increased ambient noise levels in construction locations. During project operations, unavoidable air impacts would occur primarily during operation of mining and tar sands processing facilities and equipment and associated vehicular traffic. Noise impacts could also be incurred as the result of these activities, as well as from the operation of pipeline compressor stations. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.5 Ecological Resources.** No adverse impacts on ecological resources would occur as a result of the identification of lands as available or not available for application for leasing under all four alternatives and associated land use plan amendments under Alternatives 2, 3, and 4. Unavoidable adverse impacts would occur under all alternatives as a result of commercial development of tar sands projects. The construction and operation of project facilities, as well as the maintenance of project-related utility, pipeline, and transportation ROWs, under each alternative could result in unavoidable temporary and permanent changes in aquatic resources, plant communities and habitats, wildlife, and threatened and endangered species.

Ecological resources immediately within a project footprint would be destroyed during clearing, grading, and construction activities. Unavoidable impacts on wildlife could include habitat loss, disturbance and/or displacement, mortality, and obstruction to movement. Increased noise during project construction and operation could disrupt local wildlife foraging and breeding of some wildlife. Aquatic biota and habitats could be affected by siltation resulting from runoff from areas of disturbed soils and from accidental releases of hazardous materials from construction and operations equipment (such as fuels) and from an accidental oil pipeline release. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.6 Visual Resources.** No adverse impacts on visual resources would occur from the identification of lands as available or not available for application for leasing and associated land use plan amendments under Alternative 2, 3, or 4. Unavoidable adverse impacts would occur under all alternatives during the construction and operation of future commercial tar sands projects. Under each alternative, short-term impacts could occur during construction. Fugitive dust and the presence of construction equipment and crews would be visible in the vicinity of the construction site, potentially affecting local viewsheds and recreational experiences. Because project-specific ROWs and infrastructure (e.g., electricity transmission towers, pipelines and compressor stations, surface mines, and tar sands processing facilities) would be visible throughout the life span of any project, there could be long-term unavoidable impacts on some viewsheds and the recreational experiences of visitors in those viewsheds. The likelihood, magnitude, and extent of unavoidable adverse impacts could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.7 Cultural Resources.** No adverse impacts on cultural resources would occur from identification of lands as available or not available for application for leasing and the associated land use plan amendments under Alternative 2, 3, or 4. However, leasing itself has the potential to impact cultural resources to the extent that the terms of the lease would limit an agency's ability to avoid, minimize, or mitigate adverse effects of proposed commercial tar sands development on cultural properties. Unavoidable adverse impacts could occur as a result of the development of commercial tar sands projects in areas identified as available for application for leasing under all four alternatives. Under both alternatives, cultural resources could be destroyed by construction activities such as clearing and grading, mining, facility construction, and pipeline trenching. Development of new ROWs could also increase access to previously inaccessible areas, which could lead to vandalism of both known and undiscovered cultural sites. The likelihood, magnitude, and extent of unavoidable adverse impacts on cultural resources could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.8 Indian Tribal Concerns.** No adverse effects on resources important to Native Americans would occur from the identification of lands as available or not available for application for leasing and land use plan amendments under Alternatives 2, 3, and 4. However, these resources could incur unavoidable adverse impacts as a result of any future development of commercial tar sands projects in areas identified as available for application for leasing under all four alternatives, depending on the location of the project in relation to resources important to Native Americans. Resources could be destroyed by construction activities, such as clearing and grading, mining, facility construction, and pipeline trenching. The visual and auditory context of sacred sites could be impaired. Development of new ROWs could also increase access to previously inaccessible areas, and this could lead to vandalism of culturally important sites. The likelihood, magnitude, and extent of unavoidable adverse impacts on resources important to Native Americans could be reduced under each alternative through government-to-government consultation with the affected tribes and the implementation of appropriate project- and location-specific mitigation measures, but may not be entirely avoidable.

**6.2.7.1.9 Socioeconomics and Environmental Justice.** With the exception noted for potential impacts on land values, the identification of lands as available or not available for application for commercial leasing under all four alternatives would not result in any adverse socioeconomic, transportation, or environmental justice impacts. Unavoidable adverse social and environmental justice impacts could occur under all four alternatives as a result of construction and operation of commercial tar sands facilities and the associated transportation infrastructure and employer-provided housing. Rapid population growth following the in-migration of construction and operations workers associated with tar sands and ancillary facilities into communities could lead to the undermining of local community social structures with contrasting beliefs and value systems among the local population and in-migrants and, consequently, to a range of changes in social and community life, including increases in crime, alcoholism, drug use, and so forth. Impacts may also occur in association with the degradation of air and water quality, increases in traffic and congestion, visual resources, and removal of land from traditional uses during commercial project development. Many of these impacts would affect quality of life for the general population in many communities, in addition to that for low-income and minority populations residing in the vicinity of commercial tar sands developments. Although many locations of cultural significance to tribal groups may have been protected or identified, impacts of commercial tar sands developments may also occur with the alteration of, or restricted access to, water and visual resources; the degradation or migration of particular animal species; and the resulting impacts on subsistence and traditional landscape-based activities important to tribal groups.

**6.2.7.1.10 Hazardous Materials and Waste Management.** No adverse impacts from hazardous materials and waste management would occur from the identification of lands as available or not available for application for leasing and the associated land use plan amendments under Alternative 2, 3, or 4. Unavoidable adverse impacts could occur as a result of the potential future development of commercial tar sands projects in the areas identified under all four alternatives. Construction and operations of tar sands projects would result in the use of hazardous materials and the generation of hazardous and nonhazardous wastes, including materials typically utilized during construction and operations (e.g., fuels, lubricating oils, hydraulic fluids, glycol-based coolants and solvents, adhesives, corrosion control coatings, and herbicides for vegetation clearing). During construction, nonhazardous landscape wastes would be generated. In general, the appropriate management of these materials would result in only minor impacts. Disposal of spent tar sands within the leased area could result in unavoidable adverse impacts. The likelihood, magnitude, and extent of unavoidable adverse impacts from hazardous materials and waste management could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

**6.2.7.1.11 Health and Safety.** No adverse impacts on health and safety would occur from the identification of lands as available or not available for application for leasing and the associated land use plan amendments under all four alternatives. Unavoidable adverse impacts could occur as a result of the potential future development of commercial tar sands projects in the areas identified under all four alternatives. Hazards for workers at tar sands development facilities include risks of accidental injuries or fatalities, lung disease caused by inhalation of particulates and other hazardous substances, and hearing loss. A comprehensive facility health and safety plan and worker safety training would be required as part of the plan of development for every proposed commercial tar sands project. The likelihood, magnitude, and extent of unavoidable adverse impacts on health and safety could be reduced under each alternative through the implementation of appropriate project- and location-specific mitigation measures.

### 6.2.7.2 Short-Term Uses of the Environment and Long-Term Productivity

The amendment of land use plans to identify lands as available or not available for application for leasing for commercial tar sands development would not affect the short-term uses or long-term productivity of the environment. The impacts (short- and long-term) from utilization of resources associated with project development under all four alternatives are presented in Chapter 5. For this PEIS, *short-term* refers primarily to the period of construction of a commercial tar sands project; it is generally during this time that the most extensive environmental impacts would occur. *Long-term* refers primarily to the 20-year time frame considered within this PEIS.

Within the 20-year time frame considered in this PEIS, the development of tar sands projects would not require short-term disturbance or long-term alteration of a major amount of federal and nonfederal land under any of the four alternatives. Future development of commercial tar sands projects under all four alternatives would result in local, short- and long-term disturbance of most resources. There would be little difference in the types of impacts that could result from future project development under any of the alternatives. Under these alternatives, land clearing and grading and construction activities would disturb surface soils, wildlife and their habitats, and affect local air and water quality, visual resources, noise levels, and recreational activities within individual project footprints. Similar effects could be expected on other federal and nonfederal lands where project-related infrastructure (such as utility and pipeline ROWs, and worker residences) would be located. Short-term construction-related disturbance of biota (and their habitats) could result in long-term reductions in biological productivity within the project areas.

The long-term presence of commercial tar sands projects and associated ROWs could affect long-term land use within and in the vicinity of any commercially developed lease areas, as well as on both federal and nonfederal lands where support infrastructure (e.g., ROWs and employer-provided housing) would be located, especially if previous land use activities in those areas are determined to be incompatible with commercial tar sands projects. The lands and surrounding areas associated with all four alternatives currently support a variety of land uses (depending on their specific locations), including livestock grazing, agriculture, recreation, oil and gas leasing, and minerals extraction. Commercial tar sands projects under both alternatives could also affect long-term quality and use of visual resources and recreational use on federal and nonfederal lands. While some recreational activities (such as OHV use) could experience long-term increases in activity as a result of new ROWs into previously inaccessible areas, changes in the types and patterns of recreational usage can be positive or negative, depending on the subjective values of the interested and affected public.

#### 6.2.7.3 Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable commitments of resources associated with the implementation of the tar sands alternatives evaluated in this PEIS. A resource commitment is considered irreversible when direct and indirect impacts from its use limit future use options. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and to those resources that are renewable only over long periods of time, such as soil productivity or forest health. A resource commitment is considered irretrievable when the use or consumption of the resource renders it neither renewable nor recoverable for future use. Irretrievable commitments apply to the loss of production, harvest, or use of natural resources.

The amendment of land use plans to identify lands as available or not available for application for leasing for commercial tar sands development would not result in the irreversible or irretrievable commitment of resources. However, irreversible and irretrievable commitments of resources could occur as a result of future commercial tar sands projects that are authorized, constructed, and operated on lands identified as available for such activities. The nature and magnitude of these commitments would depend on the specific location of the project development as well as its specific design and operational requirements. The commitment of resources would be identical for any specific project located in the same lease area under any of the alternatives.

In addition to the tar sands, the construction of future commercial tar sands projects under any of the alternatives could result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials. Water resources could also be consumed during construction, although water use would be temporary and largely limited to on-site concrete mixing and dust abatement activities.

In general, the impact on biological resources from future project construction and operation would not constitute an irreversible and irretrievable commitment of resources. During project construction and operation, individual animals would be impacted. Site-specific and species-specific analyses and mitigation conducted at the project level during authorization would make adverse impacts on entire populations unlikely. However, if adverse impacts on threatened or endangered species occurred, these impacts would likely constitute an irreversible and irretrievable commitment of resources.

The clearing of project areas (including off-lease locations where utility and pipeline ROWs, and employer-provided housing would be located) would result in the direct loss of vegetation and habitats within the construction footprints, which would be irretrievable in areas where project infrastructure would be constructed and operated. While habitat would be impacted during project construction, implementation of project-specific mitigation measures (such as habitat restoration) would reduce these impacts over time. However, habitats within project infrastructure footprints (such as buildings and surface mines) would be irretrievably committed with the development and operation of commercial tar sands projects.

Cultural and paleontological resources are nonrenewable, and any disturbance of these resources would constitute an irreversible and irretrievable commitment of resources. However, consideration and implementation of mitigation could minimize the potential for impacts on these resources. Access to previously inaccessible areas could lead to vandalism of both known and unknown cultural and paleontological resources, thereby rendering them irretrievable. Impacts on visual resources could constitute an irreversible and irretrievable commitment of resources, but these impacts could also be lowered somewhat through the consideration and implementation of the mitigation measures.

#### 6.2.7.4 Mitigation of Adverse Impacts

Following the amendment of land use plans to identify areas as available or not available for application for leasing for commercial tar sands development, future development of commercial tar sands projects within the lease areas could result in adverse impacts on many resources (see Chapter 5). The nature, extent, magnitude, and duration of any project-related impacts would be directly determined by (1) the project location, (2) the nature and quality of the resources at and in the vicinity of project site (and its associated infrastructure), and (3) the technology used and the plan of development for the project. Many of the impacts may be reduced or avoided through the implementation of appropriate site- and project-specific mitigation measures. Development of individual commercial tar sands projects would require additional project-specific NEPA analyses and the identification of location-, project- and resource-specific mitigation measures, and mitigation measures would be identified as lease stipulations by the BLM for any authorized commercial development. Chapter 5 of this PEIS identifies many types of resource-specific mitigation measures that could be implemented during project planning, construction, and operation.

## 6.3 REFERENCES

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